

# WCSS



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Proceedings of

## **WORLD CONFERENCE ON SCIENCE AND SOCCER**

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The city of Rennes (France) is immensely honored to host the Vth World Congress in Science and Soccer, after Portland (2014) and Copenhagen (2015) and before Melbourne (2019).

This year again the congress brings together around 300 participants from all over the world. More than 20 countries are represented.

WCSS provides an opportunity to regularly report on the multiplicity of research and their interdisciplinarity, to facilitate relations between scientific disciplines, researchers and technicians, and to share scientific knowledge and experiences about football.

It also provides an overview of current issues, theories and methods that are currently used to advance knowledge in the field of football science.

We are grateful to all the invited speakers who have agreed to participate in this new edition and thanks to which we can propose a very high quality scientific program.

We also thank all of our sponsors, both institutional and private, without whom this event could not take place.

Finally, thanks to all contributors, researchers, doctors, physical trainers, coaches who have proposed a wide range of oral communications and posters. This makes it possible to propose a wide and varied program. This congress allows to foresee developments that will mark the development of research in football science and to raise new questions concerning scientific research.

So, welcome to our beautiful city of Rennes. We hope you enjoy your stay in Brittany, which also offers world-renowned tourist and cultural assets and that will undoubtedly contribute to the success of such an event.

Geneviève CABAGNO and the Organization team

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# The future of science in soccer: pragmatic perspectives

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The use of sports science in soccer and other elite team sports continues to grow around the world, being in part technology driven, as new and updated measurement methods and devices enter the market. There is a risk of becoming enslaved to these advances, with a perception that "new must be better" becoming commonplace. In many cases large amounts of data relating to (in particular) player "work rate" are generated and interpreted, with these indicators then being used as surrogates of "performance". However, there is very limited evidence available to show that individual player or team performance is strongly influenced by "work rate", as success in team sports is very multifactorial in nature. Consequently, sports science personnel working in clubs should broaden their thinking to consider performance in a more holistic and global sense to continue to show their worth to coaches and players. There is no doubt that sports science has much to offer in the areas of fitness, training, recovery, nutrition and fluids, travel and injury rehabilitation and prevention (to name the most common), but a greater emphasis should also be brought on skill acquisition and psychology programming, to provide an "all-round" and comprehensive plan for achieving optimal performance. These latter areas are sometimes considered the domain of specialists and/or coaches, so an integrated approach to performance across the whole club is required. This plenary session will look at these points from both a coach's and sport scientist's perspective, hoping to stimulate discussion and generate some thoughts on how sports science can be better integrated into the coaching and performance philosophies of clubs.

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# The UEFA elite club injury study helping clubs avoid injuries

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## Introduction

Injury study is the first step in injury prevention. The UEFA Champions League injury study is ongoing since 17 years and includes information from 55 elite level clubs in 20 countries in Europe (Ekstrand 2016; Ekstrand et al. 2013).

## Methods

The database, consisting of 24 000 injuries is the world's largest concerning male elite level football. A large database from a homogenous material provides robust information of the risk of specific injuries, their consequences in form of lay off days and the risk of recurrence etc. Further, injury studies provides an instrument to follow injury rates over time and to evaluate the effect of preventive programs or change of factors such as rules, match frequency or training load.

## Results & Discussion

The match unavailability due to injury is 14% and has been constant over the last decade (Ekstrand et al. 2013). The injury incidence has been lowered for ligament injuries but injury rates for muscle injuries and severe injuries remain high and are still unaffected by preventive measures (Ekstrand et al. 2013). On average, a team of 25-28 players can expect around 50 injuries per season (Ekstrand et al. 2013). Injuries and team success are correlated. Teams with fewer injuries have better results both in UEFA tournaments and in national leagues (H'agglund et al. 2013). A period of match congestion can lead to player fatigue, which may result in injury and/or underperformance during the following period (Ekstrand et al. 2004). Injury rates and especially muscle injury rates increase in matches with short recovery period between matches (Bengtsson et al. 2013). The coach/manager is more important than doctors for the injury situation in top class football clubs. Replacing the head coach during a season increases the injury rate in the team but not as much as replacement of fitness coaches. Load on players, leadership styles of coach/manager, internal communication in a club and the wellbeing of players are the most important factors for injury rates in top class teams (Ekstrand 2016).

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# New approaches to optimize soccer player performance from biomechanics and motor control points of view

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## Introduction

The soccer players' environment is complex and influence their movements. On the one hand, when players are running or kicking for instance, when there is no influence of other players and the performance is only dependent on their motor abilities, understanding their movements could be achieved thanks to biomechanical analyses. On the other hand, during duels or interactions with partners and/or opponents, the players' movement is also related to their perceptive abilities. To ensure an efficient movement or to limit risks of injuries, it is thus essential to identify discriminant criteria from biomechanical but also from motor control points of view.

In biomechanics, numerous studies have evaluated kinematic, kinetic and electromyographic characteristics of players in standardized situations (Kellis & Katis, 2007; Lees et al 2010). Inverse dynamics models have also been used to evaluate net joint moment (Nunome et al 2002) for kicking action. While inverse dynamic could provide relevant information, the model used is often not accurate enough to reflect individual muscle contributions. Musculoskeletal modelling is an innovative approach to understand the internal mechanisms of a player during various movements and loading conditions (Rasmussen 2012). Usually such evaluation is realized in very standardized situation. However in real game situation the players' movements depend on visual information perceived in the environment. Improving performance thus requires a better understanding of the perception-action loop used by players. Because of its inherent limitations, video playback doesn't allow this kind of in-depth analysis. Interactive, immersive virtual reality can overcome these limitations and foster a better understanding of sports performance (Bideau et al 2010). Until now virtual reality methods in sport have not be coupled with musculoskeletal model. The implementation of musculoskeletal models in virtual reality simulations of soccer game would allow to better understand dynamic of player movement.

The aim of this talk is to present news approaches in biomechanics and motor control (through virtual reality system) to optimize soccer players' movement.

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# Tactical analysis in soccer: how to play the game?

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Tactical analysis in invasion games, like soccer, is the objective recording and examination of behavioural events of players or teams in space and time during training or competition. The goal is to provide information to coaches and players about player and/or team behaviour to 1) intervene during the game, 2) plan subsequent practices or 3) support preparation for the next match in order to be successful. Tactical analysis is most often based on a permanent record of actions of players through hand-based or computerized systems using video technology. However, these analyses have certain limitations from a tactical perspective. For example, spatial information of the actions of players often lacks accuracy and only on-the-ball actions of players are monitored.

Technological innovations, such as tracking systems based on synchronized multiple video cameras and/or GPS-like technology, have led to new possibilities for training and match analysis in soccer. Positional player data (up to 1000 Hz) are typically used to calculate distance, speed and, more recently, acceleration/deceleration profiles of individual players. Interestingly, these data sets also open up new possibilities to capture accurate spatio-temporal information of all players and the ball to unravel the dynamics and complexity of game-play in soccer.

In the last decade, the availability of more sophisticated data sets has led to a burst of scientific literature with new ideas, concepts and methods to analyse behaviour of players and teams. However, to really understand the mechanisms of game-play, there is an urgent need to integrate knowledge from different disciplines and relate this to expertise from soccer practice. More specific, spatio-temporal concepts like dynamic systems and networks should be combined with knowledge from data science tuned to the expertise from coaches and trainers to make a step forward in understanding the game and develop new training concepts. Several examples will be presented and future directions will be discussed.

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# Periodised Recovery in Football

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Elite players are exposed to high competition loads. These high loads reflect a number of factors, including an increased frequency of domestic competitions, particularly for higher-level players, as well as a higher intensity of competition due to enhanced player preparation strategies. Higher loads may also result from the increased demands of international competition during both the domestic season and the off-season period.

An increased availability of players for selection, as a result of a reduction in injuries, substantially increases a team's chance of success. Managing the balance between the stress of training and competition and sufficient recovery has therefore become an increasingly important area in elite football. Routine modifications (periodisation) in training load (frequency, duration, intensity) occur during the training cycle in an attempt to increase or decrease fatigue. Management of fatigue is important in mediating adaption to training and ensuring the athlete is prepared for competition, as well as for reducing the athletes susceptibility to non-functional overreaching, injury and illness.

Whilst the periodisation of player load is the starting point in any recovery strategy, a plethora of interventions are routinely employed in an attempt to accelerate the rate of recovery. These interventions often target the short-term disturbances in homeostasis, which often stem from metabolic stress associated with high-intensity exercise and/or the longer-term impairment associated with mechanical stress (damaging eccentric biased contractions). Sleep and nutrition represent core components of the recovery process and have been subject to extensive study. Indeed, the concept of periodised nutrition (nutritional training) is used to describe methods through which nutrition can optimise training recovery and adaptations. In contrast, the efficacy of a number of recovery interventions applied in the field has yet to be fully elucidated. Furthermore, any decision on whether to implement such interventions in a given scenario may be dependant upon whether the aim is to accelerate the rate of restoration or influence specific skeletal muscle cell signalling pathways leading to altered training adaptation.

The current presentation will consider published research concerned with a number of non-nutritional recovery interventions presently used in elite football. The author will then discuss how periodised models of recovery may be applied to promote the desired recovery and adaptation within different scenarios routinely encountered by practitioners in the field.

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# Football Performance Research: Are we winning, drawing or losing?

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The role of scientific research in sports such as football, should be to provide recommendations and guidelines for practitioners to implement evidence based strategies<sup>1</sup> e.g. for fitness coaches to implement specific training interventions. When reviewing the research evidence, the first port of call is likely to be a systematic review and/or meta-analysis. Such studies can be extremely useful as they summarise a body of literature in a specific area to provide specific recommendations based on all findings to date. Unfortunately, while systematic reviews and meta-analyses may be considered a gold standard, all that glitters is not necessarily gold<sup>2</sup>. A systematic review or meta-analysis containing poorly conducted original studies is, itself open to bias and therefore, the overall conclusions may be misleading or inaccurate. In the medical and scientific research literature, many systematic reviews and meta-analyses have been shown to be likely redundant and unnecessary<sup>3</sup>. It is not known if football performance related research is following a similar trend, and this is vital information to know as it is an important part of the evidence based practitioners' programme design. The aim of this presentation is to systematically search and assess the quality of football performance systematic reviews and meta-analyses and to provide suggestions for improving the quality of football research.

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# Workload monitoring and injury prevention in soccer

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Workload monitoring has been applied to individual sports since the late 1950s. Before the technological evolution in sports, the middle and long distance runners used the time taken to complete a given set of running repetitions as a training load (TL) index. The introduction of the heart rate (HR) and the session rate of perceived exertion (RPE) led into a new era of internal load monitoring in sports. In soccer, the quantification of training load is relatively complicated due to the complex nature of the sport. At the early stages, the internal load variables (HR and sRPE) were used. Although the session RPE is a practical, low-cost tool it must be acknowledged that the complex interaction of many factors that contribute to the personal perception of physical exertion, including hormonal and neurotransmitters concentration, substrate levels, external factors (environment, spectators), psychological states, previous experience and memory may limit its (RPE) use in accurately quantifying training intensity and workload (Abbiss et al., 2015). Nowadays, training load is being monitored with a number of external and internal load variables in high level soccer including the total distance covered, the running distances at various speeds, the number of accelerations and decelerations, the time at HR above 85% of maximum and sRPE, among others (Akenhead & Nassis, 2016). At the moment there is no consensus regarding the most appropriate TL variables for performance optimization and injury prevention in soccer (Nassis & Gabbett, 2017). Actually, there are very few studies examining the relationship between TL data and injuries in soccer. The first study, published in 2016, showed that the players covered higher total distance during training in the weeks preceding a non-contact injury compared with their seasonal averages (Ehrmann et al. 2016). Recent data showed that the acute to chronic workload ratio, calculated from the session RPE, was associated with non-contact injuries (Malone et al., 2017). However, these studies are in youth soccer players and to the best of this author's knowledge no study has examined the relationship between external load and injuries in senior and/or high level soccer players. Modern approaches, such as the accelerometer-derived data, require further investigation regarding their practical applications in injury prevention in soccer.

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# Judging soccer players' performance from biases and sampling traps to the power of intuition

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Judging players' performance is a central activity for most people involved in soccer - either as managers, coaches, player, referees, or spectators. It has been argued that the respective judging processes can be understood by the application of a general social cognition approach (Plessner & Haar, 2006). Due to the classical orientation of this approach, judgment errors, biases, and sampling traps became the main focus in the corresponding research areas (Bar-Eli, Plessner & Raab, 2011). For example, the literature on referee decisions in soccer reported a biasing influence of players' size, color of jersey, reputation, direction of motion, among others. In another line of research, it has been found that coaches are in general not aware of the potential biases that are inherent in their samples of observations on which they base their inferences. Under specific circumstances, this lack of awareness can lead to distorted assessments of a soccer player's performance. Unfortunately, the fallible judgment processes that may be responsible for these effects have frequently been associated with the term intuition. In contrast, so called multiple-cue approaches to intuitive judgment and decision making generally highlight people's ability to make accurate decisions by assessing multiple features of the decision-making situation (Plessner, Betsch & Betsch, 2008). According to these approaches, the ability to process multiple cues in a parallel fashion and to draw valid conclusions even under time pressure can be considered as an important factor of decision makers' expertise. Consequently, the value of multiple-cue approaches for the understanding of expert performance in sport has been recognized as well (e.g., Araújo, Davids & Hristovski, 2006; Plessner, Schweizer, Brand, & O'Hare, 2009). It draws the attention to the development of judgment and decision making expertise, and the development of learning environments that support the development of this expertise, respectively (e.g., Schweizer et al., 2011). The present talk concludes with a discussion of potential learning and decision tools that help to improve intuitive judgments of soccer players' performance.

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improving soccer referees' intuitive decision-making skills. *Journal of Applied Sport Psychology*, 23, 429-442.

# Training of the top-class football player

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Professional football has become more and more intense, and the demands on the players are progressively increasing (Bangsbo & Iaia, 2013). There are clear evidence that fatigue occurs both temporary and towards the end of game. Thus, training to increase the physical capacity of the players, making them able to recover faster from an intense action and enhance their endurance, is essential (Bangsbo & Iaia, 2013).

Additional speed-endurance training during a 5-week period in the season for semi-professional players has been shown to increase Yo-Yo intermittent recovery (YYIR) level 2 test (Bangsbo et al., 2008) performance by 11% (Gunnarsson et al., 2012) and an extra 30 min of aerobic high intensity training once a week for 8 weeks increased YYIR2 performance by 18% (Jensen et al., 2007) in elite football players. In accordance Nyberg et al. (2016) found that thirteen semi-professional football players, who completed additional speed endurance training sessions consisting of 2-3 sets of 8–10 repetitions of 30-m sprints with 10 s of passive recovery during the last nine weeks of the season, had a 12% improvement in the YYIRT level 1 test. In addition, faster O<sub>2</sub> kinetics and better running economy, but no change in the content of muscle proteins regulating oxidative metabolism (HAD, COX IV and OXPHOS) and a reduced capillarization. The training in football should resemble those experienced during the game, e.g. changes of speed, direction and typical movement patterns, so that the specific muscle groups recruited in football are trained and the coordinative, technical and tactical elements are developed under physical demanding conditions similar to those encountered during actual match-play (Bangsbo & Mohr, 2014).

In conclusion, high-intensity training need be conducted in football and it should be specific to the individual technical, tactical and physical demands imposed on each single player.

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# Quality versus quantity? Evolution of the number of national teams and impact on outcome uncertainty in the fifa men's world cup

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## Introduction

The FIFA men's World Cup took place for the first time in 1930. 13 teams took part in the first edition. The number increased to 16 in 1934, decreased to 15 in 1938 and 13 in 1950 then increased again to 16 in 1954 and remained the same until 1982, when 24 teams took part. The number increased to 32 in 1998 and is still currently the same. However, it will increase to 48 in 2026. In this presentation, the aim is to investigate the impact of the evolution of the number of national teams on outcome uncertainty in the FIFA men's World Cup. There is often an assumption that increasing the number of teams will reduce outcome uncertainty. Nevertheless, some actors and in particular those deciding to increase the number of participants argue that the relative levels of the different teams justify such an increase.

## Methods

Outcome uncertainty is measured with the concepts of intra-game competitive balance and intensity. Intra-game competitive balance refers to the percentage of time with a difference of no more than one goal between both teams; intra-game competitive intensity refers to the percentage of time when a coming goal can change the situation of at least one of both teams regarding its qualification or the team it will face for the next round. The two concepts are different: a game can have a perfect competitive balance (100% of time with a difference of no more than one goal between both teams) but no competitive intensity if both teams are already eliminated as this is sometimes the case in the last matchday of the group stage.

Competitive balance and intensity are supposed to be dependent on the number of teams but also the development of football and the format of competition, underlining the importance to consider the evolution of the latter. This has been as follows:

– 4 groups of 3 or 4 then semi-finals in 1930; – knockout tournament in 1934 and 1938; – 4 groups of 2, 3 or 4 then their 4 winners in a new group with the winner being World Champion in 1950; – 4 groups of 4 then quarter-finals from 1954 to 1970; – 4 groups of 4 then first 2 of each group in 2 new groups of 4 then semi-final in 1974 and 1978; – 6 groups of 4 then first 2 of each group in 4 new groups of 3 then semi-final in 1982; – 6 groups of 4 then round of 16 from 1986 to 1994; – 8 groups of 4 then round of 16 since 1998.

## Results & Discussion

In respect to the impact of the evolution of the number of teams, competitive balance was better in 1934 and 1938 with 16 teams (more than 75%) than in 1930 and 1950 with 13 teams (less than 70%), which suggests that the difference in the number of teams was not sufficient to have an impact on competitive balance and that a knockout tournament generates more competitive balance, probably because each team has something to compete for in each game. This seems to be confirmed by a low competitive balance in 1954 (66.7%) but not when looking at the following editions with 16 teams, i.e. until 1982 since competitive balance was always higher

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than 80% (except in 1974, 79.8%). A shift seems to have operated in 1958 with an increase in the level of the nations leading to more competitive balance. Competitive balance remained higher than 80% in 1986 with 24 teams and was even always higher than 85% since 1990 (except in 2002, 84.8%), suggesting that the increase to 32 teams did not decrease competitive balance. The fact that the increases to 24 then 32 teams did not reduce competitive balance suggests that these numbers were not too high to ensure quality, consistent with the idea of an increase in the general level in football over time.

In respect to the impact of the evolution of the competition format, the best way to capture it is to calculate the ratio competitive intensity / competitive balance. The rationale is that an appropriate format should ensure that competitive intensity is as close as possible to competitive balance (no game without sporting prize where competitive balance may be 100% but competitive intensity 0%). It may be anticipated that the best format is the knockout tournament since competitive intensity = competitive balance, meaning a ratio of 100%. Nevertheless, the ratio was more than 100% in 1990 and 2002. The reason is that in some matches, the goal difference between both teams was more than one goal but the coming goal could still change the situation of at least one team due to the influence of the goal difference on their group ranking and qualification. A ratio close, equal or higher than 100% is more likely to occur with at least 50% of teams qualified for the next round than less than 50% of teams (e.g. in 1930 and 1950 for which the ratios were respectively 81.4% and 80.4%).

### Conclusion

Results suggest the importance of the number of teams and the level of development on competitive balance. The question is to know whether 48 teams will be appropriate to ensure such competitive balance in 2026 given the level of football development in the different continents at that time. The proposed breakdown would comprise: Europe 16 teams (13 currently); Africa 9 (5); Asia 8.5 (4.5); South America 6 (4.5); Concacaf 6.5 (3.5); Oceania 1 (0.5); Host Nation 1 (1) (MacInnes, 2017). This may allow some countries like China and Canada to qualify. From an economic point of view, reaching such countries is clearly interesting for FIFA. Nevertheless, a model we built for the 2011-2013 period (Scelles & Andreff, in press) showed that they were around one goal short from the lowest qualified countries for the 2014 FIFA men's World Cup Honduras and Cameroon that did not perform well (0 point with respectively 62.6% and 69.3% of time with a difference of no more than one goal). The format of competition decided by UEFA (16 groups of 3 then round of 32) may limit the number of matches played by the lowest teams and, as such, their negative impact on competitive balance and intensity, while a knockout stage from the round of 32 is positive for competitive intensity.

As a whole, the new format should be beneficial from an economic point of view without being too detrimental for competitive balance and intensity. Besides, it might generate an incentive to play their best in more matches for more teams during the qualification phase, which might contribute to a general improvement in the level of football. In other words, quantity should not be detrimental to quality and might even improve it on the long term.

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# Physical performance and subjective ratings after a soccer specific exercise simulation: comparison of natural grass versus artificial turf

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Artificial turf is currently used for competitive soccer games and training purposes. Change-in-direction speed is faster on artificial turf than on natural grass which may be explained by more force being exerted during the change-in-direction motion resulting in more intense accelerations and decelerations on artificial turf (Gains et al., 2010). Changes in direction, accelerations and decelerations are repetitively generated throughout a game and induce muscle damage (Thompson et al., 1999). This study aimed to compare the recovery kinetics of physical performance and subjective ratings in response to a soccer-specific exercise simulation on natural grass and artificial turf. Physical performance tests and subjective ratings were assessed on 13 professional soccer players before, immediately after, 24 h and 48 h after the test (Small et al., 2010). Physical performance tests included squat jump, countermovement jump, 6-s sprint on a non-motorised treadmill and isokinetic eccentric hamstring assessment (2.09 rad.s<sup>-1</sup>). Hamstring peak torque decrement was higher ( $P < 0.05$ ) on natural grass than on artificial turf immediately (-4.0%, CI 95%: -10.0 to 2.0%, Effect Size [ES]=0.29), 24 h (-3.1%, CI 95%: -9.3 to 3.1%, ES=0.29) and 48 h (-3.8%, CI 95%: -8.5 to 0.9%, ES=0.43) after the test. Squat jump performance decrement was significantly lower ( $P < 0.05$ ) on natural grass than artificial turf 48 h after the test (+3.7%, CI 95%: 1.1 to 6.3%, ES=0.40). Sprint performance showed no change from baseline performance for both trials throughout the protocol. No significant interaction between surface and time was found for countermovement jump and subjective ratings. These results suggest that a one-off exercise on artificial turf does not induce greater fatigue nor does it delay the recovery process when compared to natural grass among regular artificial turf players.

Keywords: fatigue, recovery, football, field test, muscle soreness

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# The global game and globalization: towards ‘peak football’?

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In this paper, I explore the diverse political-economic, socio-cultural, and normative issues and questions that surround contemporary globalization processes within football. The discussion draws particularly on theories of globalization, notably critiques of neo-liberalism, world system theory, and glocalization theory. In regard to political-economic issues, I consider the global expansion of elite football clubs, leagues, associations and tournaments; the governance of football, and the FIFA crisis; the role of football in international soft-power strategies of different nations; gender relations, and the position of the women’s game; and, the emerging powers within the game (notably the Gulf States and China). In regard to socio-cultural issues, I explore the making of ‘glocal’ meanings and identities within football; the blurring of ‘producer’ and ‘consumer’ roles through social media; and, the transnational flows of information, knowledge and expertise within and through the game. I conclude by reflecting on the extents to which the global game is insulated from major political-economic shocks, and to which we are approaching ‘peak football’ at global level.

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# In Focus: Concussions In Women's Soccer Players

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The concussions are significantly more frequent for the women's soccer players Dvorak estimate the frequency at 1.1/1000 H for the men, 2.6/1000 H for the women.

The risk is more important for the younger players (37 % in U13, 27.8 % in U15), the incidence also decreases with the level (35.2 % among the players playing in national team, 64.8 % among the other players).

The traumas arise more frequently during competitions, unlike boys, traumas arise more often during a shock with the ball or with the ground it involves side shocks for the temporal zones. The post-traumatic cognitive disorders are more frequent and more important and longer for girls (1.7 times as frequent as for boys), it results most of the time in headaches, slumbers, and sensibility at the noise.

The thickness of the osseous mass of the skull exercises a protective action, the ratio cuts of the feminine skull, and size of the ball is lower for the women players. The lower cranial osseous mass (15 %) associated with a muscular weakness of flexors and chest expanders of the neck (on average lower 50 %) is responsible for a bigger acceleration of the movement when we exercise a strength ( $F = my$ ). It means that for the same strength exercised on the skull, the speed of movement of the head during the impact will be more important for the women players (on average 10 %) faster.

Now the American Soccer Association of U.S.A is in favour to the wearing of a protection especially for the younger players. A study showed a decrease from 30 to 60 % of the strengths passed on the brain after a direct shock head against head or head against ground (Withnal\*coll). To summarize: Concussions are twice as frequent for the women's soccer players, the risk is more important for the younger inexperienced player's. The post-traumatic disorders are more severe and persist longer.

Interest of a prolonged stop for at least 3 weeks for the younger players, Interest to strengthen the flexor muscles and the chest expanders of the neck.

Interest to play with a protection.

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# Perceptual-cognitive skill and the performance of soccer players

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The pattern recall skills of talented soccer players by means of two innovative methods of analysis and gaze behaviour data will be presented. Young female soccer players watched video clips of 3 vs. 3 small-sided games and, after occlusion, had to reproduce the positions of the players. Recall performance was measured by calculating the spatial error of the recalled player positions at the moment of occlusion. Further, the player positions relative to each other are analyzed, by assessing geometric pattern features in terms of angles between players, and we transformed the data into real-world coordinates to exclude the effects of the 2D perspective in the video clips. The results showed that the participants anticipated the movements of the patterns. In real-world coordinates, the more experienced players anticipated the pattern further in advance than the less experienced players and demonstrated a higher search rate, a shorter fixation duration and a higher fixation order. These findings are in agreement with many studies have shown that experts possess better perceptual-cognitive skills than novices (e.g., in anticipation, decision making, pattern recall), but it remains unclear whether a relationship exists between performance on those tests of perceptual-cognitive skill and actual on-field performance. In the presentation a second study will be presented, in which we assessed the in-situ performance of skilled soccer players and related the outcomes to measures of anticipation, decision-making, and pattern recall. In addition, we examined gaze behaviour when performing the perceptual-cognitive tests to better understand whether the underlying processes were related when performing those perceptual- cognitive tasks.

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# Soccer refereeing in the future game: science or art?

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The field referee (FR) has the task to regulate players behavior and to enforce the rule of the game. In this, the FR is helped by two assistant referees (AR) that take care of the off-side lines during the game. A fourth official takes care of the substitutions, communications of extra-time allowance and of team benches activity. Recently the additional assistant referees were introduced to help FR and ARs in covering the view of each of the goal areas. Besides the human eyes, FIFA allowed the use of high-tech sensors for goal-line incidents. The implementation of match technology is further developing through the current experimentation of the Video Assisted Referee (VAR) technology with the aim to reduce incorrect decisions. In this presentation will be examined the role of match officials in modern soccer addressing their match demands and training requirements in light of the introduction of technology and the increasing match tempo. The development of an ergonomic model of soccer refereeing for future football will be discussed.

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# The specific patterns of athlete's heart in football player

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Intense physical training can induce specific cardiovascular changes. Morphological and functional electrical changes can be observed. They are grouped under the term athlete's heart. They depend on the type of training, the gender age and ethnicity. The difficulty in analyzing the athlete's heart is to accept that what is abnormal is not necessarily pathological. A good knowledge of the signs of the athlete's heart is therefore important for the sports physician. We will present the peculiarities of the heart of the footballer of high level of training.

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# Talent identification and development of young soccer players: some growth and maturational-related questions

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The organized sport is one of the most important opportunities of social participation of the adolescents. In spite of the emergency of a social alarm about a sedentary way of life and paediatrics obesity, the statistics of sport participation continue to give information about a crescent volume of people practicing. Among the most popular sports, soccer is configured as the predominant choice, with about 165 million players around the world with positive annual variations and in all of the age-groups.

Meanwhile, the applied investigation to youth soccer has shown equally an abundant and growing production. The topics more studied in the investigation are based in problems as talent and readiness and soccer selection.

The growing popularization of soccer and the increasing demand in the long term sport preparation results in the need of answers to new problems related with the prognosis of the sport performance, the adjustment of the training and match contents to the growth characteristics, maturation and young athletes' development, the control of the incidence of sport injuries and the predict variables of the injuries and the description of the players with different sport trajectories.

Talent identification and development is one of the emerging topics in the research in sport sciences, partly, for the capacity to request concepts and methodologies in domains as different as the sport medicine, genetics, sport psychology and other disciplines. The analysis of the programs of sport preparation evidences a huge variation associated with the number of age-groups, the duration of the age-groups, the beginning of the formal competitions and their organization and stages of the sport selection. Different sports assume different models being the organization relative to male and female sector an additional source of variation. However, in all of the cases the chronological age constitutes the agglutinant element of the long term programs of sport preparation. Malina *et al.* (2017) detach the need to complement the organization of the sport career based in information that considers the substantial biological variation that happens inside the same age-group. This consideration has not been contradicting with other sport agents, once the problem locates, above all, at the operational level. Even FIFA has been sensitive to the discussion of the problem.

Although just the concept of biological maturation exists, the scientific and technological progresses make available a group of somatic, sexual and skeletal indicators, each one of them with different potentialities and limitations with an increased capacity to use in sample with more participants and out of the context of investigation. The determination of the stages of the secondary sexual characters promotes the invasion of the privacy of those observed. On the other hand, the methods as the radiological exams are revealed extremely difficult to become massively used. Alternatively, the percentage of predicted adult stature seems to be of easy utilization, having, however, a possible question about the validity of the formulas out of the original population.

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There is a strong link between maturational development and growth and performance. Organizing age-groups using the criteria of chronological age leads to a big difference in size, composition and performance, and adolescence is the period when these differences are more visible and the ages between 13 and 15 years old seems to be the most heterogeneous period (Figueiredo et al., 2014). In the same age group, the subjects maturationally more advanced are in general heavier and taller than their peers of the same chronological age since childhood until the end of adolescence. However, adults don't usually show the same differences when the same comparison is made. This situation can be explained by the *catch up* phenomenon in the late mature individuals.

The initial process to identify promising soccer players is multidimensional and the literature in the area show that growth and maturation are two important concepts to better understand the identification, selection, and development processes of young athletes. Usually young soccer players tend to be above the mean for height and mass and tend to be advanced in biological maturity status with increasing age during adolescence and in elite development programs. Worst results is been reported for body size and functional performance in young soccer players who were not selected to play in more demanding competitions or who dropped out from sport. The same trend was visible in academy players to whom were not proposed a professional contract. Despite of the lack of evidence that the anthropometrical, maturational and physical characteristics in the beginning of the process are not direct associated with the exceptional performance in the adulthood it is of interest to understand that these indicators may open the doors of academies and others training centers of excellence promoting better conditions and better coaching to the selected players. Recently were not found decennial differences in the entrance profile of soccer players in a club academy. This finding suggests that soccer promoting strategies are being maintained despite of the increased demanding in the anthropometric characteristics of professional players and demands of the actual professional soccer competitions.

# 10 years of time-motion analysis research in a professional soccer club: 2006-2016

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Over a 10-year period, competitive physical performance measured via computerised time-motion analyses in players belonging to a French Ligue 1 professional soccer club was investigated. The knowledge base derived from this applied research conducted within a real-world high-performance context specific to a professional soccer environment has led to conclusions and recommendations that are of recognised importance to the scientific community. The main aim of the research however was to create a vehicle to direct a more evidence-based framework for the application of time-motion analysis; making training and preparation more theory-based and generally impacting on policy and professional practice in the club. Positively, several of the studies' findings were adopted by the club's fitness and medical practitioners and coaching staff and impacted at different operational levels both in training and match preparation. Findings were used in structuring frameworks for physical conditioning programmes and preparation for competition and technical training. Examples of work conducted on match-play running performance profiling included investigation of: 1) The effects of opposition team formation, a sending off, cold and hot environments, and short and prolonged periods of fixture congestion, 2) The effectiveness of post-match recovery interventions, 3) Physical activity profiles when running with the ball, 4) The association between transient and end match fatigue and changes in skill-related performance, 5) The association between aerobic fitness and repeated sprint ability and match fatigue, 6) Match-to-match variability in high-speed running activity, 7) The contribution of physical performance over the course of a Championship-winning season.

Examples of areas in which the findings have clearly had a quantifiable impact include improvements in the physical contributions of substitutes and changes in the pre-match warm-up regimen prior to matches played in cold conditions and in the development of conditioning strategies in an attempt to reduce the risk of muscle strain injury in competition. Work also had an impact on the design and implementation of drills used to train performance when running with the ball at senior and academy levels. Several of the present findings also had the merit to question club practice and policy as well as querying current opinions, observations and techniques presented in the scientific literature. For example, the findings helped clarify the importance of general and position-specific repeated high-intensity activity and the real-world necessity to test and train this component in the club's players. Similarly, the high between-match variations observed for end match and transient reductions in high-intensity running cast doubt on the appropriateness of declines in such variables as stable enough indicators to determine the occurrence of fatigue across games. However, despite the breadth of studies conducted, there is still potential for researchers and physical conditioning practitioners to replicate, verify and extend the present body of knowledge by combining larger samples and contemporary physical performance metrics notably acceleration and deceleration actions and high metabolic power.

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# Engineering the play properties of artificial turf

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A focus for much of our recent research work has been to develop a comprehensive framework to explain the engineering behaviour of modern artificial turf (and to some extent hybrid turf), with a focus on its role in player surface interactions for traction and impact response (Severn 2011, Fleming, 2011, Dixon 2015). Several PhD research projects at Loughborough University have investigated the influences of the artificial turf components on the behaviour of the installed surface system, providing data from both mechanical testing and human subject testing. The recent human testing has pioneered work into tracking the boot studs through the surface during player movements (Ferrandino, 2015). The mechanical test data shows the importance of the infill state and shockpad properties for response to impact loading. The data can be interpreted in terms of changes in stiffness due to changes in infill morphology and changes in state (i.e. density). A finite range of density state has been identified and associated field testing has attempted to establish how best to identify when a field needs the required maintenance interventions to reverse the observed increased density (compaction). Mechanical testing of systems has further shown the importance of the carpet fibres in providing enhanced stability to the infill for improving resistance to impact and stud translation and rotation, which acts in addition to the greater resistance offered by denser infill states. Human movement test data have demonstrated that the initial engagement of a studded boot can cause very high transient compression under the large point loads around studs. Furthermore, boot/stud rotations and translations have been measured after full penetration has been achieved during the contact phases and have shed new light on the importance of infill horizontal stiffness behaviour. Improved instrumenting of mechanical traction tests has further verified large changes in stiffness resistance during increasing horizontal strain of the filled carpet systems, and also highlighted shortcomings in current industry standard tests. Our understanding of the key mechanisms of player boot-surface interactions is reaching a new paradigm. Current work is extending the experimental data through developing numerical models of the systems.

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# Biomechanical evaluation of the risks of injury in the knee for three typical playing surfaces

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## Introduction

Sports such as soccer or rugby are associated with high injury rates (Engebretsen et al. 2013). Anterior cruciate ligament (ACL) injury is of critical concern as the human and financial costs for the player and for the club can be very substantial. As about 70% of these ACL injuries are non-contact injuries (Rochcongar et al. 2009), it becomes a priority to understand the injury mechanisms. However, non-contact injuries remain extremely complicated to describe due to the number of factors involved (Orchard et al. 2013). The aim of this study was to analyse the effect of 3 different playing surfaces on knee loads during sport tasks as they could modify ACL injury risks.

## Methods

Three tracks (15m x 2m) were built with artificial turf, natural grass and hybrid grass. Fifteen rugby players (mean  $\pm$  SD; age:  $17.7 \pm 1.3$ yr; height:  $1.75 \pm 0.05$ m; mass:  $83.4 \pm 17.0$ kg) were equipped with blade shoes (Predator Absolado, Adidas, Germany). All trials were recorded by an 8-cameras optoelectronic system at 300 Hz (VICON, Oxford, UK). Ground reaction forces were recorded on each track by 2 force plates at 1200 Hz (AMTI, Watertown, US) that were placed under a 17cm thick layer of the corresponding track. Inverse dynamic calculations were performed with a MATLAB. For each task, peak *valgus* moments (PVM) and peak internal rotation (PIRM) moments that are considered as good predictors for ACL risk injury evaluation (Dempsey et al. 2012) were quantified during weight acceptance phase. All moments were normalized by subject mass.

## Results & Discussion

Considering PVM values, AT showed significantly higher values compared to NA and HY for right stance during running and left stance during sidestep cutting (respectively  $1.98 \text{ N.m.kg}^{-1}$  SD  $0.83$  p-value =  $0.003$  and  $3.73 \text{ N.m.kg}^{-1}$  SD  $1.13$  p-value <  $0.0001$ ). The lowest values for all tasks were observed for HY. PIRM values showed similar trends. AT track showed significant higher values for both stances during sidestep cutting ( $1.28 \text{ N.m.kg}^{-1}$  SD  $0.67 \text{ N.m.kg}^{-1}$  p-value =  $0.001$  and  $1.71 \text{ N.m.kg}^{-1}$  SD  $0.75 \text{ N.m.kg}^{-1}$  p-value <  $0.001$ ).

Several limits must be considered: motion analysis presents limitations and marker placement inaccuracy, causing skin and muscle movement artefacts, also introduce errors. However, motion analysis and inverse dynamics have proved their reliability for *in vivo* kinetic and kinematic sport movement analysis (Dempsey et al. 2012).

## Conclusion

This study has been able to highlight the influence of the playing surface on intersegmental loadings. Further investigations could help develop detailed models to understand the influence of the mechanical behaviour of different playing surfaces.

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# Recent soccer development in china : opportunity for large-scale research

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In 2015 year, the government of China announced that the development of soccer pitched its new high to being one of the national strategies. In 2016, the government of China released an official document outlining the 35 years plan. In this document, it stated that there will have 20,000 number of primary and secondary schools specializing in soccer by the year of 2020. In addition, by the year of 2025, there will have 50,000 schools of such, with 50 millions total number of students in these schools. This provides an excellent opportunity for soccer researches, in particular to those large-scale ones. In this presentation, Prof Wong will talk about the contents of this 35 years development plan, and how researchers in soccer all over the world can take part in this.

The China Football Academy is newly established in 2017, the only one government owned football academy in China. Professor Wong is appointed as the leader of the research department of this academy to oversee all research activities. In this presentation, Prof Wong will outline the research plan of China Football Academy and specify the research areas that are at higher priority. Researchers are invited to join this exciting opportunity for research collaboration.

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# Nutritional interventions to enhance fatigue resistance in football

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## Introduction

In football, the pattern of play is "stop and go", *i.e.* where players perform and repeat brief high-intensity movements interspersed with low-to-moderate intensity activities in addition to sport-specific skills over a prolonged period of time. Temporary (transient performance reduction following a physically demanding phase of play) and progressive (decline in physical and technical skills toward latter stages) fatigue develop during match play. Intra-muscular phosphocreatine and glycogen depletion and metabolic by-products development represent the main peripheral causes of fatigue during such high-intensity intermittent exercise. Besides or in combination with training or match, intake of nutritional ergogenic aids is commonplace to enhance performance of high-intensity exercise by offsetting the potential mechanisms of fatigue. Depending of the scenario, well-chosen nutrition strategies may be implemented prior to, during as well as after training or match with an appropriate type, amount and timing of intake to promote optimal performance and recovery.

Evidence is accumulating that carbohydrate ingestion before and/or during exercise can delay the onset of fatigue and improve performance of high-intensity intermittent exercise as well as prolonged continuous exercise. Although the daily intake of carbohydrate should be proportionate to estimated fuel cost of the training or match, sports nutrition experts recommend carbohydrate consumption of ~1–4 g/kg 1–4 h before training or match to replenish liver and muscle glycogen stores, 30–60 g/h during (including halftime) to preserve endogenous glycogen and increase blood glucose throughout exercise to support performance and preserve sport-specific skills, and 1–1.2 g/kg/hr and 20–25 g protein as soon as possible after exercise to facilitate recovery. Similarly, creatine which is a critical fuel for sprinting and other brief efforts may also be beneficial for high-intensity intermittent exercise. Its ergogenic effects are related to faster regeneration of adenosine triphosphate and increase in muscle buffer capacity, thereby enhancing resistance to fatigue, increasing performance and promoting greater training adaptations.

Other nutritional interventions can also enhance fatigue resistance and improve performance during single or repeated bouts of high-intensity intermittent exercise. For instance,  $\beta$ -alanine dietary intake (*e.g.* ~3–6 g/day for > 4 weeks) is known to increase muscle carnosine concentration, an effective intramuscular buffer, whereas sodium bicarbonate ingestion (*e.g.* ~0.3 g/kg 1–2 h before exercise) can improve extracellular bicarbonate concentration. However, conflicting results regarding repeated-sprint ability improvement as well as potential side effects (*e.g.* gastrointestinal disturbances for sodium bicarbonate, paresthesia for  $\beta$ -alanine, in particular during "high-release" supplementation) have been found. A further example concerns the targeted effect of nitrate ( $\text{NO}_3^-$ ) supplementation (beetroot juice or sodium nitrate) on fast twitch fibres which may have important implications (*i.e.* improved local oxygen perfusion, fatigue resistance and fibre contractility) for improving performance during high-intensity intermittent exercise. Overall, while carbohydrate supplementation remains central, other carefully chosen ergogenic aids can promote high-intensity intermittent performance. That said, it seems that supplementation dosage play a key role in training adaptation. For instance, periods of reduced carbo-

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hydrate and elevated dietary protein intake has been shown to enhance training adaptations whereas high carbohydrate availability and antioxidant supplementation (*e.g.* vitamin C and E) seem to attenuate and even blunt training adaptation. Similarly, caffeine, when consumed in low-to-moderate dosages (~3-6 mg/kg) and anhydrous state (compared to coffee), appears beneficial for high-intensity intermittent exercise.

### **Conclusion**

It is therefore difficult to draw clear conclusion regarding the effects of specific nutritional interventions, which may vary with respect to footballers' training status and nature. A "one-size-fits-all" approach should be avoided given the fact that individual nutritional intervention should be plan for each player. In addition, footballers' adherence to nutritional intervention is depending of an ongoing nutritional education and culture at the club (*i.e.* from grassroots to professional level). Promoting healthy eating habits for players of all ages should precede any ergogenic supplements which should be safe, legal, have a well-grounded scientific rationale and supporting evidence and be complementary to a sufficient daily diet to promote training adaptations, improve match-day performance and maximize recovery.

# Talent identification and development in a football club setting: Club Brugge Academy

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Talent identification and talent development play a crucial role in the pursuit of excellence. In professional football clubs the academy and the youth development to professional transition pathway is key in the future squad planning and the overall football philosophy. Moreover, most European clubs expect the academy to create added value (Jarosz et al., 2015).

As many professional football clubs, Club Brugge has adopted a scientific approach in the daily working methodology. Both at the first team and youth level the training sessions of players are adjusted to their individual working points based on the basis of e.g. (physical, medical and psychological) testings, analysis of game performances and exposure, age and/or maturity level. The current presentation will highlight some of the initiatives taken at the Club Brugge academy to optimize the potential of our youth players and improve the success ratio of their transition into the first team squad.

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# Shoe-surface interactions & injury in modern-day football

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Injuries to the lower extremity are common in professional soccer football. Among the modifiable risk factors, interaction between player's footwear and the surface has been implicated as an influencing factor in non-contact lower extremity injury risk.

Players now complete more passes per match, perform more explosive sprints and cover greater running distances than ever before in the English premier league. Football shoe design and playing surface properties are constantly evolving alongside these technical and physical movement strategy changes in the game.

Optimal performance and/or risk of injury may be associated with certain playing surface and footwear characteristics. Higher rotational traction at the shoe-surface interface is associated with 2.5 times higher risk of lower extremity injury in American football. At present, it is unknown if this relationship extends to non-contact lower extremity injury in elite soccer.

This brief lecture will give an overview of the concepts involved with measurement of player shoe-surface interaction and possible implications for performance and injury.

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# Cardiac events and soccer: who is at risk?

## Why can soccer be dangerous?

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Occasionally cardiac events are reported in soccer players during or shortly after physical activity. They may even be fatal and have the potential to discredit regular training although there is plenty of evidence for its overall preventive character. When such events occur in famous soccer players, this effect is even more pronounced. Therefore and for the sake of individual health care, efforts should be spent into avoiding dangerous situations. To lower the likelihood of cardiac events, pre-competition medical assessments (PCMA) are installed by the international and many national associations – in most countries in the highest leagues only. For designing an appropriate protocol of such PCMA as well as for the health care in lower leagues, some knowledge about contributing factors to cardiac events is warranted. By far the most relevant aspect is the presence of (sometimes undetected) cardiac disease. This is complemented by the typical cardiovascular strain of the game as well as by traditional circumstances within soccer (like the management of infections). These factors will be explained together with most current controversies about how an ideal PCMA should look like.

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# Beyond musculoskeletal injuries in European professional football: any relation with symptoms of common mental disorders?

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## Introduction

In professional football, all stakeholders should bear in mind that they must protect and promote the physical, mental and social health of players, both during and after their career. To present time, most of the scientific medical studies have been directed towards the physical health of professional footballers, especially severe musculoskeletal injuries. Recently, mental health problems were shown to be prevalent in professional footballers. Consequently, the assumption is that a better understanding of the interaction between physical and mental health problems among professional footballers can lead to a better medical care and support. The aim was to explore the associations of severe musculoskeletal injuries with symptoms of common mental disorders (distress, anxiety/depression, sleeping disturbance, adverse alcohol use) among male European professional footballers.

## Methods

Cross-sectional analyses were conducted on electronic questionnaires completed by professional footballers recruited from the national players' unions of Finland, France, Norway, Spain or Sweden. The number of severe (time loss of more than 28 days) musculoskeletal injuries during a professional football career was examined through a single question, while symptoms of common mental disorders were evaluated through validated scales.

## Results & Discussion

A total of 540 professional footballers (mean age of 27 years; 54 % playing in the highest leagues) participated in the study. Seventy-nine per cent of the participants had already incurred one or more severe musculoskeletal injuries during their football career. Prevalence of symptoms of common mental disorders ranged from 10% for distress to 37 % for anxiety/depression. The number of severe musculoskeletal injuries during a football career was positively correlated with distress, anxiety/depression and sleeping disturbance. Professional footballers who had sustained one or more severe musculoskeletal injuries during their career were two to nearly four times more likely to report symptoms of common mental disorders than professional footballers who had not suffered from severe musculoskeletal injuries.

## Conclusion

It can be concluded that the number of severe musculoskeletal injuries during a career is positively correlated and associated with symptoms of common mental disorders among male European professional footballers. This study emphasises the importance of applying a interdisciplinary approach to the clinical care and support of professional footballers, especially when a player faces lengthy periods without training and competition as a consequence of recurrent severe joint or muscle injuries.

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# MLS and College Football in the USA

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In 2014 at the 4th World Science and Soccer Conference, Jeff Agoos Major League Soccer's (MLS) technical director, outlined a vision for the MLS to be ranked in the top 5 leagues in the world by 2022. The MLS continues to invest judiciously as a league but some structural problems that may limit a rapid rise. The MLS currently with 22 teams, soon to expand to 24, plays a 34 game unbalanced schedule allowing teams to play more regional games in order to reduce travel expenses and fatigue (although the Vancouver White Caps still travel about 60,000 miles per year compared with 3,500 miles for Manchester United) but also to increase regional rivalry games. The MLS employs a season-end playoff system to generate additional revenue where teams are seeded according to regular season finish. Twice in the last five years, teams with the lowest seeding have won the MLS Cup showing good competitive balance, if not parity. Estimates that the league loses an aggregate of about \$100 million each year. But still wanting to grow the quality and enhance revenues of the league the MLS employs three strategies meant to combat excessive spending. The MLS Teams share league wide revenues almost evenly, utilizes a draft system to spread out rising talent from the US collegiate pool, and employs a salary cap to prevent teams from overspending (except for designated players). TV revenues are rising and increased over 250% from the last contract and televised games are spread across three different networks, FoxSports, ESPN and Univision in order to reach a wider audience. Three years ago, the MLS provided financial support for each team to hire a data and match analyst in order to bolster the quality of play. Now each team employs at least one full time analyst and supplement that with part time staff. With regard to sport science, about 50% of the teams have a director of sport science and a full-time strength and conditioning coach while the other teams employ a single person in that role. The league continues to target key international player that will increase the quality of the play and contribute to rising attendance across the league. While the MLS has made major investments in both identifying quality foreign players in order to increase the quality of the game, several challenges remain. Despite increases in revenue streams and "financial fair play" strategies, the league may not be able to continue to grow revenues fast enough to meet rising salary requirements. Collective bargaining has raised the average MLS salary up to \$325,000, yet the median salary is far below that at \$120,000 and trails Mexico's La Liga at \$400,000. The top 20 highest-paid players in the league account for \$73 million or 48 % of the league's total compensation. To this point, the quality between the top players and the bottom is marked. Despite the intentional and expensive efforts to fund academy teams, youth football in the US is fractured and often focuses too much on winning rather than long term player development. Most MLS academy teams can only enroll players from a local network leaving many talented players across the without an option to join academy teams making national talent development spotty and problematic. The large majority of athletes in the MLS academies enter college as a developmental stepping stone, but the US collegiate system which aims to protect the student-athlete experience by limiting competitive opportunities and placing limits on training. Despite the fact that 205 men's college teams spend about \$50 million annually on tuition, room and board, training, sports medicine and coaching, few athletes successfully migrate to the MLS.

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# Bridging the research & practice gap in return to play

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## Introduction

Return to play following injury is complex and multifactorial. The evidence-based practitioner combines the best of research evidence with his or her practice to make quality decisions. Effective return to play decision-making requires effective risk management – assessing each case on its individual merits – and effective communication. The aims of this presentation are to 1) present current consensus regarding return to play after acute injury, and 2) to examine how research and practice can fit together when managing the return to play process (including rehabilitation) following hamstring injury in football.

## Methods

In November 2015, the *Swiss Sport Physiotherapy Association*, *International Federation of Sports Physical Therapy* and *British Journal of Sports Medicine* hosted the first international return to sport congress in Bern, Switzerland. A half-day consensus meeting followed the congress, and 17 international experts in return to play, who had presented at the congress, participated. The main sections of the 2016 Bern consensus statement were initially agreed upon by discussion and vote. Participants then joined one of four groups, and each group wrote a different section of the statement. A second round of discussion and voting was used to decide upon the key issues to be covered, and to refine each of the four sections of the statement. The consensus statement provides a framework for examining all aspects of return to play in football.

## Results & Discussion

The key points arising from the consensus statement were:

Return to play starts from the moment of injury (or at least the moment the practitioner first sees the athlete following injury)

Return to play can be thought of as a continuum starting at injury occurrence and rehabilitation commencement (return to participation), and continuing through to the athlete reaching his or her performance goals (return to performance)

Wherever possible, the return to play decision-making process should be shared, with all key stakeholders in the decision-making process, contributing relevant information so the athlete may make an informed decision

The tests practitioners use to determine whether the athlete is physically ready to return to play need to incorporate the reactive, decision-making elements of the athlete's sport, particularly in a fatigued state

Internal and external workload should be monitored during the return to play process, as appropriate workload management is an important part of minimising the risk for re-injury

Assessing psychological readiness to return to play is important given the strong relationship between negative psychological responses and not returning to sport

## Conclusion

Following injury, the return to play process should be thought of as being on a continuum starting from rehabilitation (return to participation), through return to sport and finally return to performance. This continuum requires input from a range of key stakeholders (defined by the decision-making team) throughout its entirety, and should involve the player, coach and practi-

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tioner/s simultaneously. Finally, reliable and valid monitoring, and criteria-based progressions that are specific to the athlete's sport should be used to help the practitioner to be confident in the recommendations he or she provides to the player and coach. In practice, return to play is a continual learning process, refined by experience and self-reflection.

# In search of fairness in local sport: a grassroots study from the UK

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When writing in the 1960s about its educational significance, the French philosopher and novelist Albert Camus famously claimed that the context in which he learned and understood most about morality and fairness was that of sport. Times may have changed. The Council of Europe's (1992) Code of Ethics on sport states that: '*The potential benefits to society and to the individual from sport will only be maximised where fair play is moved from the peripheral position it currently occupies to centre stage. Fair play must be given the highest priority by all those who, directly or indirectly, influence and promote sporting experiences for children and young people.*' (Council of Europe, 1992). Developments since these words were written might suggest such ambitions constitute little more mere rhetoric (Humphreys, 2008). There are certainly few real signs that fairness and questions about positive ethical behaviour have moved centre-stage, at least in relation to the practices of elite sport in Europe and the USA (Simon, 2016). Indeed, many sports have been routinely subject to charges of corruption, widespread cheating, and a corrosive commodification (Morgan, 2006). However, an ERASMUS-funded project E4S is currently examining questions of ethics and sporting practice in Europe, including studying expectations from parents and coaches about what grassroots sports clubs can deliver for young people. This involves a new focus on the 'Big Six' lessons we all might take from sport. As part of this project, this interview-based paper examines in a preliminary way a junior grassroots football club in Leicestershire in the Midlands area of the United Kingdom. It explores how parents and those involved in the club attempt to balance the influence of professional sport and the competitive motivations of their young male players, with communicating core values around sporting fairness.

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# Physiology of women's soccer and the challenges of increasing number of matches for top-elite players; from theory to practical experiences

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Women's soccer is developing rapidly, with over 30 million participants around the World today. In the 2015 FIFA Women's World Cup, 24 teams participated which is double the number that participated in the first World Cup in 1991. The number of participants in the World Cup qualifiers has almost tripled from 45 teams in 1991 to 128 in 2015, and the number of qualification matches has risen from 110 to 398. In 2011, the FIFA Women's World Cup in Germany was covered on television in 181 territories, with the 32 games drawing 407.8 million viewers around the world showing the increasing public popularity for female soccer (FIFA, 2015).

Accordingly, the career opportunities for female players are growing and players are now able to train and compete full-time. The improved professional training environment has increased game intensity for elite female players. The number of matches has also increased at the top level. Many of the top national teams have three international tournaments in a four-year-cycle (The FIFA World Cup, the Olympic Games and the European Championships/Asian Cup are played every four years). In addition, for club teams the UEFA and AFC Women's Champion's league are gaining more credibility and the clubs are focusing at performing in this tournament. This results in high physical demands on the top-elite players as well as their ability to recover quickly. Consequently, players need to plan and prepare more optimally for match-play.

The growing interest and professionalism in women's soccer have resulted in more scientific research on the female population in recent years. The studies available have focused on the physical demands during games (FIFA, 2016, Gabbett et al., 2013, Hewitt et al., 2014, Vescovi 2014), performance testing (Ozbaer et al. 2014), and fatigue and recovery (Andersson et al. 2008). Despite this progress, there still is a need for more scientific knowledge on elite female players as the number of players and games are increasing world-wide and the game intensity at the top level is developing rapidly.

In this presentation, specific considerations for female players are addressed, and include recent scientific research and highlight the current status and physical standards of elite female players. In addition, the challenge of increasing number of international matches for the top-elite players, both in national teams and club teams, will be discussed. Finally, practical experience from the Olympic Games in RIO 2016 concerning the above issues will be presented.

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# The analysis of the management and marketing strategy for the little tigers soccer campaign in Kaohsiung, Taiwan

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## Introduction

The purpose of this study was to analyze the effect of management and the marketing strategy for children's soccer campaign in Kaohsiung.

## Methods

The little tigers participated ages were grade 1 to grade 6. In addition, the satisfaction questionnaire of Two hundred children participated in little tigers club lasting six months and their parents. It included the satisfaction of the questionnaire for the parents in soccer equipments, surrounding places, tuition fees and teaching services, teaching skills and the teaching quality were also analyzed. The results could make the social more understand the club and provide the suggestions to it in management.

## Results & Discussion

The results were showed as below: The coaches of this soccer campaign are college level soccer athletes, and divided the children into different groups based on the ability and ages when training. The little tiger camps have set up a website and line groups, and they are positive marketing communications for this soccer camp, parents and the coaches. The main motivation for participating in this soccer camp was the disciples needs of the first highest scores  $4.35 \pm 0.22$ , secondly, health needs scores  $4.15 \pm 0.55$ , third is social needs scores  $4.01 \pm 0.34$ , the last one is influence scores  $3.99 \pm 1.33$ . It showed that the children participated this campaign mostly for the improvement of the personal characteristic and physical fitness. The influence of social communication and TV to make parents participate this campaign were not very important and significant. Generally speaking, the loyalty of parents were very high, especially in "After the kids participate in soccer camp, parents will continue to apply the next course" and "After the kids participate in soccer camp, parents will recommend their friends' and relatives' children to apply the course", both scored  $4.30 \pm 0.59$ . It showed that the soccer campaign obtained the high recognition and support.

# The effectiveness of injury prevention program on reducing the incidence of lower limb injuries in adolescent male soccer players

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## Introduction

The highest incidence of injury is seen in adolescent playing pivoting sports such as soccer, basketball, and handball. The purpose of this study is to examine the effectiveness of a neuromuscular prevention program in reducing knee and ankle injuries in adolescent male soccer players.

## Methods

Fifty Malaysian boys [25 experimental (EXP); or a 25 control (CON)] adolescent male soccer players (age  $13.3 \pm 0.4$  yr; BMI  $20.9 \pm 1.5$  kg/m<sup>2</sup>; stature:  $160 \pm 0.1$  cm) from two sport schools, with  $4.4 \pm 0.5$  years playing experience participated. The EXP group followed neuromuscular prevention program 5 days per week, for 12 weeks. The CON group was instructed to continue training and warm-up as usual. A neuromuscular exercise programme designed exclusively for adolescent soccer players was including jumping, eccentric strength, agility, balance, dynamic stretching and speed. Over 1 year all injuries were documented monthly by physiotherapist. Complete monthly injury reports were available for 50 players.

## Results & Discussion

Eight lower limb injuries [Knee 3, ( $0.12 \pm 0.32$ ); Ankle 5, ( $0.19 \pm 0.38$ )] occurred in the EXP group, and 11 lower limb injuries [Knee 1, ( $0.03 \pm 0.12$ ); Ankle 10, ( $0.40 \pm 0.50$ )] occurred in the CON group. The incidence of injuries per 1000 player- hours of training and playing soccer was 1.7 in the EXP group, and in the CON group 2.4 injuries per 1000 player-hours, which equates to 29% fewer injuries in the EXP group. Significance of difference between the EXP and CON groups was  $p < 0.05$ .

## Conclusion

Effective implementation of neuromuscular injury prevention program can reduce lower extremity injury incidence in adolescent male soccer players. Adolescent players need better education regarding injury prevention strategies and should include such interventions as part of their regular training.

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# Stakeholder's understanding and perceptions of bio-banding in junior-elite football training

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## Introduction

Annually age grouping children, for reasons of convenience and simplicity, is one typically employed by professional football academies in the United Kingdom (UK) and across Europe. Given the biological and maturational differences observed between children of similar ages, the grouping of children using chronological age can be problematic. 'Bio-banding' is considered an alternative method, which is where children are grouped or 'banded' according to their skeletal maturity rather than their chronological age (Tucker et al., 2016). The purpose, therefore, of this particular study is to examine key stakeholder understanding and perceptions of the use of bio-banding during training within a junior-elite football environment.

## Methods

Three key stakeholder groups (players n=66; staff n=8; and parents/guardians n=80) from an English Premier League category 1 academy participated in this study. Players were aged between 9.2 years and 14.2 years ( $\pm 1.5$  years). Parents were aged between 31 and 53 years ( $\pm 6.1$  years). Staff participants were aged between 27 years and 48 years ( $\pm 7.76$  years) and were a combination of staff from the coaching (n=4) and recruitment (n=4) departments. All stakeholders were recruited to the study through purposive sampling approaches.

One-to-one interviews (n=22) were conducted with academy staff (n=22) and players (n=66). Focus groups were conducted with parents (n=80). Interviews and focus groups were conducted at three times: prior to the start of pre-season training, during pre-season training, and after pre-season training had occurred.

Data collection and data analysis occurred concurrently: Data were subjected to open and axial coding to determine the number of concepts and categorisations. Themes were considered significant enough for reporting when there was a minimum agreement of 50% amongst participants.

## Results & Discussion

The study was concerned with two main issues: understanding and perceptions of bio-banding. In terms of examining the issue of understanding, this was divorced from the rest of the analysis by being a pre-determined 'theme'. Analysis of the data identified six themes related to the perceptions of stakeholders in relation to the use of bio-banding in a junior-elite training environment: (1) interpretation of bio-banding; (2) perceived disadvantages; (3) perceived advantages; (4) changes to coaching planning and practice; (5) educating stakeholders; and (6) logistical issues.

## Discussion & Conclusion

The study highlights six key areas that emerged over a five-week pre-season training period. These areas provide a framework against which future applied delivery of bio-banded football training may be considered. Indeed, the six themes should be considered carefully in any junior-elite performance environment prior to the operationalisation of bio-banded training.

Whilst all of the findings lend themselves to applied practice within junior-elite football environments, the issues bio-banding attempt to overcome (i.e. those associated with RAE) appear to pertain more readily to developing attributes within the psychological and sociological domains



of performance.

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# Concurrent training and nutritional practices carried out by an English senior professional soccer team.

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## Introduction

It is common for elite soccer players to perform resistance and endurance-training within the same training cycle. Authors have noted that the adaptive process can be modulated by a number of variables including the volume and frequency of training, the timing of macro-nutritional intake around each training session and potentially the organisation of exercise bouts (i.e. the order of sessions and/or the recovery period between sessions) (Wilson et al. 2012). The present investigation aimed to explore concurrent-training and nutritional practices carried out by a senior professional football team. Specifically, we aimed to (i) to describe the volume and intensity of all aspects of training across a 10-week period (ii) to characterise the, volume, intensity and organisation of ‘same-day’ concurrent football-specific endurance and resistance-training and (iii) to describe the quantity and timing of macro-nutrient intake around training on concurrent-training days.

## Method

This study observed the concurrent training (CT) and nutritional practices carried out by 21 English professional soccer players (mean  $\pm$  standard deviations [M  $\pm$  SD] 26  $\pm$  4 years, stature 1.84  $\pm$  0.1 m, body mass 83  $\pm$  7 kg, VO<sub>2</sub>max; 58  $\pm$  3 ml  $\cdot$  kg<sup>-1</sup>  $\cdot$  min<sup>-1</sup>) across a 10-week period (5 weeks pre-season and 5-weeks in-season). Internal, external training load, the organisation of CT (training sequence, training rest period between bouts) and the nutritional intake around CT (timing, type and quantity) was collected across the observational period.

## Results & Discussion

CT took place on 17 occasions (endurance-training [ET] + resistance-training [RT]; n = 11; RT + ET; n = 6) rest period between bouts was not consistent and varied depending on the sequence of CT (RT + ET , 75  $\pm$  48 min ; ET + RT; 60  $\pm$  5 min ; P = 0.04). sRPE of football-specific ET was higher in RT + ET (RT + ET, 7  $\pm$  1 ; ET + RT , 6  $\pm$  1; P = 0.05). The timing of meals around training was influenced by the organisation of CT. Carbohydrate (CHO) consumption before training session one was significantly less in RT + ET (CHO; 0.10  $\pm$  0.5 g  $\cdot$  kg<sup>-1</sup> vs. CHO; 0.45  $\pm$  0.2 g  $\cdot$  kg<sup>-1</sup>).

## Conclusion

The present data demonstrate that the organisation of CT (i.e., exercise order and/or recovery time between bouts) and nutrition (i.e., timing of meal intake) can be unsystematic in the applied environment. The organisation of training and nutrition might influence the players’ ability to perform high-intensity actions in secondary training sessions and could potentially impact acute metabolic processes associated with muscle recovery and muscle adaptation.

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# Functional Movement Screen (FMS™) score does not predict injury in English Premier League youth academy football players

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## Introduction

The Functional Movement Screen (FMS™) is widely used within elite football in an attempt to highlight players with elevated risk of injury (McCall et al., 2014). Despite being commonly used, the interaction between FMS™ score and injury in any elite football population has not been studied. The aim of the present study was to investigate the relationship between FMS™ score and non-contact injury among elite youth players from a Premier League football academy.

## Methods

Eighty-four players were screened during the pre-season period and non-contact injuries recorded prospectively for the entirety of the 2013/14 football season. Logistic regression analysis was utilized to explore the relationships between the individual sub-tests of the FMS™ and injury. Receiver operating characteristic (ROC) curves were used to assess the predictive value of the FMS™ composite score. Cut-off scores maximizing specificity and sensitivity were identified to allow formation of 2x2 contingency tables.

## Results & Discussion

FMS™ composite score did not differ between injured and uninjured players. Logistic regression revealed no relationships between score achieved on the individual sub-tests and injury. ROC curves indicated poor predictive ability. Players scoring below the identified cut-off values ( $\leq 14$  or  $\leq 15$  depending on injury type considered) were 0.66 (95%CI: 0.40-1.10), 0.70 (95%CI: 0.32-1.57) and 1.52 (95%CI: 0.50-4.61) times as likely to suffer ‘any’, ‘overuse’ and ‘severe’ injuries respectively than those who scored above the identified cut-off values.

## Conclusion

There was no relationship between FMS™ composite or individual subtest scores and injury, hence the test was unable to predict any non-contact injury among English Premier League youth academy players.

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# Fatigue impact to mechanical movement of maximal instep kicking in soccer

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## Introduction

The fatigue factor can restrict and disrupt the player's decision-making and also obstruct player's cognition during the match. It is found that fatigue can decrease the speed of the ball while kicking after being trained (protocol fatigue training). Meanwhile, another finding comes out different that the speed of the ball doesn't change significantly while playing in simulation match. The purpose of this study is to find out more comprehensively the level of fatigue to the change of movement's mechanism that occurs in instep kicking technique.

## Methods

The method used in this study is quantitative descriptive. The independent variable consist of fatigue index levels (normal and fatigue). Meanwhile, the dependent variables are the momentum of the ball, ground reaction force, and impulse.

## Results & Discussion

The result of the study shows that there is a significant difference in the speed of the ball between normal condition and fatigue. Furthermore, the result of Ground Reaction Force (GRF) and impulse shows significant difference as well.

# Groin injuries in elite male soccer players in the Netherlands

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## Introduction

Groin injuries are common in soccer players. The Dutch GRoin Injury Prevention Study (GRIP) project focuses on prevention and rehabilitation of groin injuries. One of the aims of this cohort study is to describe groin injuries in elite male soccer players.

## Methods

Teams of the first and second division in the Netherlands were invited to participate. At the start of the pre-season all participants underwent a baseline measurement. During the 2015-2016 competition season the included soccer players were prospectively monitored. Individual exposure and the occurrence of time-loss groin injuries was weekly reported to the research team. If a player sustained an injury also characteristics about injury and rehabilitation were reported.

## Results & Discussion

In total, 284 players from 10 participating teams were followed. Twenty-nine players from 9 teams sustained 37 time-loss groin injuries. The most commonly mentioned diagnosis was adductor-related groin injury (62%). Also pubic-related (29%), iliopsoas-related (6%), and inguinal-related (3%) injuries were mentioned. In 6% of the groin injuries a combination of aforementioned entities was observed. Six percent of the injuries was classified as hip-related. During the rehabilitation period most players visited a physiotherapist and/or manual therapist. Besides this therapy session treatment also consisted of ice(compression), cryotherapy (41%), dry-needling (41%), and medication (38%). The mean time to return to play (RTP) was 25 days (median: 11, range: 1 – 149 days). After RTP 1 out of 3 players (32%) still reported complaints.

## Conclusion

Almost 10% of the professional soccer players in the Netherlands can expect a time-loss groin injury during the season. Treatment procedures are diverse and sports absence can be long.

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# Positive effects of calf neuromuscular electrostimulation on performances during second half-time of a soccer match

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## Introduction

Soccer is characterized by between-halves declines in both physical abilities and technical skills (1). However, increases in lower-limbs blood-flow were correlated with improvements in performance-recovery (2). Therefore, the present study aimed to investigate the effects of calf-neuromuscular electrostimulation assessed during half-time recovery on the second-half performance.

## Methods

Twenty-two highly trained young players ( $13.5 \pm 0.5$  years;  $164.9 \pm 10$  cm;  $52.3 \pm 9.7$  kg) underwent to a soccer-match simulation (SAFT90). During half-time (15 min), they were randomly assigned to electro-stimulation (simulated group SG) (VeinoplusSport®, AdRem Technology, Paris, France) or placebo group (PG) (identical to VeinoplusSport®). Each half was split in 3 bouts of 15 minutes, separated by 3 minutes. Following each bout, strikes speed (SS), maximal speed (MS), maximal sprint accelerations (MA) and metabolic power (MP) were collected for both groups. Arterial (AF) and venous flows (VF) were measured at rest and at the end of the half-time. Data were analyzed according to Hopkins 2009 (3) and reported as qualitative and percentage chances, mean change effect size (ES) and confidence interval.

## Results & Discussion

Analysis of physiological values shows an increase of lower limb flow (likely effect on AF [95/5/1%, ES=-0.87 (-0.19; 0.68)] and very likely effect on VF [98/2/0%, ES=-0.74 (-1.16; -0.31)]), in stimulated group (SG) at the end of half-time compared to control group (PG).

SG obtain beneficial effects on performance during first 15 minutes of second half compared to CG with likely effect on SS [87/11/1%, ES=-0.56 (-1.10; -0.01)], on MS [90/10/0%, ES=0.47 (0.12; 0.83)], on MA [88/10/2%, ES=-0.69 (-0.94; 0.49)], and possible effect on MP [53/44/3%, ES=0.21 (-0.15; 0.58)].

## Conclusion

Our study highlighted that calf electro-stimulation during half-time improves performance during the beginning of the second half. The increases in lower-limbs blood flow may allow greater oxygen supply and glucose uptake to the exercised muscles, fastening the metabolic by-products removal.

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# Anticipatory processes of agility outcomes in soccer: the relationship between action capabilities, movement time and affordances

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## Introduction

In a recent systematic review of agility research Paul et al. (2016) recognised that the term ‘agility’ should only be applied when a task requires an anticipatory process. Attacking players will attempt to evade or deceive defenders, which results in defensive players having to initiate appropriate responses towards unpredictable actions. Based on the above, successful agility performance in soccer requires the interaction and synchronisation of anticipation and movement. Research has implied that action capabilities may directly influence anticipation, which raises the possibility that action capabilities appear to be the central tenet of what underpins anticipation skill. Therefore, enhanced action capabilities could enable performer’s greater affordances, offering the invitation to move later and rely on more useful information (Brault et al., 2012; Dicks et al., 2010).

## Methods

Twenty elite youth football players were recruited, aged between 12 to 14 years ( $M = 13.8$ ,  $SD = 0.6$ ). Mean height and weight of this study group were 165.3,  $SD = 9.4$  cm and 50.5,  $SD = 9.5$  kg, respectively. To assess the athletic capabilities of the players, the study utilised the 2011 Elite Player Performance Plan (EPPP) battery of tests; countermovement vertical jump (CMVJ), 20 m sprint, with a 5 m split and the arrowhead pre-planned COD test. The player’s anticipatory-agility was tested via a soccer specific agility test (SSAT). Players were assigned to either a change of direction group (CODG) or a small-sided games group (SSGG). The CODG was a plyometric based intervention and the SSGG was a game specific intervention.

## Results & Discussion

Individual analysis of the CODG signifies that of the 24 physical variables (6× 5 m, 20 m, CMVJ and COD test, respectively), 17 had improved post-intervention (71%). Five participants delayed their IMT post-intervention and two participants (CODG 5 & CODG 6) showed improvements in all four physical tests. Furthermore, both participants displayed meaningful delays in IMT (Cohen’s  $d$ , 0.47 & Cohen’s  $d$ , 1.67, respectively). This finding supports previous works, in highlighting that enhanced action capabilities offer players the opportunity to delay IMT. The findings of the present study can provide some support to the studies that have highlighted the efficacy of SSGs in improving physiological fitness components.

## Conclusion

The overall findings of this study may not provide conclusive evidence supporting a strong action capability and anticipation-agility relationship. However, previous research and aspects of the present study highlight the need for further investigation of this relationship. The present study may be the first intervention study that has attempted to highlight the relationship between physical capabilities and IMT. Anticipation and decision-making research has identified that an early response is not what differentiates between skilled and novice performers. Thus, it could be argued that identifying what affords an individual the option to delay a movement response during agility scenarios, may help to bridge the gap between traditional agility research perspectives, and skill acquisition theories of anticipation in sport.

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# Sport and Discrimination: 'I can not believe they keep coming back!' Male and Female Football Coaches' Experiences of the Football Associations Formal Coach Education Process

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In recent years, the provision of formal coach education has been regarded as a crucial mechanism for endorsing sports coaching and facilitating sports coaching practitioners' professional development and competency. As a result, there has been a noticeable increase in the number of sports coaching research scholars investigating formal coach education. However, previous research has recognised that formal coach education has had a limited impact on learning and professional development. In addition, the research surrounding females in sports coaching, and in particular their experiences of formal coach education, is limited. It is a vastly under-researched area, and currently it is not known why females are under-represented in formal coach education courses. To that end, this study aimed to explore the gendered issues associated with the complexities of the Football Association's formal coach education process, and the evidence affecting female football coaching practitioners' incentive to attend formal coach education. The data was analysed utilising an interpretive phenomenological analysis approach, and emerged, broadly speaking, out of the Bourdieun and feminist theoretical framework.

The research findings generated point towards a range of contexts and challenges concerning formal coach education. It was established that high levels of gender discrimination, inappropriate cultural practices, and sensitive, yet, traditionally silenced issues, were evident. Accordingly, these were discussed in line with the Bourdieuan notions of social acceptance, symbolic language and violence. Ultimately, due to the sports coaching practitioners' many insights, it can be argued that motivation levels and consequently attrition, have indeed been affected, and could well continue to be. Hopefully, the recommendations provided could go a long way to enhancing the future provision of formal coach education.

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# Perceptual-cognitive processes underlying creativity in skilled soccer players

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## Introduction

*Creativity* is a divergent thinking ability to produce varying, original, and flexible solutions across different situational contexts (Memmert et al., 2007). It forms a key part of expert performance in soccer and other domains. The aim of this study was to determine the underlying perceptual and cognitive processes that underpin superior creative performance in soccer players.

## Methods

Forty skilled adult soccer players participated. In the experimental task they viewed life-size video of 11 *vs.* 11 attacking situations whilst in possession of a ball. Clips were occluded at a key moment and they were required to play the ball in response to each situation. Moreover, they were required to verbalize the additional actions they could execute for each situation. Their solutions on the task were measured using the three observation criteria for creativity of originality, flexibility, and fluency of decisions. Players were categorized using these criteria into either more- or less-creative groups. Visual search and cognitive processes were recorded during the task using a portable eye-movement registration system and retrospective verbal reports, respectively.

## Results & Discussion

The creativity-based between-group differences in decision making were underpinned by differences in visual search strategy. Creative players made more fixations of shorter duration in a different sequential order and towards more informative locations of the display compared with less-creative players, indicating a broader attentional focus. They generated a greater number of verbal report statements related to assessment of the current situation and planning of future actions when compared with the less-creative players. Our findings highlight the perceptual-cognitive processes underlying superior creative performance in soccer.

## Conclusion

Creative performance in soccer players is underpinned by perceptual-cognitive processes that appear to be crucial in facilitating more novel solutions.

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# Position specific player load during match in a professional football club

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## Introduction

To understand physical demands of match play in football we need objective data.

Most studies have focused on distance covered at different speed to explain match load (Bradley et al, 2009). Physically demanding actions like accelerations and turns are not well explored (Iaia et al, 2009). The aim of the study is to describe and compare physical demands of five playing positions in official match play.

## Methods

32 players ( $21.8 \pm 4.3$  years) from a Norwegian elite football club were tracked in 27 home games. Players' positions were classified into: central backs (CB,  $n=7$ , observations (obs) =43), full-backs (FB,  $n=6$ , obs=35), central-midfielders (CM,  $n=10$ , obs=40), wide midfielders (WM,  $n=6$ , obs=22) and central forwards (CF,  $n=3$ , obs=10). Physical parameters were captured by ZXY Sport Tracking and included: accelerations (Acccounts), acceleration work-rate (Accwr), turns, high intensity runs (HIR) work-rate (HIRwr) and HIR distance (HIRdist). Data was analysed if: (1) players completed the match in the same position and (2) the team used 4-5-1 or 4-3-3 formations. Means, ( $\pm$ SD), factorial analysis of variance and Bonferroni test for multiple comparisons were used to check for differences by field positions (SPSS 24.0).

## Results & Discussion

CF performed more Acccounts and had higher Accwr ( $94.9 \pm 14.7$ ;  $6.3 \pm 0.8$  m/min) than CB ( $67.5 \pm 9.9$ ;  $4.0 \pm 0.7$  m/min), FB ( $74.6 \pm 10.3$ ;  $4.7 \pm 0.6$  m/min), CM ( $70.2 \pm 13.3$ ;  $4.0 \pm 0.9$  m/min) and WM ( $79.2 \pm 16.6$ ;  $4.7 \pm 0.9$  m/min) ( $p < 0.001$ ).

CF ( $47.9 \pm 9.3$ ), CM ( $47.5 \pm 20.5$ ) and FB ( $43.7 \pm 11.6$ ) performed more turns ( $90^\circ - > 360^\circ$ ) than CB ( $30.9 \pm 9.6$ ) ( $p < 0.001$ ).

CF ( $10.1 \pm 1.5$  m/min), WM ( $9.3 \pm 1.8$  m/min), CM ( $8.3 \pm 2.9$  m/min) and FB ( $8.6 \pm 1.8$  m/min) had higher HIRwr than CB ( $5.8 \pm 1.9$  m/min).

Regarding HIRdist, CF performed a higher number of 11-15 meters ( $9.6 \pm 3.5$  vs.  $5.3 \pm 2.2$  vs.  $5.5 \pm 3.2$  vs.  $6.7 \pm 3.1$ ;  $p < 0.001$ , for CF, CB, FB and CM) and 21-25 meters distances ( $5.8 \pm 2.0$  vs.  $3.1 \pm 1.6$  vs.  $4.0 \pm 1.7$ ;  $p < 0.001$ , for CF, CB and CM).

Distances of 36-40 and 46-50 meters were covered more times by FB ( $1.6 \pm 1.4$ ;  $1.0 \pm 1.1$ ) and WM ( $1.8 \pm 1.3$ ;  $1.0 \pm 1.2$ ) than CB ( $0.8 \pm 0.9$ ;  $0.3 \pm 0.6$ ) ( $p < 0.001$ ).

## Conclusion

Significant differences in physical parameters by playing positions have been observed during match play. These observations provide the foundation for a real-time personalization computerised coach toolkit we currently are developing to customize individual training load to player positions while the practice is unfolding.

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# From traditional football to the 3halves methodology: sociological reflexions

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## Introduction

A methodology originated between Medellin and Buenos Aires is now carried out by the network of *Streetfootballworld* (SFW). The methodology resorts to a gender-mixed football designed in 3 halves (F3H). During the first, participants have to agree on the rules. For the second, they put in practice what they previously defined. As for the third, participants evaluate what happened on the field beyond goals and add points according to consensus (Gannett et al, 2014). This innovation was incorporated in 2006 into the programs known as *Football for Hope* and has benefited from FIFA's support.

## Methodology

Based on field-work observations at *The 2013 Latin-American Festival of F3H in Salvador* (Brazil), *The 2014 Football for Hope* in Rio de Janeiro and *The 2016 Streetfootballworld and Sport dans la Ville Festival* in Lyon, this proposal seeks to discuss the capacities opened by this type of football, which has been transformed into a social intervention tool. But which are, in fact, the potentialities of this methodology for social impact?

In order to offer responses at the *2017 World Conference on Science and Soccer*, a comparative basis with another event, the *Homeless World Cup* (HWC), will be taken as measure, since its consecutive editions between 2008 and 2012 were observed (Segura et al, 2015).

## Results & Discussion

This comparison allows emerging the advantages of the F3H methodology. Whilst the HWC also fosters social change, it uses a traditional type of football, where the team that scores more goals wins. F3H is underpinned on gender-mixed formats, from which participants are empowered to create the conditions for the matches. Once at the field, they are encouraged to behave in respect of their own rules. Thus, debate and negotiation are enhanced when deciding final scores. The possibilities apply either for NGOs, networks and sport bodies, but are also likely to be promoted by institutions such as the United Nations and governments. Nevertheless, sociological observation obliges to identify limits of any tool. Some programs consider that goals scored by girls count double, whereas others estimate that this may represent discrimination. Moreover, both at the SFW and HWC's festivals, the overwhelming number of games and the exhaustion of players showed to be a constant.

## Conclusion

The challenge for this kind of programs and events relies whether to focus on traditional football. Social accompaniment through the F3H is likely to have a stronger basis for tracking participants' evolution throughout the year. Ten years of empirical research suggest that moving away from competition and resort to other social tools appears be the key to produce significant social impact on participants.

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# Passions of managing: empirical insights from professional football managers

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## Introduction

Passion in the workplace has recently been recognized as an understudied topic in the field of sport management (Anagnostopoulos, Winand, & Papadimitriou, 2016), although practitioners have emphasised both personal, interpersonal, and organisational related benefits (Nesti, 2010). The present study attempts to deepen the understandings of what constitutes professional league managers' passion in work and how their passion might inform their managerial philosophy and efficiency.

## Methods

A qualitative position was adopted, aiming to explore experiences that embody meanings and understandings that operate in "the real world" from the perspective of a manager/head coach (Hoepfl, 1997). A series of deductively developed individual semi-structured interviews was conducted with a sample of managers/head coaches (n=16) from the English and Norwegian professional leagues. Data was recorded, transcribed verbatim and exposed to notions of content analysis.

## Results & discussion

The findings suggested that passion for football was present in all of the participants. The personal value in this regard related to their identity towards football in the wake of a long life within the sport. It also related to strong individual interests, which differed between managers, and that seemed to inform their ways of performing their job. Their managerial philosophy and maintenance in work seemed therefore strongly related to their passion and love for the game. Given that a shared understanding of the managerial philosophy is needed for the development organisational consistency and efficiency (Mintzberg, 1973), knowledge of the manager's passion should be considered when a clubs are recruiting their next manager.

## Conclusion

Managerial efficiency depends on the ability to integrate, or being integrated to, a shared, value-based understanding of how to operate internally to the club. Given that passion seems to form the cornerstones of the manager's philosophy, the awareness of managerial passion should be present in both the manager and the club already in the recruitment process to intentionally reduce frictions in the sequel.

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# Evaluation of Technological Officiating Aids

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## Introduction

To overcome limitations of human perception and information processing, an increasing number of game sport associations introduce Technological Officiating Aids (TOA). Introductions of such aids must be seen as interventions in social settings and should be subject of evaluative research. The aim of this project was to create a conceptual framework for comprehensive evaluations of TOA and apply it for two recently introduced devices: the goal line technology and the vanishing spray.

## Evaluative framework for TOA

The framework for evaluative research of TOA is based on three dynamic flows of factors. First, the structure of the competition, which creates the need for such aids and is vice versa influenced by it. Second, the technological progress that provides potential solutions and third, the influence of and on stakeholders' opinions. The framework also demands evaluations at several points in time, starting prior to the introduction and continuing after the first evaluations of its application.

## Study I: Goal Line Technology

In this study of Kolbinger et al. (2015) investigated the frequency of critical goal line calls and compared it to critical goal calls in general. The results showed that 5.0 scenes per season in the Bundesliga could only be solved by using goal line technology. Further, critical goal line decisions just hold 4.7% of all critical goal calls. Thus, the authors raised concerns about the cost-benefit ratio for this TOA.

## Study II: Vanishing Spray

For the evaluation of the vanishing spray Kolbinger and Link (2016) investigated its influence on violations of the minimum distance rule, the success of free kicks and the referee's behaviour. It was found that the spray led to a lower extent of rule violations, but had no effects on the success and the referee's behaviour. It was further shown that the respective set of rules was not applied in accordance with the laws of the game concerning the distance set by the referee and the penalization of minimum distance rule violations.

## Conclusion

The findings of the two studies showed the need for the evaluation of TOA and supported the developed conceptual framework. There is a strong need to include the stakeholder's opinion in the evaluative process and to start this process prior to the introduction to provide information about the necessity of TOA.

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# Changes in kicking as a result of motor skill program in preschoolers

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## Introduction

Kicking is a fundamental motor skill which is used in different sports like soccer, rugby, and American football (Payne & Isaacs, 2012). It is generally developed in early childhood period. A clear understanding of this skill has essential implications for instructors seeking to improve kicking performance of children. However, limited research exists on the instructional process of kicking. Therefore, the purpose of this study was to examine the effects of kicking instruction in preschoolers.

## Methods

Participants ( $N=56$ ) consisted of preschool children in a motor skill program ( $n=33$ ) and comparison group ( $n=23$ ). All children were evaluated using the kicking criteria (0-8 points) from The Test of Gross Motor Development-2 (TGMD-2, Ulrich 2000) before and after the instructional program. Children in motor skill program received 8, 12 min sessions of kicking instruction as a part of an 8 week, 480 min motor skill instruction. Kicking instruction included developmentally appropriate instruction and task analysis was conducted to develop individualized instructional activities. The comparison group did not receive any structured motor skill instruction.

## Results & Discussion

An analysis of variance with repeated measures found a significant Group X Time interaction,  $(1, 54) = 6.74, p < .05$ , but no significant Group X Time X Sex interaction ( $p = .20$ ). Chi-square analyses were used to determine the distribution of scores for the critical elements of kicking between the groups. The four critical elements of kicking in TGMD-2 were as follows: 1) rapid continuous approach to the ball (C1), 2) an elongated stride or leap immediately prior to the ball contact (C2), 3) non-kicking foot placed even with or slightly in back of the ball (C3), and 4) kicks ball with instep of preferred foot (C4) (Ulrich, 2000)

At the pretest, there were no significant differences between the motor skill group and the comparison group with regard to the distribution of scores for the critical elements. At the posttest, there were significant differences between the groups with regard to the critical element 2 ( $p \leq .001$ ). There were little changes in other critical elements. Mean scores of critical elements in the motor skill program for pretest/posttest were as follows:  $M = 1.27/1.70$  (C1),  $M = 0.09/0.85$  (C3),  $M = 1.33/1.76$  (C4).

## Conclusion

The findings of the study showed that developmentally appropriate instruction plays a critical role for teaching the motor skills in early childhood period and this study has important implications to teaching kicking to preschoolers.

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# Aerodynamics of dimple soccer balls

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## Introduction

A report on the study of smooth balls shows that the critical Reynolds number is affected by the roughness of the surface of the ball (Achenbach, 1974). Further, the form of the seam has also been said to impact the trajectory of the ball (Carré and Barber, 2012; Passomre et al., 2008; Tuplin et al., 2012). However, the surface form of the soccer ball is a complex combination of various types of ball panels and seams, and hence, the small dimple like projections on the surface of the ball have changed in recent years (Hong and Asai, 2014; Hong et al., 2015). Therefore, in the present study, we created dimples on the surface of the soccer ball and studied their effect on the aerodynamics of the ball

## Methods

In this study, we performed experiments on soccer balls made using the same material (leather) in the thread (seam) between the panels. Three types of soccer balls, with 32, 12, and 6 panels, were fabricated, and in each type, balls with and without dimples were made. In total, 6 types of soccer balls were studied, and the impact of the number of panels and existence of dimples on the aerodynamic characteristics was measured using wind tunnel experiments.

## Results & Discussion

The aerodynamics of the balls indicate that the aerodynamic drag tends to drop faster for the dimple-type soccer balls than for the dimple-less soccer balls. This is believed to be due to the fact that in the intermediate speed interval ( $Re = 1.5 \times 10^5 \sim 3.0 \times 10^5$ ), the dimple-type soccer ball experiences a smaller drag than the dimple-less ball and hence is perceived to be faster. In contrast, in the high speed interval ( $Re = 3.8 \times 10^5 \sim 5.0 \times 10^5$ ), the dimple-less ball had a smaller drag value. Further, the force variation in the side and lift forces due to the presence or absence of the dimples, the dimple-less ball is seen to have a larger value than the dimple-type ball with an increase in the wind speed.

## Conclusion

The results confirm that the aerodynamic force acting on the ball vary greatly depending on the impediments on the surface of the soccer ball, such as surface unevenness. First, with regard to the impact of dimples on the drag of the soccer ball, it is found that the drag acting on the ball changes depending on the wind speed interval. Thus, it is clear that the drag acting on the ball varies depending on the presence or absence of dimples on its surface. Further, with regard to the impact of dimples on the lift and side forces of the ball, the dimple-type ball is observed to have less force variation than the dimple-less ball. Thus, creating dimples on the surface of the soccer ball makes it possible to control the irregular movement of the ball in the up and down and left and right directions to some extent.

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# Longitudinal development of speed abilities and technical skills in youth soccer and its relationship to adult performance level

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## Introduction

Several talent development programs in soccer have implemented diagnostics measuring motor performance factors. Recent research provided empirical evidence with regard to the prognostic relevance of singular assessments. Although theoretical frameworks argue for a dynamic conceptualization of talent, there is a lack of studies investigating the relevance of the development of players' skills and abilities (Höner & Votteler, 2016). This longitudinal study analyzed the 3-year development of elite youth players' speed abilities and technical skills and investigated the relevance of this development for adult success.

## Methods

$N=1134$  players born between 1993 and 1995 were investigated annually from U12 to U15. Each player was selected for the German Soccer Association's talent development program and participated in nationwide motor diagnostics (sprinting, agility, dribbling, ball control, shooting) four times (once each season). Additionally, players' relative age (RA) was assessed. Players' adult performance level (APL) in the 2014/15 season was used to distinguish between elite (1st-5th German division,  $N=145$ ) and non-elite players (other divisions,  $N=989$ ).

Using multilevel regression analyses (Random Intercept and Random Slope Models) each single test performance was predicted by time,  $\text{time}^2$  (level 1-predictors), APL and RA (level 2-covariates) with simultaneous consideration for interaction effects between the respective variables. Only significant predictors ( $\alpha=.05$ ) were included in the final model (random as well as fixed effects).

## Results & Discussion

Time and  $\text{time}^2$  were significant predictors for each test performance indicating that players' test performance improved non-linearly within the investigated 3-year period ( $p < .05$ ). A predictive value of RA was confirmed for sprinting ( $p < .05$ ). A significant influence of APL was detected for the other tests ( $p < .05$ ). Interaction effects distinctly failed to reach significance. The analyses of random effects revealed a significant inter-individual variation with regard to the intercept as well as the slopes time and  $\text{time}^2$ .

## Conclusion

The study revealed an improvement in players' performance for all considered motor predictors over a 3-year period from early to middle adolescence. While APL was found to be significant for most of the considered factors, there was no significant interaction between APL and time which indicates that future elite players had already been better in the beginning of the talent development program and maintained this level throughout their promotion.

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# A video-based diagnostic of decision-making skills in soccer: an investigation of adolescent players' decision competence based on age, playing position and playing status

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## Introduction

In previous research physiological, physical, and techno-motoric talent predictors in soccer have been investigated extensively. Cognitive skills are further important performance indicators for soccer, in particular players' ability to make the right decision in different game situations under time constraints. However, there is a lack of diagnostics that measure decision-making performance using soccer specific stimuli in combination with a realistic motor response. This study aimed to implement and validate a video-based test battery that assesses decision-making at one of the leading German youth academies. Furthermore, adolescent soccer players' competence in decision-making was examined based on age, playing position and playing status.

## Methods

The sample consisted of  $N = 49$  German youth academy players born between 1996-2000 ( $17.2 \pm 1.0$  ys.). To examine the correctness of the decision-making task players had to dribble and pass to one of three targets in various game situations that were projected on a large video screen. The video-based test included 48 video clips, which were separated into four categories based on different playing positions such as wing and central defender (WDF, CDF), midfielder (MF), forward (FW). A total score (SC) and a score for each individual category (SCWDF, SCCDF, SCMF, SCFW) were computed and also analyzed based on age (U16-U19), playing position and playing status, i. e. first team regular player (FTRP) vs. reserve player (RP).

## Results & Discussion

The test instrument showed a satisfactory reliability (odd-even-method) for SC ( $r = 0.78$ ;  $p < .01$ ). Diagnostic validity was assessed with independent two-sample t-tests comparing players' decision-making skill based on their playing status. FTRP revealed significant better results in SC than RP ( $d = 0.61$ ;  $p < .05$ ). One-way ANOVAs were used to identify differences in decision-making competence with regard to age and playing position. Age comparison did not show significant differences for SC. In regard to playing position, MF revealed better SC than DF and FW. Within the individual categories MF reached their highest scores in SCWDF and SCMF, DF in SCCDF and FW in SCFW. However, none of the differences were significant.

## Conclusion

Overall, the applied video-based test that is close to real game situations seems to be a suitable instrument for discriminating playing status. In addition, the findings indicate that players in certain positions perform better in their respective category, whereas for age no differences in decision-making performance were found. Furthermore, the prognostic validity of this diagnostic will be a future interest.

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# Effects of competition on multidimensional recovery/stress states in elite youth football players

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## Introduction

During in-season weeks in football, when players are required to compete weekly or even bi-weekly, it is crucial to balance out recovery-stress states (Dupont et al., 2010). Especially, the perception of fatigue observed after matches is consistent with changes in physical and neuromuscular performance in the aftermath of football competition (Thorpe et al., 2016). However, as recovery and stress are multidimensional processes (Kellmann, 2010), focus should be on mental and emotional states after competition as well. The aim of this study was to quantify changes through self-report measures of physical, mental, and emotional states after matches during in-season weeks in football.

## Methods

A total of 25 players ( $17.5 \pm .5$  yrs,  $MBMI$   $22.67 \pm 1.57$ ) of an *U19 Junioren Bundesliga* team participated over the entire 6-month assessment (12 matches) period. The players completed the Short Recovery/Stress Scale (SRSS, Kellmann et al., 2016) twice a week on Monday and Friday mornings between 7 and 9am. To allow for a sophisticated analysis of the 12 matches, the team was divided in those who played more than 60 min in a match and those who played less than 60 min.

## Results & Discussion

Wilcoxon signed rank tests revealed significant main effects for changes from Friday to Monday ratings in players who played more than 60 min (group 1) and less than 60 min (group 2). However, different items of the SRSS were relevant for the two subgroups. For example, group 1 was less recovered physically ( $Z = -2.98$ ,  $p = .003$ ,  $r = -.86$ ) and mentally ( $Z = -2.93$ ,  $p = .003$ ,  $r = -.85$ ) after matches. Taking group 2 into account yielded a different pattern. This group was less recovered mentally ( $Z = -2.20$ ,  $p = .028$ ,  $r = -.64$ ) and had lower emotional states ( $Z = -2.60$ ,  $p = .010$ ,  $r = -.75$ ) when comparing Fridays' and Mondays' recovery scores.

## Conclusion

The present study examined the impact of matches on subjective ratings of physical, mental, and emotional recovery/stress states using the SRSS. Results revealed that matches affect those who played more than 60 min differently compared to those who played less than 60 min. This was the case not only for physical recovery/stress ratings but also for mental and emotional self-reports. Therefore, to be holistic and potentially more effective, recovery after matches should adopt a multidimensional approach.

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# Prognostic relevance of motor talent predictors in elite girls' soccer: A prospective cohort study

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## Introduction

In order to promote the players with the highest potential for success as soon as possible, the process of talent identification and selection in soccer has become increasingly important. Recently, there has been a trend to complement the subjective assessments of coaches with objective diagnostics. While multiple researchers have investigated the prognostic relevance of motor talent predictors in youth soccer (e.g., Gonaus & Müller, 2012), to date, no studies have been conducted with female participants. Therefore, the purpose of the current research was to: (a) analyze the prognostic relevance of motor talent predictors for female youth soccer players and (b) compare the motor performance of girls and boys.

## Methods

Participants were 499 female soccer players born between 1993 and 1998 who were selected for the German Soccer Association's talent development program. Players participated in motor diagnostics at U12 assessing sprinting, agility, dribbling, ball control, and shooting. Subsequently, girls' motor performance was used to predict their success at U17 based on three selection levels (youth national team, regional association, and not further selected). One-way analyses of variance (ANOVA) were used to determine the significance of mean differences in participants' performance at U12 based on their future selection levels. In addition, girls' results were compared to the performance of 19,633 male U12 players within the German Soccer Association's talent development program (see Höner & Votteler, 2016) using independent sample t-tests.

## Results & Discussion

With the exception of the motor predictor shooting all variables significantly discriminated between the selection levels ( $p < .01$ ). More specifically, girls who were selected for the U17 youth national team performed significantly better at U12 than non-selected players ( $0.55 \leq d \leq 1.04$ ). When comparing the average performance of all girls and boys, male players were significantly better across all variables ( $p < .01$ ). Yet, with the exception of dribbling, at U12 there was no significant difference between the performance of selected girls (youth national team or regional association) and the average performance across all boys.

## Conclusion

The current findings provide evidence for the value of motor diagnostics in girls' soccer. That is, motor performance can help to predict female U12 players' future success in mid-adolescence (U17). Overall, boys appear to already possess higher motor abilities and skills at an early age (U12). However, the most talented girls perform comparably to average boys in childhood.

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# ”Should you be fast or powerful?” A new way for sprint training in soccer

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## Introduction

Resisted sprint running is a common training method for improving sprint ability (Petrakos et al., 2016). The present study proposes a new way for sprint training in young adult soccer players during an in-season period (de Hoyo et al., 2016) using the Power Sprint device.

## Methods

The study involved two groups of young adult players, both groups consisting of 5 subjects. The experimental group was trained using the Power Sprint device while the control group performed a traditional training by jumps and sprint repetitions to enhance the sprint ability. This training machine allows the subject to work counter a mechanical resistance ranging from 6 to 24 kilograms, during sprinting. The resistance is applied close to the center of gravity of the body through a waist belt. Before and after administration of the two training protocols (Power Sprint training or traditional training performed during a 6 weeks in-season period), both groups were subjected to a test with Power Sprint to determine the individual peak power and to two independent control tests: a Counter Movement Jump (CMJ) test and a sprint test with two changes of direction of 90° on 15 meters.

## Results & Discussion

The experimental group was trained using a load corresponding to the individual peak power. Data, analyzed by Student’s t test for paired samples, showed that the Power Sprint training improved individual peak power, CMJ height and speed in the sprint test on 15 meters with two changes of direction of 90° ( $p=0.035$ ,  $p=0.009$  and  $p=0.02$ , respectively). Traditional training produced no improvement in the outcome variables ( $p=0.84$ ,  $p=0.48$  and  $p=0.24$ , respectively).

## Conclusion

Our findings indicate that Power Sprint training significantly improves the individual peak power, the CMJ height and the running speed on traits with the presence of changes of direction without the ball. This new way of sprint training is therefore suitable to increase both the CMJ height and the speed in short distances with changes of direction in young adult soccer players during an in-season period. The individual peak power training appears to be more appropriate to improve the sprint ability compared to traditional training.

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# Planning Training Workload in Football Using Small Sized Games Density

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## Introduction

In the past few years, integrated athletic preparation (incorporating athletic preparation within technical skills practice) has appeared as an alternative to athletic training without ball. Small Sided Games (SSG) play a key role in this approach. Programming the sessions requires for coaches and athletic training staff to know the influence of the field’s size and/or the influence of the number of players on the workload. This study aims at assessing the relation between training workload and small sided games’ (SSGs) density (field area divided by the number of players) for European Football athletic preparation.

## Methods

25 French professional players (including 11 international players) involved in the French professional Championship and Europa League have been studied through GPS data collected from 41 practice games including 33 different densities and 3 full games.

## Results and discussion

The results from this study show that all the essential athletic skills are all significantly correlated to the game’s density. Acceleration distance, deceleration distance, metabolic power and total distance follow a logarithmic regression model, while distance and number of sprints follow a linear regression model. From those various models, the research reveals options for coaches to monitor the training workload. They can indeed anticipate the load resulting from the SSGs and therefore adjust the size of the field to the number of players. For instance, if we use a regression model, having a 10 minutes SSG training (on a 40m x 52m field with 7 players on both sides, meaning a density of 150m<sup>2</sup>) would be equivalent to 760m of total distance, 40m of sprint, 40m of acceleration, 34m deceleration and 160m of metabolic power. The major interest of this objective anticipation capacity is the quantification of the training workload and ultimately the prevention of over-training. In addition, if we reverse the logic, the objective of reaching a speed capacity equivalent to 85% of a game pace could be obtained through setting up a SSG on a 280m<sup>2</sup> field (55m per 72m with 14 players). Defining the field size during SSGs enables to target the most favorable density for developing the expected athletic skills (Endurance, Power, Speed and Force).

## Conclusion

Calibrating intensity during SSGs as close as possible to the game conditions allows coaches to assess each athletic skill in the same conditions of intensity as in the competition. This is crucial in order to achieve the best preparation.

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# Characteristics of lower limb force exertion during diving motions by collegiate male soccer goalkeepers

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## Introduction

To make effective soccer goalkeeper(GK)'s diving motion, strategies need to produce large ground reaction force (GRF) to optimise the velocity and linear motion of the body centre of gravity toward the ball (Suzuki et al., 2011; Spratford et al., 2009). However, strategies to adapt the GRF, and the associated lower limb joint torques, to the course and flight of the ball have yet to be quantitatively verified. Therefore, our aim was to use three-dimensional motion analysis to characterise profiles of lower limb joint torques and power, based on GRF data.

## Methods

Eleven male university football team GKs were recruited into our study group: mean (standard deviation) height of 178.4 (6.2) cm and mass of 71.2 kg (2.5). Their Diving motions were analysed for two ball distances (near:1.83m from GK and far:3.5m from GK). All balls were presented only from the right side. The analysis was based on whole-body three-dimensional motion capture (250 Hz), with ground reaction forces recorded with force plates (1000 Hz). Lower limb joint torques, power and work profiles were computed using standard inverse dynamics equations.

## Results & Discussion

The work contributed by each lower limb joint were modulated by ball distance conditions. For the Contralateral Side(CS)-leg, positive ankle power was significantly greater for all dives ( $P < 0.05$ ). For far-distance dives, the negative power contributed by the ankle of the CS-leg was significantly greater than that provided by any other joint ( $P < 0.05$ ). So the ankle of the CS leg contributed a relatively larger amount of positive joint work. For the Ball side (BS)-leg, the greatest positive power was generated and contributed by the hip for near-distance dives and the ankle for far-distance dives ( $P < 0.05$ ).

## Conclusion

We identified a dominant contribution of hip extensor power to the performance of near-distance dives, with the ankle plantarflexors playing a dominant role for far-distance dives, indicative of the flexibility in the underlying biomechanics based on the kinematic features of the ball.

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# Daily variance of workload in professional soccer teams from different countries

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## Introduction

Daily variance of external load (EL) may contribute in characterizing the type of training sessions (TSs) and in differentiating microcycles between teams<sup>1</sup>. Based on that, the aim of this study was to analyze the variance of EL between days of the week in two professional soccer teams from different countries.

## Methods

Twenty-nine players (defenders n=10; midfielders n=9; forwards n=10) from two professional teams from Portugal (PT) and Netherlands (DT) (n=14, 19.211.05 yrs; n=15, 25.143.90 yrs, respectively) participated in this study. The players' EL was monitored, for 7 weeks, by means of portable GPS (10 Hz, JOHAN, Noordwijk, Netherlands). Duration of the session (DS) (min), total distance (TD) (m), running distance (RD) (m), sprint distance (SD) (m) were monitored. Accelerometer was used to calculate PlayerloadTM (PL) (g). TSs were codified as: +1d and +2d (days after match) and < -5d, -5d, -4d, -3d, -2d and -1 days before match.

## Results & Discussion

One-way ANOVA split by PT and DT tested the variance of EL variables between TSs. DS was different in PT (p=0.00, ES=0.40) and DT (p=0.00, ES=0.17). The longest duration in PT was recorded in -3d (99.3117.08) and the smallest in -5d (67.1313.50). Regarding DT, the greatest duration occurred in -2d (75.718.91) and the smallest in +1d (53.400.00).

TD was different in PT (p=0.001, ES=0.561) and DT (p=0.00, ES=0.29). The greatest TD in PT was covered in -3d (8773.362192.96) and the smallest in -1d (4099.801223.58). In DT, the greatest TD was covered in -5d (6314.20964.53) and the smallest in +2d (3975.90209.70).

RD was different in PT (p=0.001, ES=0.459) and DT (p=0.00, ES=0.17). The greatest RD in PT was covered in -5d (1096.55156.73) and the smallest in -1d (308.6068.40). Regarding DT, the greatest RD was covered in -5d (778.1897.68) and the smallest in +2d (187.30112.79).

SD was significant different in PT (p=0.00, ES=0.31) but not in DT (p=0.22, ES=0.06). The greatest SD in PT were covered in -3d (467.59308.50) and the smallest in -1d (112.7299.17).

PL was different in PT (p=0.00, ES=0.51) and DT (p=0.00, ES=0.19). Greatest PL in PT was obtained in > -5d (423.1484.69) and the smallest in -1d (188.5054.36). In DT, the greatest PL was obtained in -5d (343.7568.06) and the smallest in +2d (210.4017.84).

## Conclusion

The greater volume seems to occur more away from the match and the smaller in the day before (PT case) and second day after (DT case).

## Acknowledgements

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# Soccer coaches' education within the German tid program: perceptions of the quality and need for development

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## Introduction

The core task for coaches in talent identification and development (TID) programs is to support youth players' progress. Therefore, it is important for soccer associations to educate their youth coaches at a high level. In order to provide an optimal education, one grounded in general frameworks about the demands and expertise of coaches (Côté & Gilbert, 2009), TID programs must consider what constitutes the essential body of coaching knowledge. This investigation was designed to assess the perceptions of coaches within the German Soccer Association's TID program about the quality of their education and need for development concerning knowledge related demands. Based on the training guide for the German TID program, the study focused on five overarching demands related to coaches' everyday tasks, including the improvement of technical skills (TEC), promotion of tactical abilities (TAC), planning of training sessions (PTS), support of learning processes (SLP), and identification of talented players (ITP).

## Methods

N=985 coaches from the German TID program (response rate 68,2%) participated in the study and completed a 27 item online-survey addressing the five overarching demands. Coaches answered each item with regard to their perceptions of the quality of education (QE) and need for development (ND) on a 7-point-Likert scale ranging from 1 (low) to 7 (high). In addition to average values, 95% confidence intervals were calculated to identify significant deviations, which were classified in terms of standard deviations (z-values).

## Results & Discussion

Overall, participants held primarily positive perceptions of the quality of education ( $M=5.32\pm0.86$ ;  $5.25\leq CI\leq 5.38$ ). More specifically, the results indicate high values for TEC ( $M=5.41\pm1.17$ ), TAC ( $M=5.89\pm1.04$ ) and PTS ( $M=5.55\pm0.98$ ). Relatively lower values were found for SLP ( $M=5.08\pm1.14$ ) and ITP ( $M=4.65\pm1.53$ ). Significant differences from the total average values were found for SLP ( $z=.28$ ) and ITP ( $z=.78$ ). Participants reported medium high values for their perceived overall need for development ( $M=3.73\pm1.26$ ;  $3.63\leq CI\leq 3.83$ ) as well as for the four individual dimensions TAC ( $M=3.86\pm1.71$ ), PTS ( $M=3.74\pm1.59$ ), SLP ( $M=3.74\pm1.43$ ) and ITP ( $M=3.81\pm1.64$ ). The value for TEC ( $M=3.51\pm1.61$ ) is slightly lower.

## Conclusion

The results provide a basis for concrete conclusions regarding the education of coaches, including the implementation of specific needs-oriented education and development modules. For example, a new project was initiated within the German TID program, which focuses on coaches' subjective assessment of talent criteria in competence centers players.

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# Detecting impact points on a kicking foot

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## Introduction

Many studies have attempted to identify ways to increase ball velocity. These revealed that foot velocity before the impact affected the ball velocity (D'orge, 2002). Furthermore, it is believed that calculating the foot-to-ball velocity ratio is useful to assess impact performance (Nunome, 2006). However foot-to-ball velocity ratio doesn't include the detail of impact. Visually capturing the impact point is difficult because it is hidden by ball and foot when it is in collision. We aimed to detect impact point by using virtual model in this study.

## Methods

To identify a three dimensional impact point on foot, we recorded kicking motion by using VICON system (2000Hz). Participants are 15 male collegiate soccer players, and they performed straight, curve and knuckle kick. Kicking foot behavior was captured from the foot segment based on the displacements made by anatomical markers (the heel and first and fifth metatarsal heads). The impact points were expressed as coordinate value with the heel marker as the point of origin. We compared the coordinate values of the impact points and trajectories.

## Results & Discussion

The coordinate values of each impact point were as follows; straight (lateral: -24.0mm, horizontal: 152.7mm, vertical: 52.3mm), curve (lateral: -35.6mm, horizontal: 151.6mm, vertical: 47.5mm), and knuckle (lateral: -33.3mm, horizontal: 140.8mm, vertical: 52.1mm). The lateral value of straight kick was significantly larger than the other two kicks. This means that the impact of the straight kick is closer to the center line of foot compared to the others. The horizontal value of the knuckle kick was significantly smaller than the other two kicks. This means that the impact of the knuckle kick was closer to the foot in order to cause a few ball rotations. The vertical value of curve kick was significantly smaller compared to the others. This means the curve kick had the lowest impact on the foot. At the frontal plane, the straight kick trajectory sank once and then floated upward, while the knuckle kick trajectory kept floating in the contact phase upon impact. These factors cause the difference in the vertical rotation that result from these two kicks.

## Conclusion

We identified the impact points of three kinds of kicking motion and their trajectories. Their impact points and trajectories varied depending on the objective of the kicking motion. Revealing the three-dimensional impact points make it possible to investigate in more detail kicking motions.

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# Effects of Positional Variables on Shooting Outcome

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## Introduction

To improve the analysis of shooting performance, models describing the likelihood of a shot being converted into a goal were developed (Goal Expectancy; Ruiz et al., 2015). The context during an attacking event can affect the outcome (Tenga et al., 2010), however is not incorporated or specified by most models. The present study aimed to determine whether the positions of opponents influenced the outcome of shots taken from the same location.

## Methods

Shooting attempts were derived from all home matches played by an elite and internationally active professional team during four seasons in the Portuguese first league. To minimise variation, only shots taken from open play by the participating team and with the ball in a rolling motion were selected (n=435). After determining all shooting positions, three zones with the largest clusters of shots were identified (zone 1: from  $18.47 \pm 0.73$  m and at  $53.1 \pm 2.6^\circ$ , n=21; zone 2: from  $12.07 \pm 1.19$  m and at  $18.4 \pm 6.4^\circ$ , n=24; zone 3: from  $22.77 \pm 1.19$  m and at  $23.6 \pm 2.9^\circ$ , n=20). Analyses were executed for the number of opponents in line with the shot, the percentage of the goal line (sight) not blocked by outfield defenders and the distance from the shooting location to the goal keeper, the first defender in line with the shot, and the closest defender. Shooting outcome was computed as being a goal or no goal and on target or off target. Multiple and linear regression analyses were performed to determine relationships between variables and outcome.

## Results & Discussion

For shots from zone 2, large and significant correlations with the outcome of the shot being a goal or not ( $r=0.54$  [0.25; 0.75],  $P=0.025$ ) and being on target or not ( $r=0.61$  [0.33; 0.79],  $P=0.008$ ) were found for the combination of the distance to the goalkeeper and the opponents in line with the shot. Furthermore, the sight of goal was deemed significantly different for shots on target ( $74 \pm 19\%$ ) compared with shots off target ( $53 \pm 24\%$ ;  $P=0.026$ ) taken from zone 2. No further significant correlations were found for any of the zones or variables.

## conclusion

Shot outcome was affected by opponent positioning only in zone 2. The differences in variables affecting shooting outcome shows the importance of incorporating the context of individual match events in their analyses. Shots do not merely depend on the position they are taken from, however the influence of opponent positioning changes with shooting location. Such knowledge may improve training specificity and scouting accuracy of individual opponents.

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# Individualized reference ranges for the assessment of fatigue and recovery in soccer

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## Introduction

In elite soccer, monitoring fatigue and recovery is considered essential to prevent injuries and to optimise performance. However, large interindividual variability impedes on the diagnostic accuracy of all indicators known to date. Therefore an individualization algorithm for the respective reference ranges has been developed based on a similar Bayesian rationale as the Athlete Biological Passport. It was shown that this tool significantly improved diagnostic accuracy in endurance sports (Hecksteden et al., 2016). Thus, in this trial, application in professional soccer was scrutinized.

## Methods

Performance of the individualization algorithm (Hecksteden et al., 2016) was evaluated using repeated measures data from 14 professional German soccer players monitored during the 2015-2016 season. Group-based reference ranges were derived from that same dataset to ensure a best possible group-based reference for comparison. Reference classification of time-points was carried out using training logs and validated questionnaires. A chi-square test was conducted to analyse differences in error rates between individualized and group-based classifications. Visualization of raw data together with the development of reference ranges over successive measurements offers an intuitive plausibility control for the individualization procedure and ensuing classifications.

## Results & Discussion

Preliminary analyses based on CK values point to significantly lower error rates in the assessment of muscle recovery for the individualized approach ( $p < 0.001$ ;  $\chi^2 = 16.1$ ). Among 140 values analysed, the number of incorrect classifications was 15 (10.7%) for the individualized approach compared to 42 (20.0%) for the group-based approach. Further analyses will include alternative markers as well as a higher number of players.

## Conclusion

Assessment of muscle recovery by individualized interpretation of blood-borne markers may offer higher diagnostic accuracy as compared to even a sample specific group-based approach. The individualization algorithm is transferable to other markers within as well as beyond the field of monitoring recovery with improvements in diagnostic performance depending on the relationship between inter- and intraindividual variabilities.

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# Time-motion analysis in elite soccer players: small-sided games vs. match performance

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## Introduction

Video-analysis and global positioning system (GPS) are used to determine players' loads and drills during soccer activities. Small-sided games (SSGs) are generally utilized as skill-based conditioning drills, the workload intensity of which is a crucial feature. The aim of the study was to compare the locomotor load (total distance, TD, and total high intensity running > 15 km·h<sup>-1</sup>, HIR) determined during SSGs in different pitch dimensions with average values determined during official matches (INTmatch). For this approach, the interchangeability of video analysis and GPS during SSGs is a crucial issue and was also assessed (Buchheit et al., 2014).

## Methods

Twenty-five elite soccer players (Italian Serie A) performed a total of 1033 and 1532 observations for collective possession plays (SSG-P) and SSGs with goalkeeper (SSG-G), respectively. SSGs were evaluated by GPS (10 Hz; accelerometer: 100 Hz, 16G Tri-Axis). For each player, a median of 39±14 SSG-P (mean±SD) and 57±17 SSG-G were examined on different pitch dimensions. Each drill was normalized per meter covered in one minute (m·min<sup>-1</sup>) and area per player (m<sup>2</sup>·player). In addition, thirty-nine official matches (18±9 observations per player) were monitored by semi-automatic multiple cameras. Lastly, a typical training session with SSGs was monitored with both GPS and video-analysis to assess the interchangeability of the two methodologies.

## Results & Discussion

A small typical error of the estimate (TEE: 0.09, 95% confidence intervals, CI: 0.07/0.14 and TEE: 0.04, CI: 0.03/0.06 for TD and HIR, respectively) and a very large correlation (r<sup>2</sup>=0.99 and 0.98 for TD and HIR, respectively  $P < 0.001$ ) were found between GPS and video-analysis. A large correlation between TD and HIR with area per player was found only for SSG-P (r<sup>2</sup>=0.86 and r<sup>2</sup>=0.89 for TD and HIR, respectively;  $P < 0.001$ ). The regression analysis in SSG-P crossed INTmatch at an average area of 115±7 and 166±8 m<sup>2</sup>·player for TD and HIR, respectively (mean±SE  $P < 0.001$ ).

## Conclusion

A small TEE and a higher correlation permitted a comparison between GPS and video-analysis with these technologies for TD and HIR. Due to a lower tactical and higher physical involvement than in SSG-G, locomotor load increased with area per player and induced INTmatch only during SSG-P with a larger pitch area for HIR than TD. These findings may contribute to better determine workloads using SSGs with respect to match intensity.

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# The different physiological demands of refereeing national, super and international futsal matches in England

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## Introduction

Futsal Matches employ two referees who operate using similar movement patterns to an 11-a-side Assistant Referee. Futsal officials are however also required to control one touchline, attend to other referees position and frequent change position so that both referees can control the game together in tandem. As such although the requirements of officiating in futsal are similar to the 11 a side counterparts there are distinct differences in the performance demands inherent in refereeing the two sports.

## Methods

24 referees ( $79.89 \pm 12.79$ kg,  $177.6 \pm 8.58$ cm,  $30.75 \pm 9.76$ yrs) were recruited made up of both FIFA and national league referees. The study was approved by the Research Ethics Committee of the University of East London. National, super and international matches in England were filmed via two cameras (GoPro, USA) placed on either side of the court at the half- way line 3 metres from the touchline and 2 metres above the playing surface. Time and motion analysis was performed post-match to calculate distance travelled and locomotive data (Trak Performance, USA). This approach has previously been shown to be valid (Hartwig, *et al.*, 2011).

## Results and Discussion

The referees in this study covered an average total distance of 4.64 kilometres (3.93 – 6.28) over the course of the game which is lower than professional futsal referees and Iraqi futsal referees who covered an average of 5.89km and 5.96km respectively (Rebelo *et al.*, 2011; Ahmed, *et al.*, 2015). The average distance for national, super and international matches was 4.12km, 4.73km and 5.94km respectively. The findings replicate the work of Borin *et al.*, (2013) who also found a difference between total distances covered by Basketball referees, depending on the level of competition. The distances covered by referees in this study were between 31-36% less than those covered by Assistant referees in the 11-a-side game (Krustrup *et al.*, 2009). However, comparable times were found for standing, walking and time spent at speeds over 21km.h<sup>-1</sup> when compared to other studies (Rebelo *et al.*, 2011)

## Conclusion

Future work should consider whether it is the motion of the players or the fitness levels of the referees, the point being in this study none of the referees, that is the primary determining factor in reducing high intensity work whilst officiating. This would then allow for a more progressive training programme to be given to the referees at the different levels of competition.

# Depression in Danish and Swedish Elite Football Players

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Depression is one of the most commonly diagnosed mental health disorders and it has been estimated that approximately 15% of the population is at risk for developing depressive symptoms during their life (Vilhelmsson, 2013). Depression is defined as frequently experienced depressive moods, loss of interest or pleasure, decreased energy, feelings of guilt or low self-worth, disturbed sleep or appetite, and poor concentration. While research on depression in the general public is extensive, research on depression in the sport context, however, is limited. A main research focus has been on sport's antidepressant function and how regular physical activity can reduce depressive symptoms, preventing the occurrence of depression (Babiss and Gangwisch 2009). In line with this research it has been assumed that because elite athletes are so physically active they are immune to depression. Recent studies (Gulliver et al., 2015; Hammond et al., 2013) have, however, highlighted that elite athletes might be just as likely as non-athletes to experience depression, and that psychosocial benefits attributed to sport do not inherently occur through mere sport participation. The cause of depression given its complexity is difficult to articulate and has not been adequately elucidated (Richards, 2011). It is therefore particularly important to examine which sources may contribute to depression among elite athletes as sources might be different from those of the general population. This study investigates psychological factors related to depressive symptoms in Danish and Swedish male elite football players. A cross-sectional design was used to survey 323 A-squad and U19 players (M age = 22.08 years, SD = 5.15). The survey included biographical information as well as measures of depressive symptoms, sport anxiety, perfectionism, and social phobia. Results revealed an overall prevalence rate for depressive symptoms among the participants of 16.7%. Moreover, correlation analyses showed evidence of the relationships between depression and sport anxiety, perfectionistic concerns and social phobia. The results also demonstrated that there were positive indirect effects of perfectionistic concerns on depression via social phobia and sport anxiety. The findings indicate that more awareness of mental health in elite football is needed. The investigated psychological factors may be a starting point for establishing preventive programs and supportive interventions for footballers suffering from depressive symptoms.

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# Psychological integration in culturally diverse youth football teams: The role of players' motivational climate perceptions and cultural status.

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In culturally diverse societies, football is increasingly promoted as a means for social inclusion, particularly in youth (Parnell & Richardson, 2014). Taking part in this cooperative sporting activity is said to facilitate feelings of belonging, to bridge cultural differences, and to promote positive intercultural relationships (Coalter, 2007). However, football environments are not necessarily always inclusive (e.g., Bailey, 2005; Collins & Kay, 2014). Particularly in youth football players from cultural minority backgrounds report experiences of inferior treatment, prejudice and discrimination (see European Union Agency for Fundamental Rights, 2010). Such findings challenge football organizations and coaches to create sport environments that secure positive experiences of inclusion rather than negative experiences of exclusion for players – regardless of their cultural backgrounds. The present study investigates how perceptions of motivational goal climates relate to feelings of inclusion among male cultural majority and minority youth football players. Cross-sectional data was collected from 94 majority and 151 minority players using the Motivational Climate Scale for Youth Sports (MCSYS; Smith, Cumming, & Smoll, 2008) and the Perceived Group Inclusion Scale (Jansen et al., 2014). Hierarchical regression analyses showed that strong mastery goal climate perceptions were positively related to feelings of inclusion for all players. Moreover, only for minority players, this link was less strong when performance goal climate perceptions were high compared to low. In conclusion, creating a mastery oriented sport environment may secure the experience of inclusion of young football players regardless of their cultural background. Importantly, particularly for youth minority players, performance goal climate elements should be de-emphasized in order to strengthen the experience of inclusion.

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# Characterization of regulation modes between soccer players during offensive transition situations

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## Introduction

The purpose of this study was to describe and understand team coordination between soccer players in competition. More precisely, we aimed at identifying and characterizing how soccer players regulate online their dynamic involvement in team coordination during offensive transition situations, that is how players adjusted online to the needs of the collective behavior (Bourbousson and Fortes-Bourbousson, 2016). These situations are considered by coaches as crucial moments in high-level performance ; they are defined by a passage of play in which a team switches from a defensive to an offensive phase following a change in ball possession.

## Methods

Using an enactive approach (see Araujo and Bourbousson, 2016), we collected behavioural and phenomenological data which were processed in four steps. First, the reconstruction of the diachronic and synchronic dynamics of the player’s lived experience across these situations. This enabled us to identify the units of player’s activity. Second, each individual unit of activity was clustered using the related objectives within three categories of regulation modes - local (L), global (G), and mixed (M). Third, the connection of each player’s units of activity side-by-side in chronological order. Each connection was viewed as a collective regulation mode corresponding to which and how individual units were linked at a given moment. Fourth, the comparison of the occurrences of the collective modes in relation to the time of the offensive transition situations in order to identify typical patterns.

## Results & Discussion

The results indicated four patterns of regulation modes. Specifically, two distinct patterns were identified without possession of the ball: reorganized in play formation (G and M), then adapted to the actions relating from putting pressure on the ball carrier (M). Once the ball was recovered (offense) two additional patterns emerged: make oneself available to get the ball out of the recovery zone (L), then to shoot for the goal (L and M).

## Conclusion

These results suggested revealed that the players’ regulation modes that achieved team coordination were differently and timely mediated by contextual information picked up from the surrounding environment – L - (e.g., the behaviour of the closest opponent or teammate), the collective organization of part of the team – G (e.g., on the midfield line), or both – M – (e.g., the behaviour of the closest opponent and that of the most distant opposing ball carrier). Team coordination is therefore a fluctuating phenomenon that can be observed through these specific timed *gestalts*.

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# The talent of the Portuguese football player - a retrospective analysis

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Although some of the most world talented football players were born in Portugal (e.g., Eusébio, Figo, Cristiano Ronaldo), the triumphs of the national team are unusual. Two of the most important achievements were the under-20 world championships of 1989 (Riyadh) and 1991 (Lisbon).

Under the leadership of coach Carlos Queiroz, players like Figo, Rui Costa, Paulo Sousa and Fernando Couto became world champions. In over 100 years of history, only the last year (2016) the Portuguese national team achieved a similar feat.

How did it come that these two generations become world champions? What was the process that rise players like Figo, Rui Costa and Paulo Sousa to the level of football stars? These were the two initial questions for the realization of this investigation.

The participants were 27 (of 34) football world champions (generations of 1989 and 1991), 2 coaches (Carlos Queiroz and Nelo Vingada), 2 journalists, and the General Director of Sports (Portuguese Government) at this time. Semi-structured interviews were carried out and data were analyzed through the technique of content analysis. The elaboration of the categories had been defined *a priori* and *a posteriori*. The software QSR NVivo 10 was used in coding the transcripts of the interviews.

According the interviewed coaches this period was characterized by a significant improvement of the academic and scientific coach education in Portugal. As teachers in the Faculty of Human Kinetics (Lisbon), Carlos Queiroz and Nelo Vingada created the scientific department of football in this faculty. Additionally, they studied, observed and analysed the evolutionary tendencies of the game and developed specific training sessions according to these results.

Specific programs (e.g., Skilito, Football in schools, etc.) were developed with the Portuguese Government in order to increase the number of football practitioners (from 80 to 130 thousand). To select the most talented players, a national tournament was implemented (under-15). Each regional football association selected the most talented footballers to compete in the big event (Lisbon) where, each year, Carlos Queiroz and their staff selected the 25 best players.

The players' selection criteria were well established according to the specific game model of the coaches. Of these, about 70% remained in the national teams until the age of under-21. Players have benefited from long training internship periods (3 or 4 weeks) in the national team. At the national level the competitive system of youth groups has changed, increasing its quality.

Players highlighted the methodological rupture implemented by the coaches, their ability to observe and analyse the games, and their leadership. Critical phases of career transition (e.g., junior/senior) and their importance to the success of this generation of players were subjected to a detailed analysis.

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# Transitioning to the new US soccer guidelines regarding purposeful heading in youth players - introducing the NSCAA's Get aHEAD safely in soccer™ program

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## Introduction

Unparalleled media attention to concussions in sport has caused significant concerns for soccer governing bodies worldwide. In fact, following a concussive event in a German soccer player during the 2014 FIFA World Cup, the FIFA Medical Committee moved forward with changes in protocols impacting how sport-related concussions in FIFA –sanctioned events are managed. In the United States, the US Soccer Federation (US Soccer) in November 2015 moved swiftly in developing their "Recognize to Recover" program for youth soccer players.<sup>1</sup> As a result of this initiative, they set forth bold guidelines to ban purposeful heading in youth players below the age of 11, and called for limits in purposeful heading in practice in youths aged 11-13. However, this change in guidance did not include recommendations for coaches on how to implement safe and effective heading drills for those in the 11-13 age range. As a result the National Soccer Coaches Association of America (NSCAA) in conjunction with researchers at the University of Delaware (USA) developed an on-line educational diploma course to educate coaches on the best ways to instruct youth soccer players in the art of purposeful heading. Therefore, the purpose of this communication is to share with conference participants the NSCAA's Get aHEAD Safely in Soccer™ educational program.

## Methods

Risk for concussion in soccer, especially in youth players is high.<sup>2</sup> Because soccer is unique in that the head can be used purposefully to move the ball in a manner as to pass, shoot, or clear, the potential for head impacts that are generally sub-concussive in nature can occur. These sub-concussive head impacts have recently been implicated as a cause for CTE concern in American football, boxing, professional wrestling, ice hockey, and even soccer.<sup>3</sup> Therefore, efforts to minimize the effect of these head impacts as well as lowering the risk of concussion in the soccer population, especially youth is critical in protecting the integrity of the game moving forward. With this in mind the, NSCAA's Get aHEAD Safely in Soccer™ educational program was developed to reduce the risk of concussion in youth soccer players while at the same time teaching safe and effective techniques to head a ball purposefully. We proposed that the risk for concussions in youth soccer players could be minimized by: (1) teaching proper heading techniques, (2) develop strong neck and core musculature, (3) avoid dangerous plays situations, (4) educate referees to enforce the rules of soccer, and (5) use lightweight balls to reduce the mass imparted on the head, especially during practice drills.

## Results & Discussion

Newton's 2nd law of motion indicates that  $F = ma$  ( $F$  = force,  $m$  = mass,  $a$  = acceleration). With this in mind, the NSCAA's Get aHEAD Safely in Soccer™ educational program believes that good alignment of the head-neck-torso (eliminating the "bobble-head" effect) can increase mass thus lowering head accelerations, additionally improved head/neck stiffness through strengthening can reduce head accelerations, and finally lightweight balls to be used in practice settings can reduce the impact force thus lowering head accelerations. All this adds up to a



safer heading exposure environment for youth players whose brains are continuing to grow and mature during the ages of 11-13. The online course which is free of charge can be accessed at <https://www.nscaa.com/heading> and provides youth soccer coaches with a set of key coaching points for introducing purposeful heading in the 11-13 year old age group of soccer players; as well as providing a plethora of skills and drills to enable a safe and enjoyable progression. In addition, steps to impart a logical ball progression involving lightweight balls up to regulation size 5 soccer balls is stressed. Lastly, coaches are shown neck and core strengthening exercises that can be easily and safely adapted for this age group of young soccer players, all in an attempt to improve head/neck/core stiffness to safely and effectively head a soccer ball.

### **Conclusion**

Since being introduced in September 2016 the NSCAA's Get aHEAD Safely in Soccer™ educational program has been a huge success in the United States. More recently, the Professional Football Association (PFA) in England has begun to examine the US Soccer guidelines for purposeful heading in youth soccer players for adoption with their own members. With the intention of making the sport of soccer safer for its most vulnerable youth participants, the NSCAA's Get aHEAD Safely in Soccer™ initiative has the potential to impact the sport worldwide.

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# Psychological assessment of mental resilience in soccer: The color association method

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In psychological assessment in soccer, the most often instruction in questionnaires is that a player should choose answer that first comes up to his mind. But, there is always a possibility that association (Wundt, 1902), or ‘what first comes up in mind’, can be rationally corrected, guided by players’s previous experience or expectation of a certain outcomes. Some research in neuroscience, indicate that cognitive self-control is overrated and that sportsperson might overestimate conscious capacity to control behavior in sports setting (Damasio, 2010; Damasio & Carvalho, 2013). On the other hand, “uncensored”, authentic associations provide a very different, deeper and more comprehensive view. The color association method (CAM) deals with measuring and evaluating these “authentic uncensored associations” ([www.camethod.com](http://www.camethod.com)). Color association method is based on L’uscher’s color test (L’uscher, 1971), using palette of eight colors, but combined with words. Association between certain word related to sport setting and color, might provide insight non-conscious subjective psychological state of a soccer player. In soccer, it is possible to use CAM in order to obtain individual player’s profile, profile of a team, team’s perception of a certain rival team, and to access individual resilience and psychological energy for competition. Considering individual mental resilience in competition, CAM claims to explore mental resilience by measuring subjective sense of pain, effort, fear, injury, readiness for competition and training, ability to take a risk during the match, relying on habits in sports context (Mladenovic & Trunic, 2015). Thanks to computer technology, the color-word sensory input can be adapted to the demands of research of practical problems in soccer. During the three decades of implementation, researchers composed a major database which represent the basis of the standardization and interpretation of individual results (Mladenovic, 2016).

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# Repeated Maximal Acceleration Ability (RMAA) in elite youth football

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## Introduction

Recently, the ability to repeat accelerations with short recovery, termed Repeated-Acceleration Ability, has been proposed as an important factor for physical performance in football. The occurrence of bouts comprising  $\geq 3$  acceleration efforts with  $\leq 45$ s of recovery has been shown in referees (Barbero-Alvarez et al., 2014) and youth players (Barron et al., 2016). However, these studies used an absolute threshold to define efforts ( $1.5 \text{ m}\cdot\text{s}^{-2}$ ) that may be too low to reflect the high-intensity running phases of the game. Also, the 5Hz GPS devices employed have a large amount of error to detect accelerations. Our aim was to investigate the occurrence of RMAA bouts in elite youth football games using two different thresholds derived from players' actual maximal acceleration.

## Methods

Forty-four outfield players from an U16 State team wore a 10-Hz GPS unit (Optimeye S5, Catapult Sports) during official games. Acceleration was derived from velocity data over a 0.3s interval. Maximal accelerations were defined as efforts commencing above a threshold corresponding to either 70% (T70%) or 80% (T80%) of the average 5-m acceleration of all players obtained during a 40-m sprint test ( $2.62 \pm 0.30$  and  $3.00 \pm 0.26 \text{ m}\cdot\text{s}^{-2}$  respectively). An effort was required to remain above threshold for 0.3s to be considered and was concluded when acceleration returned to or fell below  $0 \text{ m}\cdot\text{s}^{-2}$ . RMAA bouts were defined as  $\geq 3$  efforts with  $\leq 45$  s recovery between each effort. Game files were included in the analysis only when a player completed  $\geq 75\%$  of the total game time, resulting in 655 individual files. The number of RMAA bouts, number and duration of efforts within bouts, and recovery between bouts were assessed using the two thresholds. Comparisons between game halves and thresholds were assessed using magnitude based inference statistics on the log-transformed raw data [Effect Size (Upper CL, Lower CL)] (Hopkins, 2006).

## Results & Discussion

An average of  $9.6 \pm 4.4$  and  $6.1 \pm 3.6$  RMAA bouts were detected per game with T70% and T80% respectively, with a most likely meaningful difference between thresholds  $[-0.80 (-0.86, -0.73)]$ . A small, very likely meaningful difference was found in the number of bouts between 1st and 2nd half ( $5.7 \pm 2.7$  v.  $4.7 \pm 2.4$  bouts) using T70%, while a small likely difference was found using T80% ( $3.7 \pm 2.3$  v.  $3.0 \pm 2.0$  bouts). An average of  $4.1 \pm 0.7$  and  $3.7 \pm 0.8$  efforts within bouts were found with T70% and T80% respectively, representing a most likely meaningful difference between thresholds  $[-0.55 (-0.64, -0.47)]$ . No other meaningful differences were detected.

## Conclusion

RMAA bouts occur frequently in elite youth football games, and differences exist between halves. This suggests RMAA may be an important physical capacity to be developed in young players. Manipulating thresholds based on actual average acceleration over 5m makes a meaningful dif-

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ference in the way RMAA is assessed.

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# The validity of the Borg CR100® scale for session rating of perceived exertion in elite youth soccer players

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## Introduction

Monitoring and controlling internal training loads in football is of great importance and may hold greater significance for youth athletes due to the increased physical and psychosocial stress associated with adolescence (Brink et al., 2010). One common method to monitor internal training load is via session rating of perceived exertion (s-RPE). The Borg CR100® scale has been shown to be valid in tracking the training load in elite soccer players (Fanchini et al., 2016), however, its validity has not yet been assessed in youth players. Therefore, the aim of our study was to assess the construct validity of the Borg CR100® scale for s-RPE in elite youth soccer players.

## Methods

Nineteen elite youth soccer players (age  $15 \pm 1$  y, height  $175.9 \pm 12.3$  cm, body mass  $69 \pm 15.4$  kg) participated to the study. Heart rate (HR), duration of sessions and RPE were collected over 27 sessions including both training sessions and competitive matches. Players had a minimum of seven months' exposure to the Borg CR10® RPE scale prior to the familiarisation of the CR100® scale. A Yo-Yo Intermittent Rec. L1 test was completed twice, to anchor the CR100® scale and to assess players' peak HR. Construct validity was assessed using Pearson's correlation coefficient with 90% confidence limits (LCL, UCL) between s-RPE and Edwards' Training Load (TL) and Banister's TRIMP methods. The raw data was log transformed to reduce bias due to the non-uniformity of error before assessing correlations, which were classified as follows:  $r < 0.1$  = trivial,  $0.1-0.3$  = small,  $0.3-0.5$  = moderate,  $0.5-0.7$  = large,  $0.7-0.9$  = very large,  $> 0.9$  = nearly perfect,  $1$  = perfect. The differences between the two correlations (i.e. s-RPE/Edwards vs. s-RPE/TRIMP) within individuals were assessed via magnitude-based inference statistics assuming a smallest important difference of 0.2 raw units (corresponding to the magnitude of the correlation thresholds up to  $r=0.9$ ).

## Results & Discussion

The average session duration was  $78 \pm 27$  min. Average session HR, Banister's TRIMP and Edwards' TL were  $150 \pm 15$  bpm,  $100 \pm 33$  AU, and  $214 \pm 71$  AU, respectively. The average s-RPE was  $5580 \pm 2227$  AU. A very large correlation was found between s-RPE and Edwards' TL both at overall group ( $r=0.84$ , LCL 0.82, UCL 0.86), and individual level (range 0.70 to 0.95). A very large correlation was found between s-RPE and Banister's TRIMP at overall group level ( $r=0.77$ , LCL 0.74, UCL 0.80), while individual correlations were large to very large (range 0.64 to 0.93). A most likely trivial difference was detected for the within-individual differences between correlations.

## Conclusion

The Borg CR100® scale showed acceptable validity for session rating of perceived exertion in

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elite youth soccer players. Practical implications from these finding suggest CR100® s-RPE as a valid and inexpensive method for coaches to implement with teams as a means to monitor and control internal load for youth athletes.

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# In the back of the net(work): using social network analysis to analyse the goals scored at the 2014 FIFA World Cup

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## Introduction

The global visibility, reach, and popularity of football have led to a rise in the importance of match analysis methods. Although various elements of performance can be assessed, two key components that have received significant attention are passing performance and the nature of the goals scored during games.

Typically, assessments of passing performance have involved analysing the total number of passes made; passing sequences; possession and retention, or the percentage of passes successfully completed. In recent times, however, social network analysis has emerged as a useful approach for analysing passing performance (e.g. Clemente et al, 2014). This involves constructing networks to assess passing performance during games whereby players represent the nodes and passes represent the relationships between them. For example, Clemente et al (2014) used social network analysis to analyse the passing network characteristics of successful and unsuccessful teams in the FIFA World Cup 2014.

## Methods

The goals scored during games have also been examined from a number of perspectives, including possession before the goal is scored and the frequency and pattern of passes before the goal is scored. However, despite the emergence of social network analysis as a useful approach for analysing overall passing performance, it has received little attention as a tool for analysing specifically the network of passes underpinning goals scored.

This article argues that social network analysis provides useful representational and analytical methods for analysing the passing sequences that occur prior to the goals scored in football games. To demonstrate, an analysis of the passing networks underpinning each of the 171 goals scored during the 2014 FIFA world cup is presented. Each goal was transformed into a network comprising players and the passing connections between them. The networks were classified into archetypal network structures and then analysed using a range of social network analysis metrics. The networks from successful (four finalists) and unsuccessful (knocked out in the first round) were compared statistically.

## Results & Discussion

The findings show that the most common network was the chain network (i.e. player 1 passing to player 2, player 2 passing to player 3, player 3 scoring). Whilst there were no differences between the networks associated with successful and unsuccessful teams in terms of size, origin, and connectedness, a statistically significant difference was found with regard to the duration of the networks from start (the point at which the goal scoring team gained possession) to end point (the point at which the goal was scored). Here the successful teams' goals were found to emerge from shorter networks in terms of time taken from the point of origin to the goal being scored. It is therefore argued that social network analysis provides a useful approach for

analysing goals and passing performance. In closing, the implications of the analysis for tactics and coaching are discussed.

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# What's in a game? A systems approach to enhancing performance analysis in football.

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## Introduction

Performance analysis (PA) in football is an integral component of understanding the requirements for optimal performance. Despite vast amounts of research in this area, key gaps remain, including an understanding of what performance actually comprises, how different elements of performance can be analysed in an integrated manner, and methods to minimise research-practitioner gaps. It is proposed that these gaps can be addressed by taking a holistic systems perspective to this problem. This study therefore aimed to develop a first-of-its-kind model of the football match 'system' to better describe the components of football performance that could be used to inform the design of new PA methods.

## Methods

Eight elite level football Subject Method Experts (SMEs) participated in two workshops to develop the systems model. The model was developed using the framework of Cognitive Work Analysis (CWA). CWA has been used extensively in other non-sporting domains to analyse complex systems, and to inform system design or redesign activities. CWA has the capacity to describe and analyse the complexity of football performance as it describes all of the components within a system, the functions that they fulfil, and how these functions interact.

## Results & Discussion

Using CWA, a model of the football match system was developed, which identified the overall purpose of the system, and the measures used to evaluate it. In addition to providing a comprehensive description of a generic football match system, the model enabled identification of important facets of performance that are not currently considered in existing PA measures. These included intra-team communication, team adaptability, tempo, and novel attacking and defending related measures.

## Discussion

The current study provides three major contributions to PA research. Firstly, the analysis confirmed that football is characteristic of a complex system, which has important implications for the methods that are used to understand it. Secondly, the analysis identified aspects of performance, considered by elite level football SMEs as important for optimal match performance, that are not currently measured (e.g. adaptability, communications), where existing knowledge is minimal (e.g. tempo, regaining possession), or where the investigated variable is not currently measured in the appropriate context (e.g. pitch location). Finally, the analysis revealed a substantial gap between current football PA literature and practice, with SMEs reporting that many current PA measures are of limited use in practice.

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# Time course of perceived recovery in youth football players after match play

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## Introduction

Recovery monitoring is a staple feature in most professional football clubs daily routine. The time course response of several different measures (neuromuscular and biochemical) following a match or training has been examined. However, little is known regarding the time course response of perceived recovery following a football match and its repeatability as a tool in a football setting. The aim of the study was to i) describe the time course of the perceived recovery scale (PRS) before and after a football match ii) examine the reproducibility of the PRS in football players.

## Methods

Twenty trained youth football players (mean  $\pm$  SD; age  $16.2 \pm 1.2$  y, height  $1.75 \pm 0.07$  cm, body mass  $63.9 \pm 7.8$  kg) were selected to participate in the study. Perceived recovery was collected 2hrs and 30mins before and 15mins, 3 hrs and 24 hrs after an international friendly football match. Participants were classified into two groups based on their playing time during a match ( $\leq 45$  and  $\geq 90$  mins). ANOVA was used to compare differences between the time points. T-test was used to compare incremental area under the curve (iAUC, using trapezoid rule) changes and ES were calculated. ICC was used to determine the reproducibility between 2hrs and 30min pre game PRS levels.

## Results & Discussion

Reproducibility of the PRS was high ( $r = 0.86$ ) between the two pre match measures. PRS scores at +15mins (44%;  $p < 0.01$ ; ES= 2.97) +3hrs (36%;  $p = 0.01$ ; ES= 1.82) and +24hrs (23%;  $p = 0.02$ ; ES= 1.30) were lower than scores at -30mins in the 90min group. iAUC delta change across the accumulated time points was greater in the 90mins compared to the 45mins ( $P = 0.02$ ; ES= - 1.49). For the 45min group, pre match PRS scores were similar to +24 hrs measures. Furthermore, PRS scores at +15mins were lower than +24hrs (33%;  $p = 0.04$ ; ES= -1.42) and +3 hrs were different to +24hrs (24%;  $p = 0.02$ ; ES= -1.14).

## Conclusion

These data show the perceived recovery scale is a reliable method for monitoring perceptions of recovery to football activity. The PRS of players playing 90mins had not returned to pre match levels 24 hrs post-match, whereas the 45mins group had returned to pre match measures at the same time point, suggesting it is sensitive to time course changes. The scale is an easy and efficient tool that can be used to monitor an aspect of recovery.

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# Effect of morning priming exercise on afternoon performance in young soccer players

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## Introduction

Morning (AM) priming exercise has been suggested to positively affect afternoon (PM) performance in rugby players (Cook et al., 2014). Repeated sprint running (RSR) was one of the most beneficial strategy to attenuate the PM reduction in testosterone (T) concentrations and to improve lower body explosive actions (~6 h after AM exercise) (Russell et al., 2016). Purpose of this study was to verify the effect of AM exercise on PM muscular and endurance performance in young professional soccer players.

## Methods

Twelve young players (age 17±1 yrs) from an Italian serie A team participated to a randomized counterbalanced crossover study. They completed 3 conditions during AM on 3 different days separated by 48 h: RSR (6x40 m sprints, 20 s rest), ecological exercise (ECO, 4x10 s fast half squat, 20 s rest followed by 6x5 m speed ladder drills + 20 m sprint, 20 s rest) and a control condition (CON) with no exercise. In each condition, blood T and cortisol (C) concentrations were assessed upon arrival (~08:30 AM) and ~6 h later in PM. Body temperature (BT), maximal voluntary contraction (MVC), voluntary activation (VA), rate of torque development (RTD), twitch contractile properties (TCP), sprint and countermovement jump (CMJ) were evaluated before AM exercise and after blood sampling in PM. Yo-Yo intermittent recovery L2 (YYIR2) performance was evaluated only in PM. Rate of perceived exertion (RPE), self-reported mood, motivation and feeling state were also assessed.

## Results & Discussion

RPE was likely to almost certain different in the 3 conditions (RSR 5.0±1.2, ECO 4.3±0.7, CON 2.9±0.8). Despite a possibly positive effect on T (+11.6%), RSR induced a possibly to very likely negative effect on TCP (-13.0%), CMJ height (-1.4%) and YYIR2 performance (-7.1%) compared to CON. Task-dependent motivation was likely lower for RSR (-28.0%) than for CON. The ECO condition induced a likely lower level of self-reported fatigue (-31.0%) and C (-12.9%), a possible positive effect on RTD (+4.3%) and YYIR2 (+6.5%) compared to CON. No substantial effects were observed for BT, MVC, VA and sprint.

## Conclusion

The present findings confirm that AM RSR might positively influence T. However, this did not translate into a better PM performance as both muscular and endurance performance were reduced in our group of young soccer players. This might be due to an incomplete recovery from AM exercise. A less demanding and well accepted AM exercise like ECO, might be more suitable to optimize PM performance of young soccer players.

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# Assessing the impact of upper padding thickness on passing and dribbling performance.

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## Introduction

Sporting goods companies need to frequently introduce innovations to distinguish themselves in an increasingly competitive, continually changing, global football footwear market. Today, it is common practice to market football boots with an emphasis on enhancing a single key performance characteristic (e.g. touch/control). Yet little research has been published on how design parameters impact a player's passing and dribbling ability. This study aimed to analyse the impact of boot upper thickness on for dribbling, short passing and long passing performance.

## Methods

Eight university football players ( $20.7 \pm 1.2$  years,  $1.74 \pm 3.1$  m,  $71.8 \pm 7.9$  kg) participated in a single test-retest validated session. Tests were performed on an outdoor 3G artificial pitch. Two UK size 8 football boot prototypes were compared in a blinded randomised order: no upper padding and 6 mm Poron foam.

The validated protocol assessed multifactorial performance: dribbling in a cutting and turning drill, short (14 m flat targeting centre of 2 m wall) and long (25 m airborne targeting cone) passing. Dribbling was assessed by number of touches and time for completion using recordings from chest mounted video camera and lateral deviation from cones for dribbling through four 2D high-speed video recordings. Short passing was assessed through ball velocity using 2D high-speed video and offset from target using 2D aerial view high-speed video. Long passing was assessed through ball velocity using TrackMan Football prototype (TrackMan Golf, Vedbaek, Denmark) and offset from target using 2D high-speed video. A single standard FIFA international match ball was used (pressure = 0.9 bar).

Control of human error was performed through subjective feedback of performance, ball velocity and technique. Post testing participants were asked to rate the perception of ball control, sensation and comfort.

## Results & Discussion

A total of 192 dribbling sequences, 256 short and 256 long passes were assessed. No significant difference was seen between boot designs for any of the 12 performance measures. In the subjective measures, perceived comfort was shown to be significantly different between the boots ( $P < 0.001$ ) whilst the perceived ball control showed tendencies to difference ( $P = 0.053$ ), both favouring the 0 mm boot. No difference was seen for ability to sense the ball.

## Conclusion

No differences were observed between no padding and 6 mm Poron foam upper padding boots in dribbling and passing performance.

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# Effects of recreational football performed once a week on cardiovascular risk factors in middle-aged sedentary men

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## Introduction

Previous studies have found that regular football training induces lowering blood pressure, as well as heart rate at rest, fat percentage, LDL cholesterol, and increases lean body mass as well as maximal aerobic power (VO<sub>2</sub>max) (Milanović, 2015). At recreational level, it is known that people usually practice football only once or twice per week for approximately one hour per session, but this weekly volume has not been previously investigated. The aim of this study is therefore to assess the effect of a 1-hour recreational football session per week.

## Methods

Twenty-four healthy male participants without specific pathologies were enrolled in this study (mean  $\pm$  SDs; age  $44.5 \pm 4.7$  years, weight  $81.9 \pm 10.4$  kg, height  $175.0 \pm 7.3$  cm). A RCT design was used in this study. Participants completed recreational futsal matches on a synthetic indoor field (36 x 18.5 meters). The training lasted 12 weeks (60 minutes per session) with all the matches played in the evening. Anthropometrical measurements, VO<sub>2</sub>max, systolic (SBP), diastolic (DBP) and mean blood pressure (MBP) and heart rate (HR) at rest and blood sampling were completed. After 12 weeks of training, all subjects were re-tested with the same protocol.

## Results & Discussion

VO<sub>2</sub>max and MAS improved in FG respectively of 4.4% (mean difference 1.89, CI95% (0.90 to 2.88) mL O<sub>2</sub>min<sup>-1</sup>Kg<sup>-1</sup>) and 5.9% (mean difference 0.7, CI95% (0.22 to 1.18) kmh<sup>-1</sup>) at the contrary HRmax did not change over the period ( $p > 0.05$ ). SBP and MBP decreased of 2.5% (mean difference -3.18 mmHg, CI95% (-0.17 to -6.19)) and 2.2% (mean difference -2.28 mmHg, CI95% (-0.08 to -4.47)) respectively in FG, while DBP did not change during protocol period ( $p = 0.09$ , mean difference -1.84, CI95% (0.48 to -4.16) mmHg). Anthropometric analysis and blood analysis: in both FG and CG we did not observe any variation in anthropometric parameters, as well as in blood variables.

## Conclusion

This is the first study examining the effect of a 1-hour recreational football session per week on cardiovascular risk factors in middle-aged men. This study also supports previous findings that even a low training volume is important and enough to give some meaningful improvements on health parameters in middle-aged male subjects. However, these observed changes are possible with such training volume, but they are less pronounced than in previous football studies with more frequent training and a higher training volume (Milanović et al., 2015).

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# Comprehensive injury and performance register related with the transfer value

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## Introduction

Over the course of past few years soccer players have progressed tremendously in terms of physical performance. The increasing physical, mental demands for players, and associated non-contact injuries were significantly increased (Hagglund et al., 2005; Ekstrand et al., 2011). In our time therefore, the influence of sport science on overall performance cannot be overemphasized. Considering the above the Hungarian FA have built up an evidence-based comprehensive computer system. The injury-registry collected the previously identified performance details, circumstances of incidental injuries and the whole process to return to play. The scientific statistical model through is calculated using multiple variables related injuries, physical performance and the potential transfer value.

## Methods

With a prospective analysis we examined 263 elite academy soccer players (mean age=17,63±2,53 yrs, height=169,12±4,52 cm, weight=70,02±5,32 kg). With respect to the player's positions during the game, we analysed the position's specific movement patterns adaptations and differences in the quality of functional movements. The injured players required to complete an objective and progressive approval system at every end of phase of rehabilitation before returning to the play.

## Results & Discussion

With ANOVA Fischer's LSD post-hoc and Hayter's correction method analysis we have found a significant difference between playing positions in the FMS main score ( $F(5,321)=3,28$ ,  $p<0,01$ ). We have also found statistically significant correlations between FMS main score ( $r=0,584$ ) and non-contact injuries ( $r=0,797$ ) in relation to players anthropometric parameters (height, 185,4±5,65cm; weight, 82,8±6,76kg; BMI, 24,08±1,27). 37% of players examined demonstrated movements asymmetry and limitations.

## Conclusion

The global and comprehensive growth in football, increasing demands on player's performance and the massively increased trade in sport in general, all have regulated player's value on the market of soccer (Poli et al., 2016). Subjective experiences are essential, but at present time, the objective performance data collection and analysis is irreplaceable and an essential part of the winning framework in football. Technology systems help to control objectively the processes. The result is an essential contribution in the direction of producing the most valuable individual player in to the global soccer market.

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# Technical and Tactical Analysis of Turkish Soccer Teams' Matches Participating in the European Competitions during 2012/2013 and 2013/2014 Seasons

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## Introduction

The purpose of this study is to systematically evaluate the Turkish Soccer Teams' matches, participating in the European Competitions in 2012/2013 and 2013/2014 Seasons, through technical and tactical analysis using video and computer technology and determining the parameters making a difference between the successful and the unsuccessful teams.

## Methods

The sample and the universe of the study consisted of 40 matches of the teams qualified for the European Competitions in the group phase and afterwards.

## Results & Discussion

According to the findings, out of the 40 matches analysed, Turkish teams won 19 matches, the opponent teams won 11 matches and 10 matches ended in a draw. There is no statistically significant difference between the number of successful passes and the results of the matches (0,144;  $p > 0,05$ ). Also, there is no statistically significant difference between the ball possession, another parameter investigated in the study, and the match results (0,169;  $p > 0,05$ ). Although, there is no meaningful difference those two parameters and results of matches, it is determined that average successful passes and ball possession percentages of winning teams are higher than those of losing teams.

Number of successful passes, total shots, lose balls, tackles and goals scored at home and road games were investigated and there is a statistically significant difference ( $p < 0,010$ ) in total shots parameter ( $p < 0,05$ ). After data analysis, it is found out that there is a meaningful difference between the timing of goals scored in the matches (0,023;  $p < 0,05$ ). The highest incidence of goals scored is between the 76th and 90th minutes (%27). Also, there is a meaningful difference between number of passes before goals were scored (0,00 ;  $p < 0,05$ ).

SPSS 16.0 program was used to analyse the data. Independent Samples t-Test and Chi-Square tests were used. Data was obtained via E-Analysis Program, a program for match analysis through video.

## Conclusion

In conclusion, we can assume that specific technical and tactical parameters play an important role in winning or losing the matches. However, we cannot suggest that statistically having great advantage over the opponent in several parameters cannot mean that it is enough to win the matches. Nevertheless, findings may help to determine the shortcomings and contribute to the development of the players.



# Action and state orientation in Swiss female soccer: the role of age, performance level, and playing position

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## Introduction

In soccer matches mistakes occur. A striker misses a clear opportunity to score, a midfielder plays a detrimental pass, a defender loses a game-relevant tackle, or the goalkeeper spills the ball. There are basically two ways soccer players can respond to their mistakes. They can start ruminating and become anxious to avoid similar mistakes (state oriented behavior) or they quickly refocus on the game and their task (action oriented behavior). Although the importance of this two types of responses is obvious, they have been rarely studied in soccer. Therefore, the aim of the present research was to examine how state-orientation and action-orientation a) differ in female youth national team players and non-selected soccer peers over time, b) is related to age, and c) is shown at different playing positions.

## Methods

As part of a project on talent development in female soccer in Switzerland we collected data on action and state orientation after failure in soccer games (twice in 2015 and 2016) using a six item questionnaire. Analyzes are based on 195 players born between 1996 and 2002 who completed at least one questionnaire each year. 116 were playing for a Youth Female National Team [YFNT] (age:  $16.1 \pm 1.4$  yrs.), whereas the 79 were not selected for a YFNT [NYFNT] but played for the (youth) teams of the best clubs in Switzerland (age:  $16.1 \pm 1.8$  yrs.). Our analyses included correlations and repeated measures ANOVAs.

## Results & Discussion

In general state orientation decreased 2015 to 2016, whereas action orientation was stable. This effect was moderated by performance level; the decrease was stronger for the YFNT players than the group of NYFNT players. Age was negatively correlated with action orientation but not with state orientation, i.e., the older players showed less action orientation. Again this effect stem from the YFNT players. In addition, the YFNT group players showed less action orientation the closer their playing position was to the opponent's goal, thus, strikers surprisingly showed the least action orientation.

## Conclusion

Based on our findings we recommend coaches to be more sensitive for action and state orientated behavior of their players, especially their strikers, or when a young player joins a stronger team (e.g., new YFNT players). Latter might lose their tranquility and might show decreased action and increased state oriented behavior after failure when they are playing at the higher level. Overcoming these changes might be part of a player's talent development. Therefore coaches or sport psychologists should encourage action and reduce state oriented behavior after failure in soccer matches (e.g. by using systematic goal directed feedback or inducing mindfulness based interventions).

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# Parents' emotional intelligence, coping strategies and sideline behaviors during their child's soccer games

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## Introduction

Parents with high levels of emotional intelligence (EI) seem to possess emotional skills that allow them to cope effectively with the challenges they face and promote well-being in their children (Harwood & Knight, 2015). Considering the role of EI in coping research may yield significant benefits for individuals because EI has consistently been linked with various positive outcome measures, such as interpersonal functioning, healthy relationships, psychological well-being, and adaptive coping (Martins, Ramalho, & Morin, 2010). Although the significance of EI and coping has been recognized for parental involvement in youth sports (e.g., Harwood & Knight, 2015), no studies were found that explore these relationships. The current research examines how EI facilitates adaptive coping across parents' sidelines behaviors at youth soccer games.

## Methods

*Participants.* During the IberCup 2016, an international youth soccer tournament developed in Marbella (Spain), 236 parents (126 women, 110 men) of youth soccer players (boys and girls who were between 9 and 15 years of age) were recruited to participate in this study. Parents ranged in age from 28 to 62 years old ( $M = 40.50$ ,  $SD = 5.63$ ).

*Procedures and design.* Naturalistic observations were carried out in a football field. Subsequently, parents were approached at the end of the game to participate in the study. Participants were given a brief overview of the study and then were taken to a classroom-type setting to complete the questionnaires. Participants received €10 for their participation. The parents completed written informed consent forms prior to their study involvement. All participants were assured that their responses would remain confidential and that no participant would be identified in any presentation or publication emanating from the data.

*Instruments.* Emotional intelligence was measured by the 16-item scale developed by Wong and Law (2002) which contains four subscales assessing self-emotions appraisal, others-emotions appraisal, regulation of emotion, and use of emotion; Adaptive and maladaptive subscales of the Brief COPE (Carver, 1997) were used to measure parents coping. The adaptive coping subscale contains 16 items. The adaptive coping subscale includes active coping, planning, positive reframing, acceptance, humor, religion, using emotional support, and using instrumental support. The maladaptive coping subscale contains 12 items. The maladaptive coping subscale includes self-distraction, denial, venting, substance use, behavioral disengagement, and self-blame; Parents sideline verbal behaviors were coded based on previous research (Holt et al., 2008). The coding system contained 6 behavioral categories: praise/encouragement (i.e., general supportive comments, such as "That's the way..., good work!"), performance-contingent feedback (i.e., comments intended to improve performance), instruction (i.e., direct commands such as "Shoot the ball!"), striking a balance (i.e., finding equilibrium in the positive and negative valence of a comment such as "No, c'mon...okay, good try!"), negative comments (i.e., general negative

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comments made toward athletes such as "You're playing too slow!"), and derogatory comments (i.e., depreciating and potentially harmful comments directed toward athletes such as "That's pathetic!").

**Data analysis.** A structural equation modelling (SEM) was performed to test the relationships between EI, coping strategies, and parents' sideline verbal behaviors. The appropriateness of the model was estimated through a variety of goodness-of-fit indexes. We used as guidance the cut off values (CFI and TLI > .90, RMSEA and SRMR < .08) recommended by Hair et al. (2010).

### **Results and discussion**

The overall assessment of the structural model was found to be acceptable [ $\chi^2(120) = 1242.48$ ,  $p < 0.001$ , CFI = 0.95, TLI = 0.94, RMSEA = 0.05 (CI = 0.05, 0.06), SRMR = 0.04]. Regarding the associations between EI and coping, parents' self-emotions appraisals and regulation of emotion showed significant negative relationships on maladaptive coping strategies, whereas others-emotions appraisal, use of emotion, and regulation of emotion were positively associated with adaptive coping. Next, we examined the links between coping and sideline behaviors. Adaptive coping was positively associated with praise/encouragement, and negatively with negative comments. Maladaptive coping was associated with striking a balance, negative comments, and derogatory comments.

Findings from this present study address important gaps in the literature by contributing an understanding of the strategies parents use to manage their emotions at competitions. These findings are novel in so far as they highlight the relevance of parents' emotional intelligence, and coping strategies in the expression of sideline behaviors during youth games. This study, therefore, helps address an important void in the literature by uncovering the coping mechanisms through which emotional intelligence may facilitate sideline behaviors among parents of youth athletes. Also, these findings may help practitioners in making interventions in order to improve parents' emotional intelligence and to enable them to deal with environmental stressors and difficulties during their child's soccer games.

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# Broad-spectrum fitness benefits of recreational soccer: systematic review and meta-analysis

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## Introduction

A previous meta-analysis concluded that VO<sub>2</sub>max increased by 3.51 mL/kg/min (95% CI 3.07–4.15) over a 3-6 months recreational soccer training programme compared to controls and other training models. In addition, systematic and narrative reviews have reported beneficial effects of recreational soccer on fitness status. The aim of this systematic review and meta-analysis was therefore to review the results of the current literature concerning the benefits of recreational soccer on broad-spectrum health status.

## Methods

All procedures relevant for papers identification, study selection, data extraction, and inclusion and exclusion criteria were carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement. According to the eligibility criteria, 23 papers that met the inclusion criteria were included.

## Results & Discussion

The recreational soccer effect on systolic blood pressure when compared to no-exercise controls was *likely small beneficial* (ES=0.45; 95% CI: 0.23, 0.66). In addition, *a very likely small beneficial* (ES=0.40; 95% CI: 0.13, 0.66) effect was observed for diastolic blood pressure. Furthermore, *very likely moderately to small beneficial* effect was observed for SDP and DBP in pre-hypertensive (9.5 and 7.3 mmHg decrease, respectively) and mildly hypertensive participants (12.0 and 7.7 mmHg decrease, respectively). Meta-analysis of recreational soccer determined the effect on resting heart rate as *most likely largely beneficial* (ES=1.81; 95% CI: 1.14, 2.48) when compared to non-active group. The observed recreational soccer effect on fat body mass was *likely small beneficial* (ES=0.45; 95% CI: 0.14, 0.76) and the effect on countermovement jump (CMJ) performance was *very likely moderately beneficial* (ES=0.75; 95% CI: 0.20, 1.30) when compared to non-active groups.

## Conclusion

The present meta-analysis showed multiple broad-spectrum positive effects of recreational soccer on health-related physical fitness in comparison to no-exercise controls, including beneficial effects on blood pressure, resting heart rate, fat mass and counter-movement jump performance.

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# Injury epidemiology in elite male and female football players: a five-season prospective comparison

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## Introduction

Investigating sex differences in football injury epidemiology is necessary to tailor prevention programmes and generate hypotheses on risk factors. However, only one study has done so at the elite club level.[1] Thus, the aim of the study was to compare the epidemiology of injuries between elite male and female football players from the same club, and with medical staffs following the same procedures, avoiding potentially unreliable data that might come from different medical staffs.

## Methods

Injuries and individual exposure time in Athletic Club's elite male and female teams, both playing in the Spanish first division, were prospectively recorded by the medical staff for five seasons (2010-2015) following the FIFA consensus. Injury incidences were calculated as the number of injuries/1000 hours of exposure, and incidence ratios were compared using z-tests.

## Results & Discussion

Total, training and match exposure hours per player-season were 20% higher for men compared to women ( $p < 0.01$ ). The male team had 30% more matches per week ( $p = 0.02$ ), but the match hours/total hours ratio was similar ( $p = 0.94$ ). Total, training and match injury incidence were 30-40% higher in men ( $p \leq 0.04$ ), but only for minimal (1-3 days lost) and mild (4-7 days lost) injuries ( $p < 0.01$ ). This was mainly due to a 4.8 [95% confidence interval (CI) 2.3-10.1] times higher incidence of contusions in men, as there were no differences in the incidence of muscle and joint/ligament injuries ( $p \geq 0.44$ ). The total number of absence days was 21% larger in women, owing to a 5.4 (95% CI 1.1-25.8) times higher incidence of severe knee and ankle ligament injuries ( $> 28$  days lost). Hamstring strains and pubalgia cases were 1.9 (95% CI 1.2-3.2) and 11.1 (95% CI 1.5-83.4) times more frequent in men, respectively; whereas quadriceps strains, anterior cruciate ligament (ACL) ruptures and ankle syndesmosis injuries were 2.3 (95% CI 1.2-4.2), 4.6 (95% CI 0.9-22.8) and 5.4 (95% CI 1.1-25.8) times more common in women. ACL ruptures were responsible for 43% of all absence in women, while hamstring strains were the predominant source of absence in men (19%).

## Conclusion

Preventive strategies should be tailored to male and female players. The higher injury incidence in men might be due to more contact situations and higher match congestion. Women suffered more severe consequences, and preventing ACL ruptures is a priority for them. Novel findings, such as a higher incidence of quadriceps strains and ankle syndesmosis injuries in women, need to be further explored. The limited external validity is the main limitation.

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# Matching player and coach perceptions of exertion in soccer: a quasi-experimental study

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## Introduction

A mismatch between players' perceived exertion and the observed exertion by coaches has recently been shown (Brink et al 2016). However, it is unknown if feedback provided to coaches about external and internal load of individual players improves agreement. Therefore, the aim of present study is to develop a feedback report for coaches and test its effectiveness.

## Methods

Twelve professional soccer players from an U23 team participated in the study ( $20.3 \pm 1.5$  years,  $180.5 \pm 4.8$  cm,  $74.8 \pm 6.6$  kg). The coach had an UEFA PRO license and 13 years of professional coach experience. A quasi-experimental study was conducted with and without a feedback intervention. During two mesocycles (February and March), players filled in the Rating of Perceived Exertion (RPE, 6-20). The coach filled in the Rating of Observed Exertion (ROE, 6-20) after each training. POLAR Team Pro (Polar Team system, Kempele, Finland) was used to monitor external load with GPS tracking (10Hz) and accelerometers, and internal load via heart rate recording. Verification feedback was provided only during the second mesocycle (Schute 2008). RPE and ROE were ranked from smallest to largest discrepancies after each training. In addition, the coach was provided with feedback on external and internal load twice a week. Agreement was assessed before and after the feedback intervention. In addition, the effectiveness of feedback was assessed in training sessions that were divided into those intended by the coach to be easy ( $< 13$ ), intermediate (13–14), and hard ( $> 14$ ) (Brink et al 2014).

## Results & Discussion

231 RPEs were collected and paired with that of the coach. Players' RPE was  $14.9 \pm 2.19$  and ROE of the coach was  $15.1 \pm 1.78$ . The discrepancy between RPE-ROE was significantly smaller  $0.7 \pm 0.73$  with feedback compared to no feedback  $1.0 \pm 0.89$  ( $p < .05$ , Effect size 0.24). Further analyses revealed that this reduction in mismatch was in particular present in training sessions with hard intensity ( $p < .05$ , Effect size 0.28), but not for low and medium intensity.

## Conclusion

Providing feedback to a soccer coach improves agreement with players' perceptions of exertion, particularly for hard(-intended) training sessions. Yet, whether a better match between coach and players' perceptions of exertion enhances performance and reduces injury risk has to be determined.

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# Energy intakes and energy expenditures of professional, male soccer referees

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## Introduction

Nutrition can determine physical performance. Proper nutrition and appropriate training are necessary so the human body can be trained to optimally perform under high-stress conditions. Nutrition is imperative and oftentimes overlooked in soccer referees. Referees have the unique responsibility to control the game by enforcing the rules while athletically keeping up with the play. Therefore, they require an optimal fitness level to react to the game most effectively. Current research on the energy requirements of soccer referees is limited, and even more limited is research on their actual energy intakes.

## Methods

Thirteen male soccer match officials (aged 24-47) for professional games in North America completed this study. Information on energy intake was measured by using a 4-day food journal with pictures. Their energy expenditure (kcal) and distance traveled (km) were recorded through GPS watch and heart rate monitor during a professional game in which the referee was the center/main referee. The energy consumption was analyzed with SuperTracker. Energy needs were predicted with the Mifflin St. Jeor equation with added activity factor.

## Results & Discussion

The average kilocalories consumed by the referees' was 1887 kcal  $\pm$  427.5 kcal. This was significantly less than the average recommended energy intake with activity factor (3008 kcal  $\pm$  221 kcal). The average distance traveled was 9 km  $\pm$  1.13 km. There was no association between kilocalories consumed, energy expenditure, and distance traveled when compared to age, BMI, and body fat percentage. This study found that referee's average energy intake was significantly lower than predicted energy recommendations.

## Conclusion

Low energy consumption may impact referees' ability to perform. Further, low energy intakes cause concern about prolonged recovery time. Future studies should include a seven-day food journal and the use of metabolic cart to determine energy needs. Determining energy recommendations for soccer referees is important due to the heightened levels of play in recent years.

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# Analysis of physical match activity in elite youth soccer players: a preliminary study

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## Introduction

The distance covered and intensity of youth soccer matches have been reported to increase with age and differ according to tactical role (Buchheit et al., 2010). However, to date, no data relating to European elite youth players is available. Furthermore, no studies have investigated the number of accelerations and decelerations performed by youth players in competitive matches. This study aimed to quantify physical match activities of elite youth soccer players in relation to age and playing position.

## Methods

Players physical activities were measured during 41 official league matches using a 10Hz GPS system, monitoring 119 elite youth soccer players across 4 different age groups (U15, U16, U17 and U19). Players were also divided according to their tactical role (wingers WG, center-backs CB, midfielders MD and strikers ST). Total distance (TD), distance > 15 Km/h (DS15), distance > 25 W/kg (DP25), number of accelerations > 2 m/s<sup>2</sup> (ACC) and decelerations

## Results & Discussion

A positive trend was found between age groups when considering absolute values; older players cover greater distances and perform more ACC and DEC (all  $p < 0.025$ ). Normalizing the data for playing time highlighted significant differences between age groups for TD, DP25 and DEC (all  $p < 0.009$ ). However, post-hoc analysis revealed that TD and DP25 were lower for U19 compared to all the other groups (all  $p < 0.013$ ), with DEC significantly lower for U19 compared to U15 ( $p < 0.001$ ). No significant differences were found between age groups for DS15 or ACC ( $p > 0.451$ ). Between-role analysis highlighted significant differences across all variables (all  $p < 0.023$ ). MD and WG covered more TD, DS15 and DP25 than CB (all  $p < 0.018$ ), WG covered more DS15 and DP25 than ST ( $p=0.028$  and  $p=0.025$ , respectively) and MD performed more DEC than CB ( $p=0.002$ ) and ST ( $p=0.018$ ). ACC of MD tended to be higher than ST ( $p=0.08$ ).

## Conclusion

The trend observed in absolute values (greater distances covered by older players) is not reflected when considering the physical activities normalized for match exposure. The physical demands of youth players also appear to be dependent on player position. The present findings may have some practical implications for training prescription.

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# Motion variability during small-sided games: using the dots to assessing the tactical behaviour

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## Introduction

Small-sided games (SSGs) are one of the most addressed topics in the science of soccer<sup>1</sup>. The monitoring process to assess the external load of these games has been made by using geolocation systems. However, these systems allow the analysis of more than just the physical impact. The progress of individual dots in the bi-dimensional space during the games can be used to estimate tactical behaviour and motion variability of the players<sup>2</sup>. Consequently, with these opportunities in mind, this study aims to examine the motion variability and individual tactical behaviour of soccer players during different SSGs.

## Methods

Participants were ten collegiate male players (20.3±4.8 yrs; 175.17±7.5 cm; 69.31±3.0 kg). Five formats (Fs) (1vs.1 to 5vs.5) and two pitch sizes (PS) (S: 50 m<sup>2</sup> and L: 125 m<sup>2</sup> per player) were tested randomly in two different days. Players were tracked by portable GPS devices (10Hz, Accelerometer 1kHz, FieldWiz, Paudex, Switzerland). Position data was used to calculate the player's variability in the *ultimate Performance Analysis Tool* (uPATO). The following measures were tested: Shannon entropy (SE: quantify the uncertainty of location of each player); Spatial exploration index (SEI: assess the player's exploration considering the game scenarios); Kolmogorov entropy (KE: quantify the variability of a player over time). Comparative analysis between Fs and PS was performed with one-way ANOVA and eta squared (ES) for a  $p < 0.05$ .

## Results & Discussion

Strong effects of Fs on SEI were found ( $p=0.00$ ;  $ES=0.82$ ). SEI was significantly smaller on the largest format (5v5: 63.31, 59.72-66.90CI95%) comparing with 1v1 (97.28, 93.90-100.65CI95%), 2v2 (90.28, 86.22-94.34CI95%), 3v3 (85.72, 80.94-90.50CI95%) and 4v4 (67.02, 62.96-71.08CI95%). PS had no effect on the SEI ( $p=0.80$ ;  $ES=0.00$ ).

On SE, moderate effects of Fs on SE were found ( $p=0.00$ ;  $ES=0.28$ ). Smaller SE values were found on 1v1 (0.25; 0.21-0.29CI95%), when compared to 2v2 (0.33; 0.28-0.38CI95%), 3v3 (0.33; 0.28-0.39CI95%), 4v4 (0.36; 0.32-0.41CI95%) and 5v5 (0.38; 0.33-0.42CI95%). Non-significant effects of PS on SE were ( $p=0.52$ ;  $ES=0.01$ ).

Small and non-significant effects of Fs and PS on the KE were found ( $p=0.18$ ,  $ES=0.10$  and  $p=0.14$ ,  $ES=0.4$ , respectively). Values of KE varied between 0.09 and 0.31 [CI95%].

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## Conclusion

Larger Fs decreased the SEI, thus contributing to a more positional play style of each player. Smaller Fs may contribute to a greater exploration of the pitch. However, this exploration does not seem to reflect a greater uncertainty. Smaller values of SE were found on the smallest Fs, thus suggesting a greater predictability to reproduce the same trajectories.

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# Testing the centralization, heterogeneity and reciprocity levels during passing sequences: an approach with uPATO software

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## Introduction

General properties of teams during passing sequences can be tested with network measures<sup>1,2</sup>. The common measures tested in soccer are total links and network density. Nevertheless, the variance of player's participation can be tested with alternative techniques that may help to characterize the variance of playing style of the teams<sup>3</sup>. Therefore, this study aims to test the centralization (group degree centralization index), heterogeneity and reciprocity of passing sequences in elite teams that participated in UEFA Champions League 2015/2016. Descriptive statistics will be followed by a correlation test between general network measures and the percentage of ball possession. A split per match score (losing, drawing and winning) will be made to analyze the correlation levels.

## Methods

The top-16 teams in the UEFA Champions League 2015/2016 edition were analyzed in all their matches. A total of 109 matches were tracked and converted into adjacency matrices representing the tendency of passing sequences between the members of the team. The final score of the teams per match and the percentage of ball possession (BP) were also recorded during the notational analysis. The adjacency matrices were imported in the ultimate Performance Analysis Tool (*uPATO*) and three measures were computed per match: i) group degree centralization index (GCD); ii) heterogeneity index (HI); and iii) reciprocity (R). Correlation analysis (Pearson  $r$ ) has related network measures and the percentage of ball possession for a  $p < 0.05$ . Split file was made to analyze the correlations in different match scores (losing, drawing and winning).

## Results & Discussion

Descriptive statistics of the three network variables and BP was split by final match score. In losing matches it was obtained the following results: BP (50.26±10.75%), GCD (3.22±1.46%), H (1.11±0.25) and R (0.67±0.11). In drawing matches the statistics were: BP (50.13±9.63%), GCD (3.35±1.91%), H (1.12±0.29) and R (0.68±0.10). In winning matches it was found the following statistics: BP (52.42±10.43%), GCD (3.41±1.80%), H (1.03±0.23) and R (0.69±0.09). Pearson  $r$  without splitting data found significant positive moderate-to-strong correlations between BP and GCD ( $r=0.44$ ;  $p=0.00$ ) and BP and R ( $r=0.40$ ;  $p=0.00$ ). Strong negative correlations were found between BP and H ( $r=-0.60$ ;  $p=0.00$ ). Splitting the data, it was possible to observe the following values for losing matches: significant positive moderate correlations

between BP and GCD ( $r=0.45$ ;  $p=0.00$ ) and BP and R ( $r=0.34$ ;  $p=0.03$ ) and large negative correlations between BP and H ( $r=-0.70$ ;  $p=0.00$ ). For drawing matches it was found the following results: non-significant correlations between BP and GCD ( $r=0.10$ ;  $p=0.59$ ), BP and H ( $r=-0.13$ ;  $p=0.50$ ) and BP and R ( $r=0.25$ ;  $p=0.18$ ). The following correlations were found in winning matches: significant positive strong correlations between BP and GCD ( $r=0.57$ ;  $p=0.00$ ) and BP and R ( $r=0.48$ ;  $p=0.00$ ) and strong negative correlations between BP and H ( $r=-0.76$ ;  $p=0.00$ ).

### **Conclusion**

Correlation values revealed strong evidences to argue that higher values of heterogeneity lead to smaller values of ball possession. This mean that non-cohesion interactional process between teammates influence the capacity to have the possession of the ball. Moreover, centralization and reciprocity seems to be associated with higher values of ball possession, nevertheless without the prominence of heterogeneity.

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# Factors Affecting Recovery Kinetics After a Match(es)

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## Introduction

Football competition induces an intense inflammatory response and muscle damage that result in performance deterioration for as long as 24-72 hours. This study aimed to identify potential factors that determine players' recovery potential.

## Methods

Data obtained by previous studies of our research group with a single (1-3) or multiple matches (4) as well as data from a new study that examined performance responses following two matches performed within a 3-day period were utilized. Data from a total of 94 players were analyzed. Isokinetic strength, maximal oxygen consumption (VO<sub>2</sub>max) and YO-YO IR/IE performance were measured at baseline. Performance [vertical jumping (VJ), maximal strength (squat 1RM), 20-m speed, repeated sprint ability (RSA)] was measured pre-match and 1, 2, 3 and 4 days post-match. When two matches were studied, performance was measured before the first match, 1 and 2 days after the first match, before the second match and as high intensity running, sprinting, accelerations and decelerations during the two matches.

## Results & Discussion

After a single match, discriminant and regression analysis revealed that VJ, speed and strength deterioration was related to initial strength (concentric and eccentric) levels, speed whereas RSA decline was related to number of sprints and accelerations/deceleration distance performed during the match, general (VO<sub>2</sub>max) and football-specific conditioning (YO-YO IE/IR) level. Performance recovery was associated with general (VO<sub>2</sub>max) and football-specific conditioning (YO-YO IE/IR) level. In respect to two consecutive matches, performance recovery and field activity during the second match were related to general (VO<sub>2</sub>max) and football-specific conditioning (YO-YO IE/IR) as well as the number of accelerations/decelerations during the first match. Inflammatory markers are negatively correlated with general and football-specific conditioning. These results suggest that a higher endurance potential may limit performance deterioration and facilitate its recovery in response to one or two matches.

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# Changes of physical and technical activities in professional soccer players during a league season and with regard to the team's table ranking

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## Introduction

The long duration of soccer league seasons and the high number of played matches affect changes in players' physical and technical activities as well as the match outcome (Thorpe et al., 2015, Liu et al., 2016). The aim of the study is to examine changes in selected players' physical and technical activities in six subsequent phases of a soccer league season, and with regard to the team's final rank in the league table.

## Methods

The study analyzed activities of 350 players, on the basis of 4,393 recorded observations, who participated in the entire Bundesliga 2014/2015 season divided into six phases: autumn round (Phase 1: matches 1-6; 2: 7-11; 3: 12-17), and spring round (Phase 4: matches 18-23; 5: 24-28; 6: 29-34). Furthermore the teams were classified into three groups according to their end-of-season rank: high-level teams (ranks: 1-6), medium-level (7-12), and low-level (13-18). The study used the Impire AG motion analysis system. The following variables were examined: total covered distance (TD) [km], average running speed (ARS) [km/h], number of high-intensity activities (NHI), number of ball touches (NBT), number of passes (NP), and number of accurate passes (NAP).

## Results & Discussion

Regardless of the team league rank the TD, ARS and NHI were at a constant level until Phase 4 of the season, and then decreased significantly until Phase 6 ( $p \leq 0.001$ ). Considering the team's end-of-season rank, players' TD and ARS were only significantly higher for low-level teams in Phase 4 than for medium and high-level teams. In all season phases the high-level teams had significantly higher NBT, NP and NAP values than low-level teams ( $p \leq 0.001$ ).

## Conclusion

During the spring round the levels of physical activities become significantly reduced in all players. Soccer training must involve appropriate means that will counteract negative consequences of incremental fatigue during a league season. The inverse proportion between the levels of physical and technical activities in high- and low-level teams means that lower technical skills must be compensated for with higher physical activity. This is particularly the case in the later part of the league season. The results of the present study show that the high level of physical activities maintained throughout could be the main determinant of the team's end-of-season rank in the league table.

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# Coaching: enjoyment or entrapment? Burn out and emotional intelligence on soccer coaches

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## Introduction

For the coaches, sport participation is pleasure, their professional career, fulfillment of personal ambitions, by experiencing positive and negative emotions. Occasionally, their whole activity is not progressing smoothly, satisfaction is missing, aspirations are not met, but nevertheless coaches remain in sport and experience entrapment. Entrapment is the main component of burnout, which is accompanied by a list of symptoms and different behaviors. Burn out is defined as a psychological syndrome of emotional exhaustion, depersonalization and reduced personal accomplishment (1). Pines (1993) supports that burn out can only be experienced by people who set high goals, expectations and motivation and they expect to derive a sense of significance from their work. In many cases, the recognition of the situation helps coaches prevent the syndrome. For the recognition of the situation the main factor is the awareness of the person's emotions. This ability is the emotional intelligence: a) perceiving emotion, b) using emotions to facilitate thought; c) understanding emotions; and d) managing emotions. The purpose of this study is to investigate the relationship among burnout and emotional intelligence in soccer coaches.

## Methods

The sample consisted of 132 soccer coaches aged 26-62 years. They completed the Trait Emotional Intelligence Questionnaire - Short Form (TEIQue-SF) which is a 30-item questionnaire designed to measure global trait emotional intelligence (2). Burn out was measured by Maslach Burnout Inventory (3) which consists of 22 items and three factors: emotional exhaustion, personal accomplishment and depersonalization.

## Results & Discussion

The results showed that there is a correlation among emotional intelligence and burn out. The factors of emotional exhaustion and depersonalization demonstrated a negative correlation with EQ while the factor of personal accomplishment demonstrated a positive relationship with EQ.

## Conclusion

According to the results, coaches with high emotional intelligence should feel less emotional exhaustion because they could understand their personal limits. Besides emotional intelligence helps coach feel his accomplishment and develop relationship with their partners. The results are in accordance with previous studies which demonstrated that emotional intelligence could be a factor which helps person to prevent emotional exhaustion and the syndrome of burn out.

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# Examining the external load when training on a nontraditional surface: a comparative study in semi-professional soccer players

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## Introduction

Sand training (ST) has shown efficacy in achieving fitness compared to firmer traditional surfaces (i.e. natural grass) in soccer players (Impellizzeri et al., 2008). However, the lack of surface-specificity when performing ST for field-based players should be considered. Therefore, we addressed the present research to elucidate the specificity of ST for soccer players by comparing activity patterns (AP) and self-reported exertion (RPE) during small-sided games (SSGs) played on artificial turf (AT) and on sand. A secondary aim was to analyse the transient of fatigue (changes in AP) between surface.

## Methods

AP and RPE were obtained from 8 adult male semi-professional soccer players ( $20.1 \pm 1$  yrs,  $176 \pm 4$  cm and  $70.1 \pm 2$  kg) using Global Positioning Systems and Visual Analogue Scale questionnaires. Players' AP were gathered during 5v5 (4v4+Goalkeepers, GKs) SSGs, which duration was 18-min (three 6-min repetitions separated by 3-min passive rest). Playing pitches had 37 m (length) x 28 m (width) according to Little et al. (2007). GKs were not included for statistical analysis.

## Results & Discussion

Average and peak speed as well as time spent by high-intensity running (sand > 10 km·h<sup>-1</sup>; AT > 13 km·h<sup>-1</sup>) were higher on AT (ES from 0.41 to 0.82) than on sand. It should be retained that during sand SSGs, the achievement of maximum speed was limited. Therefore, the risk of losses in sprinting capacity should be considered if ST is conducted systematically. In contrast, time spent by maximum acceleration (sand > 2 m·s<sup>-2</sup>; AT > 3 m·s<sup>-2</sup>) and maximum deceleration (sand < -2 m·s<sup>-2</sup>; AT < -3 m·s<sup>-2</sup>) was higher on sand (ES 0.91 and 0.88) than on AT. Thus, ST may constitute an interesting alternative exercise, targeting the development of acceleration-related capacity (i.e. gains in concentric strength). Moreover, players perceived ST more demanding (ES=0.72) than AT. This is in accordance to previous research analysing the influence of training surface on activity patterns during recreational soccer (Brito et al., 2012). Nonetheless, significant declines in AP were observed neither on sand nor AT. This could be due to the reduced drill duration.

## Conclusion

ST seems to provide an alternative strategy to deliver a higher muscular stimulus, given the higher number of accelerations and decelerations. However, ST appear less suitable if the training goal is to achieve maximal speed running. Further research including entire sessions with heart rate recordings is warranted to better characterise the use of ST for soccer players.

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# Academic background of young football coaches modulates the methodology of flexibility training

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## Introduction

The academic background of coaches in elite soccer academies is improving (Lledó & Huertas, 2012). Currently, football clubs are requiring to their coaches a greater academic background to be competent both at pedagogical and methodological level. Planning and periodization of training in football should be correctly organized according to the age and psycho-physiological development of the athletes (Partington & Cushion, 2013), specially during the earlier stages of their formation. Graduates in Physical Education and Sports Sciences have experienced during their academic formation higher academical charge related to strength and conditioning training and methodology than other coaches with different academic background (Lledó et al., 2014). Here, the aim is to describe the current situation of youth football academies related to the academic background of their coaches and the relevance that they give to the development of different physical fitness abilities in general, and particularly flexibility training

## Methods

98 Spanish coaches from different age categories (U9=27, U12=32, U14=24, U16=15) were recruited from Valencia Region. Coaches completed an online survey reporting their highest academic degree (AcB): University not related to Sport Sciences (NTDU, n=11), Coach Licensed without University Graduation (TD, n=32), University related to Sport Sciences (TDU, n=49), and Others (n=6). Moreover, they responded about the temporal distribution of the physical contents within their training organization (strength, endurance, speed, flexibility and proprioception). ANOVAs were carried out to explore the mean percentage of time (%) dedicated to each physical fitness content during the training sessions, considering the academic background as independent factor, and a descriptive analysis using frequency (N) and chi square value ( $\chi^2$ ) was conducted with a significant alpha set at  $p < .05$ .

## Results & Discussion

Results revealed a non-statistical difference in the distribution of coaches according to its AcB at different ages,  $\chi^2 (df=9, N=98) = 10.36, p = .322$ . Approximately half of the coaches (50%) were TDU, and 33% were TD. Only 17% of the coaches reported no education related to sports training. AcB did not modulate the weekly volume of training and % of time employed for training physical fitness abilities. Related to flexibility training methodology, we observed differences AcB in % of time employed for flexibility training in resting periods of matches ( $p = .048$ ), showing the lower AcB, the higher % of time spent on flexibility training. AcB modulate the use of different methods of flexibility training: the higher AcB, the higher % of active techniques used ( $p = .020$ ), without differences in the other methodologies (ballistic, passive stretching or FNP,  $ps > .07$ )

## Conclusion

The percentage of coaches with TDU has grown with respect to previous studies, Lledó & Huertas (2012) and Lledó et al. (2014) showing 60% and 52% respectively. This trend suggests a

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better awareness of the manage of the football academies for employing highly qualified coaches in order to reach higher standards of quality in the process of learning and development of young football players. Our data shows that there is not a clear long-term periodization of physical contents according to the athletes' psychomotor development. We agree that flexibility training have to be present in training throughout all categories as a mean of injury prevention (Leiva, 2014) but the methods have to be implemented according the age and sporting context of the athletes. In conclusion, our results suggest that employing coaches with higher academical background may enhance the global development of youth athletes.

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# Effects of learning the didactic model of game action competences compared with didactic model of direct instruction in tactical performance of school age football players

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## Introduction

The Didactic Model of Direct Instruction (DMDI) is the most used model for teaching soccer in areas with a competitive orientation. The MDID is suitable for teaching motor skills; however, it is difficult for players to learn the guidelines of tactical behavior during the game, such as the principles of play, through DMDI. Alternative models to DMDI have not been applied and validated consistently in extracurricular sports; accordingly, DMDI is the model most frequently used in the field of football even for teaching children tactical behavior. The Didactic Model of the Game Action Competences (DMGAC) could be a good alternative for learning cognitive, procedural and attitudinal skills for the practice of football. Objective : To determine the effects of learning the Didactic Model of Game Action Game Competences (DMGAC) and the Didactic Model of Direct Instruction (DMDI) on tactical performance and in the motivation for playing football of school age players.

## Methods

Participants were 36 children belonging to a sports club in the city of Medellin category, aged 8-11 years. Subjects were randomly assigned to an experimental group in which DMGAC was implemented or a control group in which DMDI was implemented. Each group had a teaching process according to the respective didactic model for 12 sessions of 80 minutes each. They were evaluated in three stages on learning the fundamentals of playing football: pre-test, post-test, and in a retention test. Performance and compliance with tactical principles were measured with The System of Tactical Assessment in Football (FUT-SAT) and the motivation to practice football was investigated using the adapted for football questionnaire Sport Motivation Scale (SMS).

## Results & Discussion

The results suggest that DMGAC may be an appropriate model for teaching football since the tasks proposed in this model promote the integral development of skills, autonomy and motivation. The principles of the game of football are learnt more effectively through an approach based on constructivism that promotes cognitive development and problem solving from a proper decision-making in game action with statistically significant differences compared to DMDI. There is also a trend of increasing the intrinsic motivation to practice. The DMGAC must be empirically tested in subsequent studies conducted in different areas, types of sports and populations.

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# Non Time Loss Injuries – Are They Worth Recording?

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## Introduction

In football research an injury is defined as "any physical complaint" (Fuller et al., 2006). Indeed, football players often fully participate whilst carrying these non-time loss injuries. However the value of recording these injuries is yet to be determined (Finch, 2016).

## Methods

Semi-professional footballers self-reported physical complaints weekly via the OSTRC Health Questionnaire (Clarsen et al, 2014) delivered online, during the 2016 season. Time loss (TL) injury and exposure (training and match) data was collected by a Sports Trainer or physiotherapist (Fuller et al., 2006; Ekegren et al., 2015). The risk of a TL injury within 7 days of self-reported physical complaints categories "full participation with injury" and "reduced participation with injury" were assessed relative to the risk of a TL injury in the absence of a self-reported physical complaints and with full participation. Binary logistic regression was performed on injury incidence via SPSS statistical software (SPSS v24, IBM, USA). The resultant p value and Relative Risk (RR) for each survey category was used to calculate the likelihood of a harmful/substantial effect statistic, accompanied by relevant probabilistic terms to describe the clinical inference (CI) ranging from "most unlikely < 0.5%" to "most likely, > 99.5%" (Hopkins, 2007).

## Results & Discussion

73 players with a survey response rate > 70% were included in the analysis. 1837 surveys with 607 self-reported injuries were collected and 265 TL injuries were recorded. The risk of TL injury was 9%, 31% and 62% within 7 days of reporting "full participation", "full participation with injury" and "reduced participation with injury" respectively. The RR of sustaining a TL injury within 7 days of reporting "reduced participation" or "full participation with injury" was 6.9 (90% confidence interval: 3.2 to 14.6; CI=100%-most likely) and 3.44 (90% confidence interval:1.0 to 11.7; CI=93.6%-likely) times higher, respectively, versus when no injury and "full participation" was reported.

## Conclusion

Players that self-reported physical complaints whilst continuing to participate in football training and match-play had an increased risk of sustaining a time loss injury within 7 days. Future research should exam interventions that address self-reported physical complaints and the effect this may have on reducing the incidence of TL injuries in football.

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# Association and predictive ability of perceived load with injury in elite soccer players

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## Introduction

Monitoring load is considered a useful tool for injury reduction in elite soccer players. Session-RPE is a valid method to assess load in soccer and its association with injuries has previously been described (Malone et al., 2016). However, this study was conducted over a single season, and therefore, generalisability of these findings is limited. The aim of this study was to examine the association and predictive ability of monitoring load and non-contact injuries over multiple seasons.

## Methods

Thirty-four players (age  $26 \pm 5$  y, height  $182 \pm 5$  cm, body mass  $78 \pm 4$  kg) from an Italian serie A team participated in a prospective study including 3 in-season periods. Predictors examined were: weekly load (WL), week-to-week load change (W-WL), cumulative 2, 3, 4 WL, acute:chronic 1:3 (AC3) and 1:4 (AC4) WL ratios. Multicollinearity was checked between predictors. Generalized Estimating Equation analysis examined association between predictors and injury risk (IR) in the subsequent week. Significant load predictors were split into 4 groups based on 15th, 50th, 85th percentile to compare IR in different zones. ROC curve analysis was performed to determine predictive ability.

## Results & Discussion

Cumulative WLs were excluded from analysis for multicollinearity. IR increased when WL of 1086-1542, 1542-1985,  $> 1985$  was compared with 1985 vs 1542-1985 and 1086-1542 au (OR, 90%CI 0.7, 0.4-1.4 and 0.7, 0.3-1.3). IR increased with W-WL change of -572-1, -1-614,  $> 614$  au compared to 1.23 was compared to  $< 0.80$  (OR, 90%CI 1.9, 0.9-3.8; 2.5, 1.2-5.4). IR increased when comparing AC4 of 0.78-1.02, 1.02-1.26,  $> 1.26$  vs  $< 0.78$  (OR, 90%CI 2.4, 1.4-3.9; 3.3, 1.6-6.6; 3.5, 1.7-7.4). An unclear IR difference was found comparing AC4  $> 1.26$  vs 1.02-1.26 (OR, 90%CI 1.1, 1.0-1.1). Area Under ROC Curve values were  $\leq 0.60$  for all predictors.

## Conclusion

IR was associated with an increase of WL. Lower IR (OR 0.7) was observed with higher WL ( $> 1985$  au) compared with intermediate levels but the effect was deemed unclear. IR in W-WL change and AC4 were similar to recent reports using similar ranges (Malone et al., 2016). In contrast, no protective effect was found with AC4 between 1.00 and 1.25. Coaches should gradually achieve relatively high WL. However, the ability of the model to predict non-contact injuries is limited.

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# Does early recruitment promise greater physical performances in academy soccer players?

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## Introduction

Talent identification and development is paramount to ensure long-term economic, sportive success and sustainability of professional clubs (Williams et al., 2000). Evidence shows a higher rate of physical development in academy compared to non-academy soccer players (Wrigley et al., 2014). The premise being that earlier recruitment will equate to greater training exposure and enhanced physical characteristics, however, this has not yet been investigated. Therefore, this study investigates whether recruitment status (early vs. late) influences neuromuscular and endurance performance in youth soccer players.

## Methods

Thirty-seven highly trained youth soccer players from an elite academy were selected over a 5-year period (2009-2013) and divided in two cohorts according to their recruitment status: Early Recruitment group (ER; n=16; 170.2±6.6 cm, 61.7±5.0 kg); training and competing for the academy at U14-U15 age groups and Late Recruitment group (LR; n=21; 173.2±6.9 cm, 63.7±6.8 kg); included in the academy training process at U16. The analysis period comprised three competitive soccer seasons (U16 to U18). All teams followed the same training methodology with an average participation of 10 hours of training and competitive play per week. Neuromuscular [squat jump (SJ), countermovement jump with (CMJwA) and without arms swing (CMJ)], 10-m sprint time) and endurance-related tests (maximal aerobic velocity; MAV) were always evaluated during the second day of the pre-season.

## Results & Discussion

There was no significant between group difference in endurance and neuromuscular performances at any testing point. Furthermore, we found no difference between ER and LR groups for the magnitude of performance change over the 2-year training in MAV (0.8±2.2%), 10m (-1.0±3.1%), SJ (-0.2±10.3%) CMJ (2.8±8.0%) and CMJwA (0.0±6.0%). Interestingly, after the first season of enrolment in the club, possibly to likely greater gains were noticed in LR compared to ER players in CMJ (LT: 11.0±6.5% *vs.* ER: 4.1±6.9%) and CMJwA (LT: 10.2±7.9% *vs.* ER: 1.0±8.0%).

## Conclusion

Earlier recruitment of youth soccer players is unlikely to result in greater neuromuscular and endurance performance measures during later stages. While late recruited players experienced a linear progression, early recruited players experienced greater improvements during the second year of training exposure. Our results call into question that earlier recruitment will allow a greater performance development in relevant soccer physical performance parameters.

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# Learning process for professionalized footballers': a way to manage their professionals' transition?

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## Introduction

This communication deals with career change issues in French Professional Soccer. More specifically, each season, a lot of professionalized players, including apprentices and professionals, are rejected from work market in France. For example, more than 350 professional players were unemployed at the end of season 2015/2016. Because there are socialized to be dedicated to professional football (Bertrand, 2012), it is hard for them to build alternative career options. Our ethnographic studies, close to young soccer players' apprentices and unemployed professional players, revealed that most of them were not prepared and instructed to move out from soccer. That was the principal reason why they exclusively get football jobs. Indeed, the analysis of semi-directive interview (more than 40) confirmed a lack of preparation and abilities (McGillivray, Fearn and McIntosh, 2005) to build a real professional double-project (Javerlhiac, 2014). These results lead us to set up learning process in three steps in order to prepare players to manage their professional transition.

## Methods

First of all, a learning cycle will be focus on professional players' abilities which are developed in Professional football. The goal of this learning cycle is to build awareness and confidence to players. The purpose of the second learning phase will be the professionalization of players, in their labour market knowledge. The third cycle will focus on developing abilities to manage double-project building process.

Eventually, this experimentation in process, will try to assess with a longitudinal study, the impact of alternative learning, in order to preserve them from classical troubles career termination (Stambulova, 2000). Because, preparing, investigating and anticipating (Fabre and *al.*, 2012) will make the difference in the after football.

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# Using generalized Voronoi-cells to calculate space control in soccer

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## Introduction

Control of space is central for successful game play in soccer. One common to quantify space control uses so-called Voronoi diagrams which partition the soccer pitch into individual cells using an Euclidean distance function. However, this effectively discards player's running and heading direction information. Therefore, Taki and Hasegawa (2000) introduced a player running-model using a generalized Voronoi-diagram. More recently, Gudmundsson and Wolle (2014) proposed to use historic running data from individual players to generate individualized models. Following this proposal we sought to establish an empirical running function to model reachability using real-time heading and speed information with respect to previous game performance data from individual players.

## Methods

To model reachability, we developed an empirical model based on performance data from fourteen female 1st Bundesliga players. Each participant ran, walked or sprinted along a ten meter run-up lane towards a turning circle area and subsequently ran as fast as possible towards a target at 10m distance. Five targets at angles between 0° and 180° were used. The empirical reachability model was parameterized according to percentage of maximum running speed and the angle deviations from the current running direction. To apply the empirical reachability function an algorithm was developed to determine pitch space controlled by the players through a hexagonal subdivision of the pitch.

## Results & Discussion

The application of a more realistic reachability function led to a much more irregular shaping of the individual Voronoi-cells compared to the standard Voronoi-diagram. However, the resulting shapes appear to model much closer the subjective perception of space control on the field. For example, due to the irregular shape narrow passing channels could be identified unlike when using a standard Voronoi-Diagram. An interesting future avenue for the present approach therefore could be to analyze game plays with respect to missed passing opportunities in an automatic fashion (Gudmundsson & Wolle, 2014). This would allow the identification of both bad decision and good decision much more efficiently enabling subsequent more in-depth analyses by coaches for improving decision making in their players.

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# Acute neuromuscular responses to a RSA test in elite futsal players

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## Introduction

The ability of elite futsal players to cope with high intensity actions has a direct influence in the final performance (Castagna & Barbero-Alvarez, 2010). However, one of the main cause of injury could be asymmetries between dominant and non-dominant limbs (Álvarez-Díaz et al., 2014). Therefore, assessing muscles' contractile properties at baseline and neuromuscular responses after a maximal effort in elite players would help to understand the sporting demands and injury risk. Thus, the objective of this study was to assess the neuromuscular profile and the effect of a Repeated Sprint Ability (RSA) test on lower limb muscles of elite futsal players, using non-invasive techniques such as tensiomyography.

## Methods

Twenty elite futsal players performed a RSA (7 x 30 m) test. The muscle responses and the lateral symmetry of rectus femoris (RF) and biceps femoris (BF) were recorded through tensiomyography (TMG-100 System electrostimulator, TMG-BMC d.o.o., Ljubljana, Slovenia). Maximum radial displacement of muscle belly (Dm), contraction time (Tc), delay time (Td), sustain contraction time (Ts) and half-relaxation time (Tr) were collected from baseline and after the RSA test. Significant differences were assessed through an ANOVA of two ways (moment vs laterality).

## Results & Discussion

No asymmetries were found between dominant (DL) and non-dominant (NL) limbs ( $p > 0.05$ ) on healthy elite futsal players. Therefore, maximal repetitive efforts in futsal neither cause asymmetries in lower limb muscles nor increase the injury risk in this sense.

The lower values in Td (DL: 1.14 ms; ES: 0.62; NL: 1.30 ms; ES: 0.77), Tr (DL: 27.496 ms; ES: 0.76; ND: 32.201 ms; ES: 0.84) presented on RF after the RSA as well as in Ts in both RF (DL: 52.97 ms; ES: 1.22; ND: 45.36 ms; ES: 0.96) and BF (DL: 58.925 ms; ES: 1.90; NL: 53.526 ms; ES: 0.83), suggest that RSA do not provoke induced fatigue on elite futsal players but rather it seems to potentiate the contractile properties of lower limbs, especially RF. However, the disparity of the described results of Td, Tc, Ts and Tr in bibliographic references makes it difficult to obtain conclusions.

## Conclusion

Elite futsal players do not show significant asymmetries in contractile properties between dominant and non-dominant lower limb muscles, neither at baseline nor after an effort consisting in a RSA test. The RSA does not seem to represent enough effort as to induce fatigue in lower limbs muscles in this population.

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# The effect of a football training programme on physical and psychological health-related measures in Chinese children and adolescents

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## Introduction

In keeping with a current global trend, Hong Kong is facing the public health concern of childhood obesity (1). Involvement in team sports promotes a more active lifestyle, enhances physical fitness and improves clinical health markers in children and adolescents (2). Unfortunately, very few studies in China and Hong Kong have placed emphasis on the use of team sports, such as soccer, among "at-risk" youth groups as an intervention strategy to increase physical activity levels, as well as physical and psychosocial status.

## Methods

Boys and girls aged between 8 to 18 years, who participated in the Hong Kong Football Association (HKFA) Summer Scheme development programme were recruited to participate in this study. All the participants were required to attend a minimum of ten 60 min football training sessions, administered by qualified HKFA coaches. The Life Satisfaction Ladder; the Physical Activity Questionnaire for Children (PAQ-C); the Physical Activity Rating for Children and Youth (PARCY); Stages of Change, and Sport & Physical Activity Questionnaire were all measured to assess the effectiveness of soccer as a tool to enhance various health-related measures.

## Results & Discussion

196 boys (n=154) and girls (n=42) from a variety of districts and from families of various socio-economic-statuses were recruited. The mean score of PAQ-C was  $2.75 \pm 0.67$  and  $2.72 \pm 0.61$  for boys for girls, respectively. Boys that spent more time weekly in football reported better life satisfaction ( $\beta=0.003$ ,  $p=0.022$ ). Life satisfaction was found to be positively related to the mean score of PAQ-C ( $\beta=0.871$ ,  $p=0.002$ ). Individuals in the older age category (13-17) reported 264 min/week in football training, which was significantly greater than the time spent by their younger counterparts (aged 8-12), which reported 181 min/week ( $p=0.002$ ). Boys that spent more time spent in football reported better life satisfaction. In addition, the primary reasons found to promote continuous soccer participation included being fit and healthy; motivation to attain skills; enjoyment of a friendly group setting; and confidence gained through skill acquisition.

## Conclusion

This study clearly illustrated the positive relationship between time spent playing football and life satisfaction in boys, which has never previously been reported in Hong Kong children or adolescents. Further analysis of these results and additional investigations into the reasons for playing soccer can serve as a potential indicator for the strategic application of sports-programme promotion among children and adolescents.

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# Movement profiles and the relationship between match result and physical performance in women's international soccer

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## Introduction

Physical preparation has become increasingly important in elite women's soccer with players covering approximately 10km in total distance each match (Datson et al., 2014) with a higher distance covered against better-ranked opposition (Hewitt et al., 2014). There is however limited research on the movement profiles in women's international soccer matches and the result of a match in relation to physical performance. The aim of this study is to examine the distances covered at various segments throughout a match and compare total distances covered in matches won, drawn and lost.

## Methods

A total of 20 female international soccer player's competed in 17 international matches with each outfield player wearing a GPS athlete tracking device, resulting in a total of 120 game files. Each game was broken down into 15-min segments with distance covered recorded as well as totals for first half, second half and full match. For differences between 15-min segments, distance covered between halves and full match comparisons, effect sizes (ES) were assessed using Cohen's *d*, where ES thresholds were qualified as trivial < 0.2, small < 0.6, moderate < 1.2, large < 2.0, very large < 4.0, and extremely large  $\geq 4.0$  and expressed as 90% confidence intervals.

## Results & Discussion

The total distance covered in a match averaged  $9680 \pm 1025$ m with an 8.4% decrease in distance covered in the second half of the match with that of the first half ( $4628 \pm 493$ m vs.  $5052 \pm 580$ m, effect size: 0.73, 90% confidence limits  $\pm 0.09$ ). There was a significant reduction in distance covered in the periods of 60-75 mins and 75-90 min when comparing both to the 0-15 min period, with moderate and large effect sizes (ES: 1.05, 90% CL  $\pm 0.11$  and ES: 1.33, 90% CL  $\pm 0.13$  respectively). Matches which ended in a draw showed a small but significant increase in total distance covered compared to matches which were won ( $9954 \pm 958$ m vs.  $9392 \pm 945$ m, ES: 0.47, 90% CL  $\pm 0.19$ ). There was no difference between matches which were won and lost and drawn and lost.

## Conclusion

The findings of the present study indicate that there is a significant decrease in distance covered between the first half and the second half and in the last 30-mins of a match compared to the first 15-mins, possibly suggesting the occurrence of fatigue towards the end of a match. Players covered more distance overall in matches which were drawn suggesting that other external factors also influence physical activity in matches such as scoreline, team tactics and substitutions.

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# Integrating Working Memory Training into Football Coaching through Action Research; advances in methodology and technology

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This research is investigating how working memory training (WMT) can be integrated into football coaching practice for the purpose of achieving performance-related neurological adaptation. Current practice in coaching allows for the pursuit of physical, technical, tactical and psychosocial outcomes in any exercise, with reference to long term planning in the learning of systems of play and physiological periodisation. This research is investigating how WMT will be combined with football coaching practice to produce neurological outcomes that will increase performance on the field. WMT is used to affect working memory, a construct that deals with the manipulation of information and the making of decisions under five seconds.

Prior to this research a systematic literature review identified principles of using WMT effectively, with a theoretical application of these principles to current practice of coaching subsequently taking place. These principles detailed how WMT could be used to systematically overload working memory, forcing players to complete actions and tasks more efficiently, with implications in areas such as cue recognition, implicit motor learning, decision making and ‘flow’ states.

This presentation details how a participatory action research (PAR) methodology was used to investigate the application of WMT in football coaching. The research used a triangulation of video footage, athlete interviews and coach-researcher interaction to develop new methods of using WMT within football coaching. This presentation concludes with the outcomes of this study, including the development and use of different technologies, delivery techniques, training tasks and coaching strategies – as well as the implications of the findings on the future development of WMT in football coaching.

# Quantifying the PlayerLoad™ differences between planned and unplanned sprint shuttles in football players

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## Introduction

Differences in planned and unplanned tasks have been shown during laboratory based studies but this may not be transferable to field based training (2). Tri-axial accelerometer (PlayerLoad™) has been emerged as a potentially useful tool for training monitoring (1). Therefore, the aim of the present study was to examine the differences in PlayerLoad™ (PL) between planned (PLA) and unplanned (UNP) agility tasks over different durations.

## Methods

Seven male club-level soccer players (age;  $27.9 \pm 6.1$  years, height;  $177.4 \pm 5.9$  cm, mass;  $78.6 \pm 5.4$  kg) were recruited for this study. During the UNP condition, they performed a total of 12 maximal sprint shuttle (180° turn) efforts of different duration (1.0, 1.5 and 2.0s) in a random order with a 2mins passive rest between each. The distance covered for each run was recorded and matched for the PLA condition, performed one week later. The PL data was gathered from 100Hz integrated tri-axial accelerometers (Optimeye S5, Catapult, Australia) placed on the upper back (SCAP) and on the right (R) and left (L) ankles. Repeated measures ANOVA was used to compare temporal differences between PLA and UNP sprint shuttles and between accelerometer locations. In addition, the magnitude of the effects (ES) were calculated.

## Results & Discussion

No significant differences in PL were found between the PLA and UNP ( $p > 0.05$ ) sprint shuttles for each of the time points. Mean PL values for PLA vs UNP were  $2.19 \pm 0.5$  vs  $2.57 \pm 0.3$  AU for 1.0s;  $3.46 \pm 0.7$  vs  $3.61 \pm 0.4$  AU for 1.5s and  $4.45 \pm 0.7$  vs  $4.59 \pm 0.5$  AU for 2.0s conditions. Large ES indicated higher PL during 1.0s condition for UNP sprint shuttles for all accelerometers' location (SCAP: ES=0.9; R: ES=1.2; L: ES=1.0). The mean distance covered during the sprint shuttles were  $8.21 \pm 0.95$ m,  $11.94 \pm 1.45$ m and  $15.94 \pm 1.51$ m during 1.0, 1.5 and 2.0s conditions respectively. No significant differences in mean time were found between PLA and UNP sprint shuttles for any condition ( $p = 0.53$ ). The PL was on average 263% (range 250 to 272%) higher for the accelerometers placed at the right and left ankles ( $p < 0.001$ ) than accelerometers placed on the upper back for all conditions.

## Conclusion

There were no differences for PL between PLA and UNP agility tasks. We found a tendency for PL during UNP tasks to be more taxing during shorter distances (1.0s). The PL values were 2.0-2.5 fold higher at the ankles than upper back.

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# Effects of One Week Taper Training on Soccer Match Performance

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## Introduction

Taper training before a major competition is a common strategy design to elicit a performance peak in a wide variety of athletic events. It is also used in soccer as an important training strategy in the transition of players from the preparatory to competitive phase of the season while keeping the optimum level of performance. Studies on taper training in soccer are very limited, thus the purpose of this study is to examine the effects of taper training on physical and technical match performance.

## Methods

The participants were 15 male amateur soccer players. The study was designed as 6-week overload training and 1-week taper training period. During the overload and taper training weeks, small-sided games were used as a method to train at the anaerobic threshold intensity. While maintaining the intensity, frequency and volume of the training sessions were decreased with the exponential fast decay taper method during the taper training week. 3 soccer matches; before training (pre-training), after overload (post-training) and taper training were played to examine the effects. Players were monitored during matches using a 10 Hz GPS technology. Physical match performances were reported as total distance, walking distance, low intensity distance, moderate intensity distance, high-intensity distance and sprint distance. (Bradley et.al 2013). In addition, defensive (the number of tackles etc.) and offensive (the numbers of passing etc.) technical skill analyzes of matches were carried out by notational analysis system. The data were analyzed using an analysis of variance (ANOVA) for repeated measures to explore differences between matches.

## Results & Discussion

Compared to the pre-training match, the total distances covered by players decreased in post-training match ( $p < 0.05$ ). This might be the result of the fatigue related to the increase in the training load throughout the overload trainings. Compared to the post-training match, the total distance covered after the taper training increased ( $p < 0.05$ ). There were significant increases in distances covered at walking and low-intensity running speeds after tapering ( $p < 0.05$ ). During the match after taper training, significant increases in the number defensive and offensive technical skills were observed when compared to pre and post-training match ( $p < 0.05$ ). These increases in the match performance after the taper training may result from the reduction in the training load and fatigue. **Conclusion** Findings of this study suggest that following pre-season training, taper training may increase match performance in soccer.

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# Quantification of training and match-load across a season in elite English premier league soccer players

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## Introduction

The monitoring of a player's training load represents a vital component of effective training periodisation. There is currently a lack of research on the periodisation models that are currently adopted in elite soccer (1, 2). Therefore, we aimed to quantify the combined training and match-load distribution across the competition phase of one full season at an English Premier League club.

## Methods

Twenty six elite-level soccer players [central defender ( $n = 4$ ), wide defender ( $n = 4$ ), central midfielder ( $n = 7$ ), wide midfielder ( $n = 3$ ), and attacker ( $n = 8$ )] were monitored across the 36-week (49 matches) competition phase of the 2012-2013 English Premier League season. Training and match load variables were segregated into 6x6-weekly mesocycles as well as in relation to competitive games (day type) within the weekly micro-cycle. Variables analysed included RPE-TL (RPE x training/match duration), total running distance, high-speed running distance and very high-speed running distance.

## Results & Discussion

A statistically significant main effect of mesocycle and day type was observed for all variables ( $p < 0.001$ ). RPE-TL (50 AU) and total distance (470 m) were generally higher in mesocycles 1 and 2 *vs* mesocycles 3-6. Greater high-speed activity was observed in mesocycle 2, 5 and 6 (range: 89 – 147 m). All variables were higher on match-days and lower on the day preceding a match, *vs* other days. RPE-TL, total distance and high-speed running distance were also higher three days prior to match-day *vs* other days. A statistically significant interaction between day-type and playing position for all variables was reported ( $p < 0.001$ ) with generally lower and greater values observed for wide midfielders and attackers.

## Conclusion

The present findings indicate that the overall loading in elite soccer players was relatively constant (between mesocycles) across the competition period. In contrast, periodisation of training load was evident within the weekly mesocycle, especially during the three day period leading into a match and was influenced by playing position.

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# Mental fatigue effects on tactical performance during soccer small-sided games

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## Introduction

Mental fatigue has been shown to negatively affect technical performance in well trained soccer players during small sided games (SSG; Badin et al. 2016). Physical activity profiles were not significantly different in mentally fatigued conditions compared to control, although higher perceived exertion (RPE CR10) was reported. Tactical performance analysis in elite soccer has indicated less team positional synchronicity during congested fixture periods despite similar physical profiles, possibly due to higher fatigue perception (Folgado et al. 2015). Therefore, the primary aim of this study was to investigate the effects of mental fatigue on tactical performance in SSG's.

## Methods

Twelve well trained amateur players ( $17 \pm 0.8$  yrs) completed six SSG's (GK+6v6+GK) in two sessions (64x43m, 3x6-min, 2-min rest). A pre-activity questionnaire preceded 30-min of an emotionally neutral documentary (control) or computer based Stroop task (mental fatigue). Mental fatigue, motivation, mental effort and physical fatigue ratings were recorded using visual analog scales (VAS) pre/post treatment and post-game (end of 3rd bout). RPE (BORG CR10) was collected post treatment and after each bout. GPS units (5Hz, GPSports, Canberra) and Polar watches (5Hz, Polar, Finland) were worn during treatment and match-play for geodetic and HR data. SSG's were supervised by coaches (blinded to treatment conditions) and video recorded for retrospective notational analysis. Magnitude based inferences were applied using customised spreadsheets.

## Results & Discussion

Subjective ratings of mental fatigue were almost certainly higher following Stroop ( $ES=1.8 \pm 0.52$ ), while motivation remained unchanged. Non-significant differences existed for physical activity profiles, whilst total negative actions ( $ES=0.61 \pm 0.68$ ) and passing accuracy ( $ES=0.81 \pm 0.38$ ) were very likely affected in mentally fatigued players. Team centroid positioning in the first two bouts ( $ES=0.39 \pm 0.47$ ,  $.43 \pm 0.42$ ) but not the third were also affected, with nearest opponent only affected in the second bout ( $ES=.33 \pm 0.48$ ).

## Conclusion

This study suggests that mental fatigue might cause small differences in team tactical behaviour, in line with a previous study of elite level players in congested fixtures. No clear difference existed between physical activity, with small differences apparent in technical performance. Perception of fatigue did increase following the mentally fatiguing treatment, in line with previous research. Thus, it appears that mental fatigue may cause a tactical shift in SSG's whilst increasing perception of fatigue without impacting activity profiles.

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# Childhood participation in play and practice activities among players with different levels of self-regulation

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## Introduction

Soccer is a highly competitive sport, and an increasing body of research have examined the importance of childhood participation in play and practice activities to achieve high levels of performance. Besides the direct learning of soccer skills, it is argued that the distinctive character of the contextual activity may influence the development of self-regulation (Perry, 1998), which has been highlighted as an important component of the quality of practice (Toering et al., 2013). The aim of the current study was to examine if childhood participation in various types of play and practice activities varied across talented youth soccer players with high or lower levels of self-regulation.

## Methods

A total of 515 regional male Norwegian U-14 ( $n=282$ ) and U-15 ( $n=233$ ) soccer players participated in the study. Participants completed a practice history questionnaire (Haugaasen et al., 2014) and the football-specific self-regulated learning questionnaire (Toering et al., 2013) under supervision prior to a practice session. Players' practice engagement during childhood was merged to represent the accumulated hours conducted in four types of practice activities between 6-8 years and between 9-11 years; organized team practice, individual practice, sport-specific play, and involvement in other sports. A median split was used to categorize players as high ( $4 <$ ) or medium/low ( $4 \geq$ ) on self-regulation.

## Results & Discussion

Results revealed that players scoring high or medium/low on self-regulation did not differ in childhood participation in organized practice ( $p > .05$ ), sport specific play ( $p > .05$ ) or involvement in other sports ( $p > .05$ ). However, the players with higher levels self-regulation reported to have conducted more self-initiated practice at both age 6-8 years ( $Md=162$ ) and age 9-11 years ( $Md=374$ ) compared to players with lower levels of self-regulation (6-8 years:  $Md=72$ ,  $z=-3.31$ ,  $p < .01$ ; 9-11 years:  $Md=200$ ,  $z=-4.31$ ,  $p < .01$ ).

## Conclusion

The results indicate that differences in childhood participation in practice activities may be important to understand differences in self-regulation in adolescence. However, it should be noted that it is uncertain whether engagement in self-initiated practice during childhood leads to improved self-regulation, as some studies have indicated that metacognitive skills start to develop at approximately 4 to 6 years of age (Veenman & Spaans, 2005).

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# Dose-response relationship between training load and changes in aerobic fitness in elite youth soccer players

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## Introduction

Establishing the response from a given training load (TL) is considered an important aspect of training monitoring. The distance covered above arbitrary speed thresholds is commonly used in practice to monitor the training dose, however this method may not represent the true exertion of each player. Hunter et al., (2014) suggest that an individualised approach, based on a player's physiological characteristics, may be more representative. If true, an individualised approach would be expected to more closely map the relationship between training load and changes in fitness parameters. This however, has yet to be investigated. The current study aimed to establish the relationship between internal and external TL (arbitrary and individualised) and changes in aerobic fitness.

## Methods

With institutional ethics approval, fourteen youth soccer players, competing in the Under-18 Premier League completed a 1500 metre time trial (TT) to estimate maximal aerobic speed (km.h<sup>-1</sup>, (MAS)) at the start and the end of a six week period. TL was monitored on a daily basis across this study period. External TL measures were; total distance covered (TD), total acceleration and deceleration distance > 2m.s<sup>-2</sup> (A/D Load). Arbitrary high speed running measures were; metres covered > 17 km.h<sup>-1</sup> (M > 17) and time spent > 17 km.h<sup>-1</sup> (T > 17). Individualised high speed running measures were metres covered M > MAS km.h<sup>-1</sup> (M > MAS) and time spent > MAS km.h<sup>-1</sup> (T > MAS). In addition, internal TL measures were also collected; heart rate exertion (HRE) (Edwards, 1993) and rating of perceived exertion (RPE) were assessed. Linear regression analysis was used to establish the dose-response relationship between mean weekly TL and changes in TT performance.

## Results & Discussion

The mean change in MAS was 0.11 km.h<sup>-1</sup> ( $\pm$  0.12 km.h<sup>-1</sup>) (Possibly trivial; 31/69/0). Very large associations were found between T > MAS and changes in TT performance ( $R^2$  = 0.59; 90% CI: 0.36, 0.82). Large and moderate association were found between M > MAS ( $R^2$  = 0.25; 90% CI: 0.00, 0.53), T > 17 ( $R^2$  = 0.14; 90% CI: 0.00, 0.38) and changes in TT performance respectively. Trivial to small associations ( $R^2$  = 0.04 to 0.07) were found between all other TL measures and changes in TT performance.

## Conclusion

An individualised approach to monitoring TL, in particular T > MAS, may be a more appropriate method than using traditional arbitrary speed thresholds when monitoring the dose-response relationship between TL and changes in aerobic fitness.

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# Considering biological maturation – changes to a national tournament

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## Introduction

Countries continue to strive to identify and fast track the development of talent to be successful at the senior professional level. However conventional measures of talent do not acknowledge that a youth’s performance is likely to be affected by a range of variables such as physical maturity, relative age, past experiences and training effects.

In acknowledging these challenges, Football Federation Australia (FFA) implemented a changed format for the Under 16 boys national championships. Historically this was conducted as a national championship with state teams competing against each other over a five day period. The concern was this format encouraged a high proportion of early maturing players being selected in teams with a focus on winning. The 2016 tournament was modified in several ways: (a) the first three days of play consisted of six matches with state teams competing against each other; (b) for the final two days players were allocated to new teams based on their biological maturity (BM). The aim was to have three teams each of late, on-time and early maturing players. Scores were recorded for all games although there were no play-offs or overall ‘winner’. The aim of this presentation is to share the players’ experiences of competing in both playing formats during the tournament.

## Methods

Participants were 161 boys (M=15.41 years; SD=0.45) from nine representative teams competing at the 2017 NTC challenge. At the beginning of the tournament all players completed a questionnaire that assessed self-reported confidence and competence related to their upcoming performance; grit; and incremental and entity beliefs. All coaches also rated their player’s competence. Player’s maturation was determined using Mirwald’s formula for Age At Peak Height Velocity (APHV). The following classifications were used: Early = APHV < 13.5 yrs (N=55); On-time = APHV 13.5 – 14.5 yrs (N=88); Late = > 14.5 yrs (n=17). As there were uneven numbers within the maturation categories players were ranked from 1-161 based on maturity offset and then allocated to teams. At the end of the tournament players completed the confidence and competence questionnaire related to their BM team; responded to questions asking them to rate their experiences regarding both playing formats; and participated in focus groups.

## Results & Discussion

Results revealed when late maturing players were playing in a BM game they rated their confidence and competence higher; were better able to demonstrate their technical skills and found the game was less intense ( $p < .05$ ). Focus group responses revealed support for the new format although reasons varied between early and late maturers. All players reported that the games with their state team were less difficult as they were “more structured”, “knew what team was going to do”, and “knew what my role was” compared to BM games which allowed “more freedom” and “could try more things”.

# The effect of match-derived relative pitch area in 5-a-side games on team tactical performance in under-19 talented soccer players

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## Introduction

Research demonstrated that small pitch sizes in small-sided games (SSGs) result in decreased physical demands (Castellano et al., 2015) and different interpersonal distances (Frencken et al., 2013) compared to SSGs played on larger pitches. In practice, soccer trainers mainly use relatively small pitches, where the relative pitch area is smaller than in full-sized matches (i.e. 320m<sup>2</sup> per player). Although physical performance increased in SSGs played on a match-derived relative pitch area compared to SSGs played on smaller pitches (Castellano et al., 2015), it remains unclear how teams tactically respond to such a pitch size manipulation. Therefore, the aim is to investigate the effect of match-derived relative pitch area in SSGs on team tactical performance.

## Methods

Forty-nine under-19 players from three Dutch youth academies played 5-a-side games on a small and a large pitch, with relative pitch areas of 120m<sup>2</sup> and 320m<sup>2</sup>, respectively. Positional data (LPM-system) were recorded during the SSGs and were used to determine team tactical performance measures, such as the inter-team distance, LPW-ratio and surface area. Differences between the SSGs were statistically evaluated with an ANOVA.

## Results & Discussion

The inter-team distance significantly increased on a large pitch compared to the small pitch ( $3.95 \pm 1.11$  vs.  $1.62 \pm 0.28$ m,  $p < .01$ ). In addition, the surface area was significantly larger on the large pitch than on the small pitch ( $143.34 \pm 26.26$  vs.  $100.68 \pm 18.79$ m<sup>2</sup>,  $p < .01$ ). These findings indicate an increased dispersion of the players on the large pitch. The unchanged LPW-ratio ( $0.96 \pm 0.16$  vs.  $0.94 \pm 0.13$ AU,  $p = .52$ ) indicates that manipulation of the pitch size did not affect the shape of the team.

## Conclusion

Team tactical performance measures were affected by a match-derived relative pitch area in SSGs. This pitch size manipulation afforded soccer players more space to explore and allowed teams to adopt a larger dispersion. Applying such pitch areas in SSGs might be a more representative playing environment for the soccer players to improve soccer skills and prepare for the full-sized match.

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# Investigating the developmental needs of players, coaches and coach educators working at the player transition from foundation to youth development phases in English academy football

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## Introduction

The introduction of the Elite Player Performance Plan in English football led the creation of three phases of player development; Foundation Phase: U5 to U11 age group, Youth Development Phase: U12 to U16 age group and Professional Development Phase: U17 – U21 age group. Subsequently the majority of football clubs implemented this structure within their academies. The implementation of the structure has led to an increase of paid coaching at the younger age groups in this structure. It also led to the creation of explicit transition points. In both cases, however, there is a lack of research in understanding the needs of coaches at this level and what demands placed on players are. The aim of this research was to engage in some exploratory study of both needs and demands.

## Methods

Thirty two coaching staff, representing senior staff and age group coaches, from eight football club academies were interviewed. Questions asked related to overall academy structure, specific goals for the 10-13 age group, the challenges of working at this age group, areas of uncertainty. A focus group of 4-6 players from each club, representative of u12 and u13 teams (i.e. boys who had transitioned) were interviewed. Questions asked related to what it was like to be a player at the club, what they felt they had improved in, what had been the challenges, how their coaches had helped them, if there was anything their coaches could do to support them more.

Data was analysed through inductive and confirmatory deductive methods (Patton 2002; Scanlan et al. 1989). Deductive reference points included known models and theories of age/stage related curriculum, talent development (TD), coaching practice, youth development and transitions.

## Results and Discussion

Nine themes emerged from the data analysis; overall strategy, planning, coaching team communication, transitions, who, what, how, age related professional development, professional development requirements. Results from both players and coaches in each theme confirmed a good conceptual alignment with suggestions for good practice from established literature. However, the alignment was weaker when deeper levels of understanding were explored. Specifically, developmental bio-psycho-social understanding was very reliant on experiential opportunity, although targeted FA youth coach education courses had raised awareness of the need to consider the needs of young people.

## Conclusion

There were gaps in the professional knowledge of coaches within the bio-psycho-social domain of understanding their players. This lack of understanding can have a big impact on coaches'

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capacity to support players progressing and transitioning through a TD system. It is of note that the 11-13 age is a very much under researched age group in TD settings. This hinders the capacity to develop evidence based professional development that these coaches require.

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# Effects of the Menstrual Cycle on Physical Match Performance in Elite Female Soccer Players

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## Introduction

The changes in hormones across the menstrual cycle have been suggested to affect sporting performance (Constantini et al, 2005). Currently, there is no consensus on whether physical performance is altered during the different phases of the menstrual cycle (Janse de Jonge, 2003). Moreover, this has not yet been considered when assessing physical performance in competitive soccer. Therefore, the aim of the present study was to investigate whether menstrual cycle phase affected physical match performance.

## Methods

During the second half of the Bundesliga season 2015/16 physical match data of 87 elite German female soccer players ( $22.5 \pm 2.9$  y,  $170.6 \pm 6.4$  cm,  $66.2 \pm 6.2$  kg) was monitored via 5hz GPS devices (TT01, Tracktics GmbH, Hofheim, Germany). Players taking contraceptive pills or using any other form of contraception were excluded from analysis. Additionally, players had to participate in a minimum of 3 matches to be included, consequently, 22 players with 96 individual observations remained for final analysis, 43 observations in the FP and 53 in the LP. Physical match parameters included total distance (TD), low intensity distance (LID), high intensity distance (HID), number of sprints (S) and sprinting distance (SD). Differences between the FP and the LP were analysed using a mixed effects model (fixed effect: cycle phase, random effects: player ID and phase-by-player ID interaction). Significant differences were accepted when  $p > 0.05$ .

## Results & Discussion

No differences between phases were observed for TD (FP  $9.8 \pm 1.0$  LP  $10.2 \pm 1.0$  km), LID (FP  $8.9 \pm 0.9$ , LP  $9.2 \pm 0.9$  km), HID ( $0.9 \pm 0.4$ , LP  $1.0 \pm 0.4$  km), S ( $26 \pm 9$ , LP  $27 \pm 9$  n) and SD (FP  $100.5 \pm 54.9$ , LP  $98.8 \pm 49.1$  m) ( $P > 0.05$ ). Variability attributed to player ID ranged between 23.3% (HID) to 63.4% (TD), while phase-by-player interaction accounted for 8.2% (TD) to 16.9% (S) of the total variability.

## Conclusion

The main findings of the study suggest that players differ in their personal level of performance regardless of their cycle phase. There was no major consistent effect of cycle phase on neither the group nor the individual level for physical performance. However, future research should aim to investigate these effects with a larger sampling size over a longer period to further assess the effects of menstrual cycle phase on physical performance in this population.

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# Effect of core training with wheeled platform on trunk muscle hypertrophy in soccer players

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## Introduction

In soccer, players often perform sprinting, change of direction running, and sudden start and stop actions. Trunk muscles play a critical role in keeping stability and control of the body when performing such actions (Andersen et al., 1988). Taken together, it is important to strengthen trunk muscles of soccer players. A core training consisting of front plank, side bridge, back bridge, and push up exercises do not alter trunk muscle cross-sectional area in junior youth soccer players (Hoshikawa et al., 2013). Muscular activities of abdominal and lateral trunk muscles are higher in the exercise with wheeled device than traditional core exercise such as sit up and crunch exercises (Escamilla et al., 2006). However, less information is concerning the effect of core training with wheeled device on trunk musculature in soccer players. Therefore, the current study aimed to clarify the effect of core training with wheeled platform on trunk muscle hypertrophy in soccer players.

## Methods

Twenty-eight collegiate male soccer players ( $19.9 \pm 1.1$  yrs,  $171.1 \pm 5.8$  cm,  $65.3 \pm 6.4$  kg) were assigned to three groups; core training with wheeled platform (N = 10, WP), core training consisting of body mass-based exercise (N = 8, STB), and control group (N = 10, CON). WP and STB groups trained twice a week for 10 weeks. WP group performed 8-14 exercises with wheel platforms. STB group conducted 4 core stabilization exercises consisting of elbow-toe, elbow-heel, side bridge, and push-up. Each exercise to failure. Before and after intervention, lean body mass (LBM) was assessed using a whole-body dual-energy X-ray absorptiometry scanner. Muscle thicknesses (MT) of rectus abdominal muscle (RA), external oblique muscle (EO), internal oblique muscle (IO), and transverse abdominal muscle (TrA) were assessed using an ultrasound.

## Results & Discussion

Whole body and trunk segment LBMs were significantly increased through the intervention without significant interaction. MTs of RA were significantly increased in WP, but not in STB. MT of EO tended to be increased in both training groups, but the significant level did not reach ( $p = 0.063$ ). There was a significant change in MT of IO for both training groups without significant interaction. No significant change in MT of TrA was found in both training groups. No significant changes in all measured variables were found in CON.

## Conclusion

For soccer players, a core training with wheeled platforms can be effective modality for increasing rectus abdominal muscle and internal oblique muscle.

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stabilization training on trunk muscularity and physical performances in youth soccer players. *J Strength Cond Res.* 2013;27(11):3142-9.

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# Which external and internal load indicators are related to injuries in professional soccer?

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## Introduction

In professional soccer, research on the relevance of external and internal load indicators for injury prevention is scarce [1]. Therefore, the aim of this study was to examine the relationship between load indicators and injuries in professional soccer.

## Methods

Data were collected from 19 professional male soccer players over one full season. Examined load indicators were total distance, high speed running distance (> 20 km/h; [HSRD]) and rating of perceived exertion (RPE) multiplied by duration. Cumulative one-, two-, three- and four-weekly loads and acute:chronic workload ratios (i.e., one-weekly load divided by four-week rolling average weekly load) were calculated and split into low, medium and high groups. All time-loss injuries (i.e., traumatic and overuse) were registered by the medical staff [2]. Generalized estimating equations modelled the association between load and all time-loss injuries in the subsequent week [3]. Magnitude-based inferences were used for interpretation of results.

## Results & Discussion

In total, 74 injuries were included. High two-weekly (> 3800, OR: 2.87, 90% CI: 1.38 – 5.98) and three-weekly loads (> 5583, OR: 2.05, 90% CI: 1.26 – 3.32) for RPE x duration, high two-weekly (> 58041, OR: 2.59, 90% CI: 1.34 – 5.02) and three-weekly loads (> 85513, OR: 3.11, 90% CI: 1.65 – 5.85) for total distance, high one-weekly (> 909, OR: 2.11, 90% CI: 1.26 – 3.54) and two-weekly loads (> 1744, OR: 2.25, 90% CI: 1.25 – 4.03) for HSRD and a high acute:chronic workload ratio (> 1.2, OR: 2.29, 90% CI: 1.29 – 4.09) for HSRD showed very to most likely harmful increased injury risks.

## Conclusion

Increased weekly loads for RPE x duration, total distance and HSRD were associated with increased injury risk. Most indicative were cumulative two- and three weekly loads. In addition, a high acute:chronic workload ratio for HSRD demonstrated higher injury risk. The monitoring of provided load indicators is recommended in professional soccer. This can aid in optimizing load management and reducing injury risk.

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# Modulating the focus of attention during soccer free kick training in developmental players using a smartphone app

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## Introduction

Since the introduction of the iPhone<sup>TM</sup> by Apple Inc.<sup>TM</sup> in 2007 smartphone usage has exploded and now pervades almost every facet of human activities. As the smartphone is basically a mobile computer including various sensor and connectivity capabilities new applications and use cases are constantly emerging. Increasingly smartphones therefore have been proposed as potential aids in various domains of exercise sciences yet often lacking any scientific underpinning. Recently, adidas<sup>TM</sup> introduced a smart soccer ball, the myCoach Smartball. The ball is equipped with various sensors measuring ball rotation speed and linear ball speed and can be paired with a smartphone app for feedback purposes. Thus, information about the movement outcome is provided supporting a so-called external focus of attention (Wulf & Prinz, 2001) during skill acquisition. Current evidence indicates that skill acquisition benefits from an external focus of attention instruction compared to an internal focus (Wulf, McConnel, Gartner, & Schwarz, 2002). Thus, we investigated whether the usage of a smartphone app supports acquisition of a knuckle ball soccer free-kick technique.

## Methods

20 developmental players participated in the study. Individuals were randomly assigned to either an internal or an external focus of attention group. The internal focus of attention group received instructions according to the coaching manual of the German Football association emphasizing internal variables like foot placement and leg position. In contrast, the external focus of attention group received instructions with respect to the ball trajectory, ball foot-contact location, ball rotation, and ball velocity as provided by the app. Participants trained knuckle ball kicks from 25m distance for two sessions per week for three weeks. 30 shots were taken during each session and feedback was given after every third kick. Participants underwent pre-, post-, and retention testing.

## Results & Discussion

Statistical testing using linear mixed-effects model of ball rotation indicated a significant main effect for testing time,  $\chi^2(2) = 8.2$ ,  $p < 0.05$ . Post-hoc testing indicated a significant effect between the retention and post-test. Participants improved their knuckle kicking skills by significantly decreased the ball rotation over the course of the training. However, no differences were found with respect to the two instruction conditions. The results therefore stress the need to investigate whether the introduction of new technologies into the training process really improves performance or whether it serves rather as a marketing tool to improve sales. Nevertheless, as technologies barriers for novel sensor technologies become lower new opportunities to monitor performance will become available.

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# Passion of Football in Boundaries

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## Introduction

The aim of this work is to show the power of football. The power of football is combine people from different nationality and culture. And also reality in sport if you dont compete you can not improve. But in my country this is not like that for our football players. Because we dont have any international compatetion. However they still keeping their passion for the sport. Think that all the year you are playing matches and at the end you become champion. Then next year and an other next year and go on so can you keep your passion to play after became a champion not to go abroad and every year is gone to be same. So it is important how our players keeps their passion to play. In our country because of political results and the rules of international associations keeps our chlidren play in boundaries. This is very hard to answer our children because when they ask ‘why they cant play matches agains teams abroad watching on tv’ there is no answer to give them; can you? But it is our reality.

## Methods

By using interview method we asked questions to the all parties who are involved in the football family. What they think and what they live during in their live while playing coaching or directing the football activities in our country. We contact with 10 person from each group. We asked them 4 questions about footbal which are 1-Did they become a champion in there football life? 2-What did they do after they become a champion? 3-What makes them to keep to play the football since there is no international matches? 4-What is their gaining from the football?

## Results & Discussion

We found out that the gaining of the parties at the end of the games who became champion was limited as its limits of the country. So the vision of the players was not mature as their limits. They satisfied what they get after became champion. Because They know that they can not go abroad. This is cause our football not to develope and to promote our stars to world football. It is like a vicious cycle. They are playing for pocket money or scholarship for school or university, or to find a job .That is all.

## Conclusion

As a cnclusion if we want to develope our football we have to break this vicious cycle. This is not possible with playing in boundaries. So we have to give a chance to players to play out of boundaries. Because football itself is given enough passion to the players to play till boundaries but break the boundaries we need more. We dont want boundaries for our children to play football.

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# Validating the Accuracy of Position Detection Systems in Sports: Methodological Considerations and Exemplary Results

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## Introduction

Electronic position tracking systems (EPTS) have become a standard tool for performance analysis in research as well as in practice. Despite this common use, studies on the accuracy of position detection and reliability of match statistics derived from positional data are scarce and sometimes methodologically debateable. This study aims at reviewing the state of the art in several methodological issues of these type of studies and reporting exemplary results of a new study.

## Methods

*Gold Standard:* A reliable gold standard should have a proven accuracy with an error at least one magnitude (i.e. 10fold) smaller than the tested systems. Studies not using a gold standard (Buchheit et al., 2014; Randers et al., 2010) can only control for deviations between different systems but do not give an estimate for the accuracy. Common gold standards used in literature are among others timing gates, video timing, laser distance measurement and marker-based position detection systems. Criteria for comparing different gold standards are measurement volume, type of exercise to be tracked, lab vs. pitch measurements.

*Exercises:* The exercises chosen should be as close as possible to a full-sized match but also allow to pin down the problems of the tested system to certain types of movements. In the literature we find linear runs with constant speed or with accelerations, specific tracks, typical exercises and games from football training and football matches.

*Data Processing and Statistics:* Accuracy testing requires quite demanding steps of data processing since the raw data consists of two streams of xy-data for each tracked object. They need synchronization in space and time, up- resp. down-sampling accounting for different sampling frequencies, as well as a comparable filtering especially when velocity and acceleration data is compared. Moreover, the most appropriate statistics for comparisons (RMSE, Bland-Altman, confidence limits) have to be applied depending on the information targeted at. Statistics used are typically different between those used for position accuracy and for comparing summary statistics.

Ten professional male football players performed straight line runs at varying speed, a sport specific running course, a small sided game and a shuttle run. All tests were simultaneously recorded by three GPS tracking systems, three video based tracking systems and one radar based local position measurement system. To validate the accuracy of all tracking systems, positional data were compared to a ‘gold standard’ (Laveg laser device & VICON motion capture system). Preliminary results demonstrate that the highest spatial accuracy was achieved by the radar based tracking system (mean  $RMSE_{xy}$  Radar: 0.24m; mean  $RMSE_{xy}$  GPS: 0.90m;  $p < 0.001$ ) whereas GPS based tracking systems provided higher accuracy in speed measurements (mean  $RMSE_{speed}$  Radar: 0.34 m/sec; mean  $RMSE_{speed}$  GPS: 0.31 m/sec;  $p < 0.05$ ).

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# Exploring coordination in soccer players' movements using regime switching state space models

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## Introduction

Understanding interactions among soccer players during competition is of great importance to coaches, match analysts, and sport scientists. The core premises of this study are that teams are self-organizing, metastable complex systems, and the dynamics in a team's coordinated behaviors change between discrete regimes over the course of a match. Player positional data, often characterized by multimodal distributions, may be modeled as emanating from two or more discrete regimes. Thus, a tutorial of regime switching state space models (RSSSMs) followed by example analyses using empirical data is provided. The aim of this study was to explore the model's value in identifying coordination within teams.

## Methods

RSSSMs use a state space representation comprised of a measurement equation and a state equation, where the measurement model varies by regime. A transition probability matrix is used to define the probabilities of switching from regime  $j$  at time  $t-1$  to regime  $i$  at time  $t$ . This model uses a hidden Markov chain approach, supported by the Kalman filter, to estimate the conditional probability of each regime for all  $t$  in the observed data. As the algorithm loops over all  $t$ , it passes the innovations and covariance to the likelihood function used in parameter estimation.

The RSSSM approach is applied to a database consisting of the spatial positioning of all 10 outfield players of one team during a preseason men's professional soccer match (Ric et al., 2016). Measurements were sampled at 5 Hz using GPS devices (SPI Pro, GPSports, Canberra, Australia). RSSSMs were used to explore discrete changes in tactical behavior dynamics (e.g., forwards switching positions laterally during play). Two main outcomes of RSSSMs that are useful to support substantive interpretation were demonstrated: the set of parameter estimates which differ in each regime and the conditional probabilities of each regime.

## Discussion

Strengths, limitations, and future directions of the RSSSM approach are discussed from methodological and substantive views. As an alternative to maximum likelihood estimation, Bayesian approaches are considered. The possibility to investigate switching dynamics as a consequence of changes in game constraints, from an ecological dynamics framework, is also discussed.

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# Case study: sleep and injury in elite soccer.

## A mixed method approach

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In elite soccer, players are frequently exposed to various situations and conditions that can interfere with sleep, potentially leading to sleep deprivation (Nédélec et al., 2015). There is an absence of scientific data to date examining the role of sleep deprivation on the risk of acute injury among elite soccer players. The aim of the present study was to examine the link between sleep and injury occurrence in an elite male soccer player competing in the French League 1 and Union of European Football Associations matches. During 4 months, a mixed method approach was used combining actigraphic sleep assessment with qualitative interviews on a daily basis. Three injuries were reported over the study period. Player's sleep onset latency both in the single night ( $117 \pm 43$ min) and in the week ( $78 \pm 50$ min) before injury occurrence was longer than baseline value ( $18 \pm 13$ min; effect size ES: 3.1 and 1.6, respectively). Similarly, sleep efficiency in the single night ( $73 \pm 7\%$ ) / the week ( $75 \pm 7\%$ ) before injury occurrence was found to be altered compared to baseline ( $90 \pm 3\%$ ; ES: 3.2 and 2.8, respectively). In addition to objective sleep assessment, qualitative interviews were performed to investigate not only how the player sleeps but also the psycho-socio-physiological acute and chronic stressors affecting his sleep. We offer this case study as a real-world applied example for other players and practitioners seeking to deploy sleep hygiene strategies to reduce injury risk and maximize player availability. Sleep onset latency and sleep efficiency may be particularly useful sleep variables to track during congested schedule in order to prevent injury occurrence. Therefore, sport scientists should address each individual's post-match sleep in an attempt to enhance recovery and preparations for subsequent training and/or performance. Individualized assessment of sleep and sleep hygiene using actigraphy and sleep diaries/questionnaires, with consideration to physiological (e.g. caffeine intake), behavioural (e.g. screen use/viewing 1 h before bed), environmental (e.g. room temperature) and psychological (e.g. stressors) factors, is recommended. Based on this assessment process, individualised sleep interventions that focus on education, awareness and practical guidance can be provided to each athlete (Shearer et al., 2015).

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# Seasonal training load and wellness monitoring in a professional soccer goalkeeper

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## Introduction

The role of a goalkeeper (GK) in soccer is an important but often overlooked position. Professional GKs are often expected to play upwards of > 40 matches per season and thus must be able to perform and recover across a longitudinal period. Whilst researchers have focused on the load monitoring strategies of outfield players (Jaspers et al. 2016; Malone et al. 2015), little attention has been given to the training practices of GKs. Specially, to the authors knowledge no study has attempted to quantify the training load of professional GKs and examined the subsequent internal response. Therefore, our aim was to quantify the relationship between daily GK training load and wellness response in professional soccer.

## Methods

Using a single subject design, training load indicators (Total and high-intensity distance (> 20 km/h), PlayerLoad, number of accelerations/decelerations > 3 m/s<sup>2</sup> and RPE load), and perceived ratings of wellness (fatigue, sleep quality, general muscle soreness, stress levels and mood) were measured daily with a professional soccer GK across the 2015-2016 Eredivisie season (153 individual sessions). Pearson correlations were calculated to determine the relationships between all training load indicators and the subsequent total wellness score on the following day.

## Results & Discussion

PlayerLoad, accelerations and decelerations were all correlated to variability in sleep quality ( $r = 0.77-0.96$ ), muscle soreness ( $r = 0.76-0.96$ ), stress ( $r = 0.77-0.96$ ) and mood ( $r = 0.77-0.96$ ). There were no significant correlations found between wellness measures and total distance ( $P > 0.05$ ). In addition, relationships between fatigue scores and training load markers were negligible.

## Discussion

Perceived ratings of wellness, in particular sleep quality, muscle soreness, stress levels and mood, were reasonably sensitive to fluctuations in training load undertaken by a professional GK. Load indicators involving short, intense actions (such as accelerations/decelerations and PlayerLoad) appear to be more sensitive to these differences. Therefore, practitioners should select variables that show evidence of sensitivity to training load prescription.

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# Emotional intelligence, efficacy beliefs and coaches' reactive behaviors in competitive settings

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## Introduction

Emotional intelligence (EI) has been an emerging topic for educational, psychological, management and sport researchers and consultants in recent years, but has been largely unexplored in terms of its potential influence on coaching behaviors in competitive settings. According to Horn's (2008) working model of coaching effectiveness, coaches' perceptions of their emotional ability can be considered as personal characteristic that is predictive of their expectancies (e.g., efficacy beliefs), which, in turn, is predictive of their behavior in competitive settings. Thus, in examining the precursors of coaching behaviors during a game, the purpose of this study was to determine whether coaches' efficacy beliefs mediated the relationship between EI and coaches' reactive behaviors during a game.

## Methods

*Participants.* A total of 75 males head coaches of soccer volunteered to participate in this study during an international youth football tournament developed in Marbella, Spain, with 3000 youth participants. In total, 39 coaches were involved with U-12 teams, and 36 were involved with U-10 teams. Participants ranged in age from 21 to 66 years old ( $M = 33.05$ ,  $SD = 10.69$ ). The mean years of coaching experience as a head coach was 9.09 years ( $SD = 7.76$ ).

*Procedures and design.* Naturalistic observations were carried out in a football field, subsequently, coaches were approached at the end of the game to participate in the study. The coaches completed written informed consent forms prior to their study involvement. All participants were assured that their responses would remain confidential and that no participant would be identified in any presentation or publication emanating from the data. Next, coaches were taken to a classroom-type setting to complete the questionnaires.

*Measures.* Emotional intelligence was measured by the 16-item scale developed by Wong and Law (2002) which contains four subscales assessing self-emotions appraisal, others-emotions appraisal, regulation of emotion, and use of emotion. In order to assess CE, the CES (Feltz et al., 1999) was used. The CES is a 24-item self-report measure. It consists of four subscales: game strategy efficacy, motivation efficacy, technique efficacy, and character building efficacy. We used the Coaching Behavior Assessment System, a coding system for observing and recording coaching behaviors during games (CBAS; Smith, Smoll, & Hunt, 1977). The CBAS contained 12 behavioral categories subdivided into reactive and spontaneous categories. Spontaneous behavioral categories included general technical instruction, general encouragement, organization, and general communication. We considered positive (i.e., reinforcement, mistake-contingent technical instruction, mistake-contingent encouragement) and negative (non-reinforcement, punishment, punitive technical instruction, and ignoring mistakes) reactive coaching behaviors as dependent variables.

*Data analysis.* We tested the mediation hypotheses for the EI variables – Self-Emotions Appraisal, Others-Emotions Appraisal, Regulation of Emotion, and Use of Emotion – in four sepa-

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rate models. For this purpose, we used the SPSS macros by Hayes (2013), with 1000 bootstrap resamples and 95% bias-corrected confidence intervals (CI).

## Results & Discussion

Four sets of mediation analyses were conducted: one for each EI dimension of self-emotions appraisal, others-emotions appraisal, regulation of emotion, and use of emotion. In all sets of analysis, the mediator variables of coaching efficacy beliefs within the game strategy efficacy, motivation efficacy, technique efficacy, and character building efficacy. In resume, the indirect and direct effect of motivation efficacy were significant between others-emotions appraisal and regulation of emotion, and positive coaches' reactions during game, suggesting a full mediation. Moreover, the indirect and direct effect of motivation efficacy and character building were negatively significant between others-emotions appraisal and regulation of emotion, and negative coaches' reactions during game, suggesting a complementary mediation (partial).

Guided by Horn's (2008) working model of coaching effectiveness, the purpose of this study was to determine whether coaches' efficacy beliefs mediated the relationship between EI and coaches' reactive behaviors during game. In general, findings of this study would seem to suggest that coaches' efficacy beliefs that they have the capacity to affect the learning and performance of their athletes transfers the effects of EI competencies on coaching reactive behaviors in competitive settings. Specifically, an emotional intelligent coach (i.e., evaluate others-emotions and regulate their own emotions) would perceive high beliefs of coaching efficacy to motivate and to build character of their athletes, and this perception has an impact on their coaching positive reactions in response to both positive and negative athletes' performances.

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# Femoral bone mineral density in lifelong trained male football players compared with young and elderly untrained men

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## Introduction

Osteoporosis is a major public health problem causing more than 8.9 million fractures annually worldwide, corresponding to a fracture every 3 seconds (Johnell & Kanis 2006). To improve bone health in society recommendations on exercise regimes with potential to increase bone mineral density (BMD) are needed. Football training is a highly intermittent sport characterized by multiple turns, jumps and sprints with accelerations and decelerations causing a high strain rate and a large magnitude of ground reaction (Randers et al. 2010). This loading pattern results in high-impact forces on the bones of the lower limb and has been shown to improve osteogenesis (Helge et al. 2014). Therefore, the purpose of this controlled cross-sectional study was to investigate proximal femur and whole-body BMD in lifelong trained elderly football players and young elite football players compared with untrained age-matched men.

## Methods

140 healthy, non-smoking men including lifelong trained football players aged 65-80 (FTE), elite football players aged 18-30 (FTY), as well as untrained age-matched elderly (UE) and young men (UY) participated in the study. To determine BMD all participants underwent DXA scans of right (R) and left (L) proximal femur and whole-body.

## Results & Discussion

FTE had 6.8-11.5% higher ( $P < 0.05$ ) BMD in R and L femoral neck, wards, shaft and total proximal femur compared to UE, and 8.5-8.9% higher ( $P < 0.05$ ) BMD in R and L femoral trochanter compared to UY. BMD of the femoral neck, shaft and total proximal femur was not significantly different ( $P > 0.05$ ) between FTE and UY. FTY had 19.5-45.1% higher ( $P < 0.001$ ) BMD in all R and L femoral regions and total proximal femur compared to the three remaining groups. The whole-body DEXA scan confirmed these results, with FTE showing a similar whole-body BMD compared to UY, and that FTY had superior ( $P < 0.001$ ) whole-body BMD compared to the three other groups.

## Conclusion

Lifelong trained male football players aged 65-80 have a BMD of proximal femur similar to untrained men aged 18-30 despite of an age difference of 47 years. Young elite football players are, as anticipated, superior in terms of bone mineralization.

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# Recreational football for adolescent boys enhance muscle strength in lower limbs

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## Introduction

Worldwide physical inactivity among adolescent leads to an increasing number of non-communicable life-style diseases such as cardiovascular, musculoskeletal and metabolic diseases (Fleming et al., 2014) and therefore it is important for adolescent to participate in physical activities. Recent evidence states that recreational football is a health-promoting activity with a high mean intensity combined with specific actions of anaerobic character (Krustrup et al. 2010).

## Methods

This study is a part of a larger intervention study aiming at investigating the long-term (2 yrs) effects of offering coaching and 3 weekly football sessions to boys at a school in a socially challenged area of Copenhagen, Denmark; Health related physical capacity and training intensity was evaluated, for those boys who in average participated in at least 2 football sessions pr. week for a school year. 61 boys, aged 12-16 yrs, and BMI  $19.4 \pm 3.3$  was a part of the Football Group (FG), whereas 41 boys, aged 12-16 yrs and BMI  $18.8 \pm 3.4$  was a part of the Control Group (CG). The Yo-Yo Interval Endurance test level 1 (YYIE1) was used to evaluate aerobic fitness, and a Standing Long Jump (SLJ) was performed as an indicator of lower limb muscle strength. 15 Hz GPS (Catapult Minimax S4, Australia) and Heart Rate (HR) monitors (Polar Team 2, Finland) were used to evaluate training intensity.

## Results & Discussion

The increase in SLJ for the FG from pre ( $164 \pm 30$  cm) to post ( $175 \pm 31$  cm) was significantly higher ( $p < 0.05$ ), than the increase from pre ( $159 \pm 23$  cm) to post ( $163 \pm 20$  cm) in the CG. The change in YYIE1-distance for the FG (pre:  $2160 \pm 988$  m, post:  $2279 \pm 1062$  m) was not significantly different from the CG (pre:  $2037 \pm 988$  m, post:  $2086 \pm 894$  m). HR during training sessions for FG showed that HRmean was 72.7 % of HRmax with 32.4 % of time spent with HR > 80 % of HRmax and 4.6 % of time spent with HR > 90 % of HRmax. GPS data showed that FG in average ran  $68 \pm 66$  m with a velocity > 21 km/h in each training session with a player load of  $6.45 \pm 1.65$ /min.

## Conclusion

Participation in recreational football for adolescent is a demanding physical activity, with high mean HR and high-intensity runs. This leads to an improvement in muscle strength and thereby to the conclusion, that recreational football is a health-promoting activity for adolescent as a means of prevention of diseases induced by physical inactivity.

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# Differences in game-reading between selected and non-selected youth soccer players

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## Introduction

Soccer players continuously integrate and act upon the moving information on the pitch, including teammates and opponents (Williams, 2000). Den Hartigh et al. (2014) developed a method to assess game-reading skills of soccer players based on Skill Theory. They also demonstrated that adult soccer players with higher levels of expertise integrated events and elements of game plays at higher complexity levels of the Skill Theory scale. Here, we test whether under-12 youth soccer players selected for the soccer school of a professional soccer club outscore non-selected peers on their game-reading skills.

## Methods

Eighty-eight youth male soccer players recruited from regional amateur clubs participated. Forty-nine players (age  $10.9 \pm 0.3$  yrs) were selected by scouts of a professional football club for one of the five soccer schools in the topographic region and thirty-nine ( $10.6 \pm 0.4$  yrs) were teammates of the selected players. Participants were asked to watch three attacking soccer game plays and to simultaneously verbalize the actions taking place. Participants were filmed and transcripts of the descriptions were coded using a soccer-specific Skill Theory coding system.

## Results & Discussion

The sample consisted of 254 transcribed videos. Monte Carlo permutation test revealed higher complexity levels of game-reading for the selected players than for non-selected players ( $3.46 \pm 0.22$  vs.  $3.34 \pm 0.23$ ,  $p < 0.05$ , Cohen's  $d = 0.51$ ). The selected players had a higher average complexity score for the game elements (including player, teammate, opponent, ball, field and goal) than the non-selected players ( $1.53 \pm 0.46$  vs.  $1.27 \pm 0.36$ ,  $p < 0.05$ , Cohen's  $d = 0.63$ ). The results indicate that the selected youth players structured the information from the game plays at higher levels of cognitive complexity.

## Conclusion

In line with previous findings among adult soccer players (Den Hartigh et al., 2014), selected youth soccer players outscore their peers on game-reading skills using the Skill Theory complexity scale. Because this approach discriminates between youth soccer players at an early age, this could impact current talent identification and selection processes.

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# Inter-seasonal Dispositions of Injury-risk Among First Division Bundesliga Soccer Players

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## Introduction

The aim of this study was to monitor injury incidence among first division Bundesliga soccer players and to compare risk differences between the preseason and the competitive season. Exposure and injury data from 1444 players was collected over six seasons from a media-base register.

## Methods

In total, 3248 injuries were documented, comprising of an incidence rate for overall, match and training injuries of 95.6 /100 player-season (95% Confidence Interval [CI]: 92.3 – 98.9), 10.7 per 1000 match-hours (95% CI: 10.10 – 11.32), and 60.1 /100 players-season (95% CI: 57.5 – 62.7) respectively.

## Results & Discussion

Using an aggregated injury incidence each season as the dependent variable in a mixed Poisson regression model, the incidence rate of training injury seem to increase by a factor of 1.07 annually (IRR: 1.07, 95% CI: 1.04-1.10,  $p < 0.001$ ). Although not statistically significant, the incidence rate from matches increases by a factor of 1.03 annually (IRR: 1.03, 95% CI: 0.99-1.06,  $p = 0.056$ ). Regarding injury types, the incidence rate of a muscle strain from matches increases by a factor of 1.08 annually (IRR: 1.08, 95%CI: 1.01-1.15). The relative risk for the preseason relative to the competitive season was 1.88 (95% CI: 1.28-2.76).

## Conclusion

Injury surveillance is a key risk management tool for monitoring injury incidence and injury patterns. Current findings may facilitate implementation of preventive measures by medical practitioners for ensuring the safety of the players.

# Changes over a decade in anthropometry and fitness of elite Austrian youth soccer players

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## Introduction

National soccer associations and professional clubs spend an increasing amount of money aiming to provide their talented players an optimized environment to achieve future elite level (Reilly, Bangsbo & Franks, 2000). In Austria, since 2001, youth soccer players have been systematically drafted nationwide into local bases (U11-U14) and soccer academies (U15-U18). However, within the past years game speed, match structure and play patterns of elite soccer have changed (Wallace & Norton, 2014). Thus, we aimed to evaluate whether these evolutions are also been reflected in changes in anthropometric and fitness characteristics between former (2002-2005) and current (2012-2015) elite Austrian youth soccer players across six age groups (U13-U18).

## Methods

Drafted U13-U18 players performed a battery of anthropometric, general and soccer-specific fitness tests: height, weight, straight-line sprint (5/10/20 m), 5x10-m shuttle sprint (SS), hurdles agility run (HAR), reaction test (RT), foot tapping (FT), 20-m multi-stage endurance run (ER), countermovement (CMJ) and drop jump (DJ), 2-kg standing medicine ball throw (MBT), and sit-and-reach (SR). Tests were conducted annually each at the end of the year. Data were analysed for the two four-year periods (2002-2005 vs. 2012-2015) and age groups: U13 ( $n=890$  vs.  $n=979$ ), U14 (999 vs. 931), U15 (769 vs. 906), U16 (551 vs. 774), U17 (474 vs. 521), U18 (261 vs. 319). Independent t-test ( $p<.05$ ) and eta squared (ES) were calculated to compare the two four-year periods at each age group separately.

## Results & Discussion

Players of the current period were significantly faster in each age group, with mean ES (across the six age groups) of .03-.04 in 5, 10 and 20-m sprint. Especially at U15 level, moderate ES of .08 (5 m), .07 (10 m) and .06 (20 m) were observed. Current players performed significantly better in SS (mean ES=.04) and HAR (mean ES=.04) at U15-U18 age groups. In contrast, former players showed significant superior performances in SR across all age groups (mean ES=.04). Almost no effects were found in CMJ, DJ, FT, MBT, ER, weight and height over each age group (mean ES=.001-.007). Elite Austrian youth soccer players have become faster over time, possibly as a result of the increased high-intensity running and sprinting demands in soccer (Barnes et al., 2014). Especially on entry into an academy (U15), coaches might select faster players now. Changes in soccer-specific speed and agility during academy years (U15-U18) may be attributed to a more soccer-specific training (e.g. small-sided games) nowadays (Chaouachi et al, 2014).

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# Locomotor activity, heart rate, enjoyment and perceived exertion from walking football for prostate cancer patients

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## Introduction

The aim of this study is to investigate the locomotor activity, heart rate, enjoyment and perceived exertion in walking football for prostate cancer patient compared to normal walking and football.

## Methods

15 male participants (age  $71.8 \pm 5.8$ ) from FC Prostate took part in the two 1-h sessions carried out 2 wks apart. Heart rate (Mio Link, Mio Global, Canada) and locomotor activities (ZXY tracking system, ChyronHego, Norway) were measured during both sessions. Each session consisted of warm-up for 8 min, normal walking for 5 min. around the soccer pitch, 3v3 or 4v4 walking football for 10 min and 3v3 or 4v4 normal football for 10 min on 16.5x40.3 m pitches, with 1.5x3 m goals. The order of the activities was randomised. Immediately after each small-sided game of walking football and normal football, the participants filled out a physical activity enjoyment scale (PACES) questionnaire and a visual analogue scale (VAS) fatigue index. All values are presented as mean  $\pm$  SD. All group comparisons were done with two-tailed paired t-tests.

## Results & Discussion

Mean heart rate was higher during normal football and walking football compared to walking  $122 \pm 17$ ,  $114 \pm 18$  and  $101 \pm 16$  bpm, respectively ( $P > 0.05$ ). Time spent with heart rate  $> 135$  bpm was higher in soccer compared to walking football and walking  $25.6 \pm 21.4$  vs.  $6.7 \pm 13.5$  and  $2.7 \pm 6.7$  % of the time ( $P > 0.05$ ). The distance covered was higher during normal football compared to walking football ( $541 \pm 91$  vs.  $486 \pm 58$  m ( $P=0.004$ ), no differences compared to walking. The distance covered at high speed ( $> 12$  km/t) was higher in soccer compared to walking football  $42.1 \pm 50.1$  vs.  $3.0 \pm 5.0$  m and walking, where no actions with high speed were performed ( $P > 0.05$ ). The PACES score was higher in normal football ( $4.4 \pm 0.3$ ) than in walking football ( $3.7 \pm 0.7$ ), ( $P = 0.002$ ) as well were the fatigue index score in the legs ( $4.5 \pm 2.3$  vs  $2.5 \pm 2.2$ ;  $P = 0.0001$ ) and at whole body level ( $4.9 \pm 2.3$  vs.  $2.3 \pm 2.2$ ;  $P = 0.001$ ).

## Conclusion

The exercise intensity was higher in walking football compared to walking, whereas the exercise intensity and enjoyment rates were lower than in normal football.

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# A functional semantic analysis of team dynamics in soccer

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## Introduction

Current models of Dynamical Systems Theory measure self-organization of team sports in terms of synchronization. Components of team systems (i.e., players) are considered as periodic phase oscillators whose degree of synchrony reflects the coordination of a team to achieve a common goal. Nonetheless, a main limitation of these models is that the collective behavior is context independent. In other words,  $N$  phase oscillators with phases  $\theta_j$  for  $j=1,2,\dots,N$  can be highly synchronized without this corresponding to a meaningful coordination dynamics relevant to the functional semantics of the game. Thus, the aim of this study was to develop a method of analysis sensitive to the contextual situations of the game and compare it to current models.

## Methods

Data were collected via GPS (15 Hz) for an entire half of a friendly match between two professional soccer teams. We analyzed the degree of synchronization for both teams in terms of the Kuramoto order parameter (cluster amplitude  $r$ , high synchronization = 1) by measuring location data (x,y pitch coordinates) over time. Team synchronization was measured in moments of the match in which either one of the two teams were in possession of the ball and relative to four equally distant quadrants in which the field was divided determining the distance between the center of mass of a team and the attacking goal.

## Results & Discussion

Phase synchrony was assessed for both teams. Then, a linear mixed effects model with role (attacking and defending) and quadrant (4-distances) as fixed effects and time as a random effect. For the away team, significant effects for role [ $F(1, 25622) = 9993, p < .001$ ] and quadrant [ $F(3, 25622) = 11691, p < .001$ ] were qualified by a role  $\times$  quadrant interaction [ $F(3, 25622) = 262, p < .001$ ]. A similar pattern of effects [role:  $F(1, 15488) = 31, p < .001$ ; quadrant:  $F(3, 15488) = 6484, p < .001$ ; role  $\times$  quadrant:  $F(3, 15488) = 622, p < .001$ ] was observed for the home team.

Overall, synchrony was always higher for the team in defense and lower for the team in offense. At the same time, differences in synchrony depending on the team's role became more pronounced as teams moved closer to the goal of interest.; likely due to the away team's dominance of the match.

Our results suggest that, while previous studies have assessed team synchrony based on motor movements (e.g., walking, jogging, running, etc.), the additional parameters in our study ground these actions in the ontology and epistemology of the game.

## Conclusion

By modeling Organism (athlete) and Environment (i.e., goals) as two coupled dynamic systems we show that context dependent models of social joint actions can have large implications for understanding collective behavior.

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# A Topography of Free Kicks in Soccer

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## Introduction

This study investigates the spatial relationship of performance variables for soccer free kicks. In order to suggest ways in which players might optimise their performance, we collected data from free kicks (< 35 m to goal line) of two German Bundesliga seasons (2013/14, 2014/15) (n=1624).

## Methods

In the analysis, we applied the ISO-map approach using colour gradients to visualize the mean values of a variable on a 2D-map of the pitch. Additionally, variograms were used to describe the degree of spatial dependence of the free kick variables.

## Results & Discussion

Results show that DENSITY, TYPE OF PLAY, PLAYERS IN WALL, DISTANCE TO WALL and RULE VIOLATION were strongly spatially dependent. Centrality and proximity to the goal increased the variables PLAYERS IN WALL, RULE VIOLATIONS and INTERRUPTION TIME, and the ratio of goals scored increased from 5.9 % (central far) to 10.9 % (central near). In 70.9 % of the shots, players preferred a switched laterality, which did not result in a higher success rate. Furthermore, there was no statistical advantage for the defensive team when DISTANCE TO WALL was below 9.15 m or when there was a RULE VIOLATION. Crosses had a success rate (i.e. first controlled ball contact after the cross) of 20.8 %. Played with natural laterality, they were 5 % more successful than with switched laterality. Crosses from the right side outside the penalty box were 10 % more successful than from the left side. Therefore, it might be worthwhile practising the defence of balls coming from this side.



# Healthy Reference Patterns (HRP) supporting prevention and rehabili-tation process in professional football

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## Introduction

In top-level football clubs players and employees are shifting between clubs. Standardised long-term information about each player is difficult to get, especially in performance diagnostics and medical. This abstract presents the idea of developing a test battery for professional football clubs that focuses the combination of performance analysis and medical data. The main issue is to develop a model for healthy reference patterns (HRP) that makes it possible to analyse the health status of each player at one specific point to determine the medical status.

## Methods

The chief objective of the development is that the HRP model should meet the needs of the medical department. Interviews with the employees had been done, leading to four tests: 3D motion capturing for gait analysis with EMG, maximum strength, drop jump and anthropometrical data. A U17 team (n = 17) of a German Bundesliga Club had passed through the tests. At IsoMed they had done static knee extension and knee flexion of each leg three time. For the gait analysis a treadmill and a Vicon 3D motion capturing system with "Plug-in Gait" model for the lower body (16 marker) have been used. The test persons had to act in two speed levels (8 km/h = walking / 12 km/h = running). For Drop Jumps an optical detection (Opto Jump) was used to measure the ground contact time. The test persons had to start of a 30 cm step and had to jump single leg over a 24 cm hurdle as fast as they could. For the bodyscan, a Vitus 3D Body Scanner (300 dots per cm<sup>2</sup>) had been used.

## Results & Discussion

The 3D motion capturing data will be used to analyse the joints and rotation of knee and ankle. Gait graphs will be created to compare them with normal standard values for prevention and also to compare further analysis with the status quo. Maximum strength data showed enormous differences between quadriceps and hamstring of the player. This data could be combined with 3D anthropometric data to see if there are any correlations. Additionally contact time of the drop jump could be added and will be used as indicator for rehabilitation and determining the health status of the player.

## Conclusion

Further research will show if healthy reference patterns could be useful and how they could be used in sport practice. After that, the influence of such data in prevention and rehabilitation has to be evaluated and should be extended to adult players as well. HRP could help medical professionals to get long-term information and get an impression of the players condition before the injury happened.

## References

A list of references would exceed the limit of 3000 characters.

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# The impact of physical and mental fatigue on decision making in intermediate soccer players

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## Introduction

Previous work has shown decision-making (DM) and other perceptual-cognitive skills are most likely to differentiate between elite and sub-elite performance (Reilly et al., 2000). Throughout a competitive football match players cover up to 11 km resulting in physiological stress being applied (Bangsbo et al, 2002). Furthermore players are tasked with making accurate decisions in a timely manner whilst carrying out required responses. Previous work has shown how mental (Smith et al., 2016) and physical (Casanova et al., 2013) fatigue in *isolation* leads to a decrease in DM accuracy. To date no research has examined the impact of a *combination* of mental and physical fatigue on the DM of soccer players nor the mechanisms that underpin them. Therefore the aim of the current project is to a) examine the impact of a combination of mental and physical fatigue on DM b) examine mechanisms underpinning DM and assess their contributions across specific fatigue protocols.

## Methods

Intermediate level soccer players will complete four separate counterbalanced conditions. The pre-test will contain a DM task in which participants will be presented with life-size video sequences of 11 v 11 football situations from the first person perspective. At the end of each clip, participants will be required to anticipate the next action of the ball carrier (i.e. pass, shoot dribble). The physical fatigue condition will compromise of participants completing a validated football specific treadmill protocol (Drust et al., 2000). At various points during the protocol participants will complete a DM test as per the pre-test. In the mental fatigue condition participants will complete a range of cognitive tests (i.e. Stroop test, MacLeod, 2015) and then complete the DM test. The final condition will contain a combination of physical and mental fatigue protocols with participants completing the DM test throughout. Measures on the DM tests will include; visual search behaviours, response accuracy and response time. It is predicted that in the mental and physical fatigue protocols DM accuracy will decrease compared to the pre-test (Casanova et al., 2013; Smith et al., 2016) and the mechanisms underpinning performance will be effected. Furthermore in the combined physical and mental condition DM will deteriorate even further. This project has the potential to inform both theoretical and applied practice by examining the influence of mental and physical fatigue on DM in intermediate soccer players and to identify the impact on underpinning mechanisms.

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# Effect of soccer specific balance training on agility and vertical jump in young soccer players

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## Introduction

Change of direction speed and vertical jump are crucial to determine the performance in soccer. It is significant to keep body parts in balance during running, especially in the change of direction. Therefore, the purpose of this study is to investigate effects of 6 weeks soccer specific balance training on agility and vertical jump performances in young soccer players.

## Methods

Thirty two elite young soccer players participated this study. Participants were divided into two groups, a balance training group (n=16) and a control group (n=16). The balance training group performed in a six weeks balance training program and the control group did not perform any balance training schedule. All participants performed a zig-zag agility test, a dynamic balance test and a vertical jumping test before and after the training. The balance training group underwent the balance training programme lasting six weeks (40 minutes three times a week) and continued to carry out their routine soccer training during the study. The training programme consisted of one-leg and double-leg static and dynamic balance drills. The demands and duration of those exercises increased progressively. The control group continued to carry out their football training during the study.

## Results & Discussion

The result of this study indicated that soccer specific balance training affects dynamic balance, agility and vertical jump performance between pre and post tests for intervention group ( $p < 0.05$ ). However there were not significant differences in agility and vertical jump performance in control group ( $p > 0.05$ ).

## Conclusion

In the consequence of this study, it has been concluded that balance training lasting six weeks not only improves balance performance but also promotes the performance of agility and vertical jump ( $p < 0.05$ ). For this reason, it has been suggested that soccer trainers could reinforce both agility and the progress of strength with balance training.

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# Effect of Ankle Rigidity on Kick Speed

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## Introduction

Plantar flexion during kick impact is considered important in kicking (e.g, Nunome et al., 2006). However, while some authors have found that a more rigid ankle has been associated with greater resultant ball speed (e.g. Sterzing et al, 2008, Ball et al. 2010), Nunome et al. (2012) reported that the kicker with the greatest ball speed in that testing cohort also exhibited the least rigid ankle. The aim of this study was to examine the effects of different ankle joint rigidity on ball speed using a mechanical leg system

## Methods

A mechanical kicking limb with mass and length characteristics based on an average football player's lower leg and foot, articulating at the knee and with a mechanism that allowed for systematically altering ankle rigidity was developed and validated (Peacock et al., in press). As the shape of the impacting object influences impact characteristics a human foot was scanned and printed to ensure ecologically valid impact.

The leg kicked a football 10 times maintaining the same foot speed and ball-foot impact location and using a range of ankle tensions. Three reflective markers on the ball and the foot were tracked (4000 Hz) through foot to ball contact, smoothed (280 Hz) and used to calculate ankle angle motion. Foot speed was measured using the five frames immediately before ball contact while ball speed was measured using the five frames immediately after the ball left the boot.

## Results and Discussion

Ankle angle changes during impact correlated with ankle rigidity settings ( $r = -0.98$ ) indicating as rigidity increased, ankle range of motion decreased. Foot to ball speed ratios (ranging from 1.25 to 1.36) showed a positive correlation with ankle rigidity ( $r = 0.91$ ) indicating a more rigid ankle was associated with a more efficient impact and greater ball speed. These ball speeds ranged from 20 m/s for the least rigid ankle setting to 21.6 m/s for the most rigid setting clearly indicating a performance difference. Further, as the most rigid setting still resulted in an ankle range of 10 degrees, and that lower values have been reported for human testing in the literature (e.g. 4-6 degrees, Ball et al, 2010), this gain is likely to be greater. Post-hoc testing using a completely rigid ankle (i.e. locked into place) confirmed this (Ball speed = 23.5 m/s, foot to ball speed ratio = 1.44).

## Conclusion

A more rigid ankle will increase ball speed during kicking for the same foot speed. To develop greater kick ball speed, strength work around the ankle and the technical cue of locking the ankle out may be useful.

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# Numerical configuration could change the behavior of youth players in different in small-sided and conditioning games?

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## Introduction

Small-sided and conditioned games have been used for assessment and training of young players' (Silva et al., 2014). With the intent of understanding the behaviour of U14 soccer players of a Portuguese team, namely in games under different numerical configuration, this study compares the number of passes made and received, the maximal velocity, distances covered, acceleration and deceleration, all over three different types of small-sided and conditioned games.

## Methods

The sample comprised fifteen U14 Portuguese soccer players. Were taken into consideration ethical procedures accordingly with the ethical council of the University of Coimbra and Helsinki treaty (2013) for Human research.

Three games, with eight minutes each and with different configurations (numerical equality – GK+6x6+GK; numerical superiority – GK+6x6+GK with an offensive joker; numerical inferiority – GK+6x6+GK with a defensive joker), were carried out. Coaches were encouraged to provide feedbacks to the players.

The displacement, velocity, acceleration and deceleration of players were evaluated using a GPS-based solution (18 Hz, SPI HPU, GPSports®, Canberra, ACT, Australia). The heart rate was measured with Polar® (T34, Finland). Software Team AMS, version R1 2015.6, was adopted to upload and assess the data.

A descriptive analysis was performed to obtain average, standard deviation and analysis of variance with ANOVA and Tukey's posthoc.

## Results & Discussion

Statistically significant differences were found in the number of passes between the configuration GK+6x6+GK and GK+6x6+GK with an offensive joker ( $p = 0,011$ ) and also between GK+6x6+GK and GK+6x6+GK with a defensive joker ( $p = 0,022$ ). Travelled distance ( $997.96 \text{ m} \pm 210.80 \text{ m}$ ) without joker yielded a higher absolute value than the games with joker (offensive –  $856.81 \text{ m} \pm 198.21 \text{ m}$ ; defensive –  $885.26 \text{ m} \pm 144.94 \text{ m}$ ).

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# Street soccer as a health-enhancing activity

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## Introduction

Street soccer (3v3) on small pitches surrounded with boards has been shown to elicit higher heart rate, similar blood lactate response, but lower external load than observed during small-sided games without boards or small sided games on larger pitches (Randers et al., 2015). Several studies have shown positive health effects of small-sided soccer games for untrained (Krustrup et al., 2010), thus the aim was to investigate the health effects of 12 weeks of street football played on small pitches surrounded with boards.

## Methods

24 untrained subjects were recruited and randomized into either a street soccer group (SG, n=12) playing street soccer on a small pitch surrounded with boards 1.5±0.6 times per week for 12 weeks or into a control group (CG, n=12) continuing an inactive life-style. 10 subjects in each group completed the pre- and post tests measuring resting HR, blood pressure, a DXA-scan, incremental VO<sub>2</sub>max test, Yo-Yo IE2 and postural balance. Two-way ANOVA was applied to evaluate possible timeXgroup changes. Data are presented as means±SD.

## Results & Discussion

Mean HR during street soccer training was 85.7±5.4% of individual HR<sub>max</sub>.

After the training period no change was observed in systolic (P=0.581, SG: 118±6 vs. 119±10 mmHg, CG: 115±10 vs. 114±7 mmHg) or diastolic blood pressure (P=0.357, SG: 68±6 vs. 68±6 mmHg, CG: 65±9 vs. 66±6 mmHg) or resting HR (P=0.765, SG: 58±12 vs. 56±7 bpm, CG: 59±9 vs. 58±9 bpm). VO<sub>2</sub>max did not change (P=0.976, SG: 41.6±6.1 vs. 42.7±7.2 ml/min/kg, CG: 38.9±6.5 vs. 40.0±5.8 ml/min/kg), but blood lactate was lowered during walking (P=0.018, SG: 1.9±0.9 vs. 1.2±0.4 mmol/l, P< 0.001, CG: 1.4±0.4 vs. 1.3±0.4 mmol/l, P=0.571) and running at 8 km/h (P=0.015, 4.5±2.5 vs. 2.5±1.3 mmol/l, P< 0.001, CG: 3.7±1.4 vs. 3.2±1.6 mmol/l, P=0.199)

No change was found in total mass (P=0.478, SG: 93.0±14.4 vs. 92.2±14.0 kg, CG: 85.2±19.7 vs. 85.1±19.3 kg) or fat percentage (P=0.151, SG: 29.8±7.2 vs. 28.4±7.6%, CG: 28.4±8.2 vs. 28.6±8.0%). Postural balance (P=0.421, SG: 15±10 vs. 14±9 falls, CG: 12±5 vs. 9±4 falls) and performance in Yo-Yo IE2 (P=0.160, SG: 618±243 vs. 769±348 m, CG: 380±75 vs. 440±104 m) did not change.

## Conclusion

Although intensity was high during street soccer on pitches surrounded by boards, we did not find any changes in systolic or diastolic blood pressure, resting HR, VO<sub>2</sub>max, total body mass, fat percentage, postural balance or intermittent work capacity. These findings are in contrast to previous findings using small-sided soccer as training intervention (Krustrup et al., 2010). A lower blood lactate concentration during submaximal work indicated an improved aerobic capacity.

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# Perceived Effort, Defensive Tactical Performance and Visual search behavior in soccer players during small-sided and conditioned games

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## Introduction

Perceptual-cognitive skills are considered essential requirements for decision making performance in soccer players (Williams et al., 2011). Among these skills, the visual search behavior allows players to identify which clues are relevant to act properly all over the field (Casanova et al., 2013). The aim of the present study was to verify the association between perceived exertion, tactical performance and visual search behavior in soccer players during small-sided and conditioned games (SSCG).

## Methods

Four amateur soccer players ( $22.2 \pm 2.4$  yrs) were evaluated. The field tests consisted in 2 vs. 1+GK SSCG (27x20m) tasks, in two moments of 1min. and 40seg. The standardization of the field measures used in the SSCG was based on the number of players' proportion (Hughes, 1994). Each field area was determined by calculating the game space ratio used by soccer players according to the maximum length and width dimensions, established by the International Football Association Board. The Rate Scale Mental Effort (RSME) was used to evaluate mental effort of the task. The scale ranges from 0 to 150 with three verbal anchors corresponding to 0 (not at all effortful), 75 (moderately effortful), and 150 (very effortful). Rated Perceived Exertion was obtained by using the Borg's Scale, in which anchors from 6 (no exertion) to 20 (maximum exertion). The visual search data were recorded by using a Tobii pro 2 eye-movement registration system. The visual search variables were defined as: percentage number of visual fixation locations (i.e., ball, head, trunk, hip, leg with ball, leg without ball, space of the player in possession of the ball, space, opponent, undefined). To analysis tactical performance all tests were recorded in video for further tactical performance assessment based on defensive soccer tactical core (Teoldo et al., 2009). We performed Pearson correlate test in order to verify the association between RSME, BORG, Tactical Performance and Visual Search Behavior.

## Results & Discussion

There was found negative association between RSME and Percentage Number fixations on the Player in possession of the ball, during the first moment ( $r = -.978$ ;  $p = .022$ ). Also, negative correlation was observed between BORG and Percentage Number fixation on the Hip of the player in possession of the ball ( $r = -.984$ ;  $p = .016$ ) and a positive correlation was found between Tac-

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tical Performance and Percentage Number fixation on the Hip of the player in possession of the ball ( $r = .953$ ;  $p = .047$ ), during the second moment.

### **Conclusion**

The perceived exertion and tactical performances were associated with visual search behavior.

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# Effect of soccer training on bone mass in young players in normal weight and overweight in pre-pubertal stage

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## Introduction

Obesity has become one of the most important threats to human health worldwide. Acquiring a high bone mass during childhood and adolescence is a key determinant of adult skeletal health (Rizzoli et al., 2010) and it may decrease the risk of osteoporotic fractures by 50% (Marshall et al., 1996). Although genetics plays an important role on bone mass, environmental and lifestyle factors such as physical activity (soccer) and nutrition, i.e., calcium intake have important osteogenic effects (Garcia-Marco et al., 2012). The purpose of this study is to assess the relationship between bone mass and body composition parameters (Fat and lean mass) in young soccer players in normal weight and overweight compared to control subjects in pre-pubertal stage.

## Methods

Methods participants were 163 pre-pubertal boys divided in 4 groups (53 soccer players in normal weight (SNW); 31 soccer players in overweight (SOW); 49 controls in normal weight (CNW) and 30 controls in overweight (COW),  $13 \pm 0.5$  years). The body composition, the lean and the fat mass were measured by dual energy X-ray absorptiometry (DEXA) with different bone variables (whole body, lower limbs, lumbar spine, and femoral neck). The bone parameters were analyzed by linear regression, and differences between weight status were analyzed by ANCOVA.

## Results & Discussion

The two-way ANOVA revealed significant main effects of Training ( $p < 0.01$ ), and Overweight ( $p < 0.01$ ) for young soccer players and controls in normal weight and overweight on BMD parameters. A significant ( $F = 10.81$ ;  $p < 0.01$ ) Training  $\times$  Overweight interaction only on BMD femoral neck. Post hoc results showed that soccer players present higher BMD femoral neck than controls both in the normal weight ( $p < 0.01$ ) and the overweight ( $p < 0.05$ ). The post hoc analysis in overweight factor also demonstrated that (SOW) had elevated values for whole body BMD, BMC ( $p < 0.05$ ); lower limbs BMD ( $p < 0.001$ ), BMC ( $p < 0.05$ ) and lumbar spine BMD ( $p < 0.01$ ), BMC ( $p < 0.05$ ) in comparison to (SNW). However, femoral neck BMD, BMC was not different between the two groups. Moreover, when the Training was used as co-variable, the (SNW) had higher whole body BMD ( $p < 0.01$ ), BMC ( $p < 0.05$ ); lower limbs BMD ( $p < 0.01$ ), BMC ( $p < 0.05$ ) and femoral neck BMD, BMC ( $p < 0.01$ ) compared to (CNW). Whereas, the femoral neck BMD, BMC and the lumbar spine BMD, BMC values were higher for the (SOW) compared to the (COW).

When measurements were adjusted for total body lean mass, the (SOW) had lower whole-body BMD ( $p < 0.05$ ), femoral neck ( $p < 0.01$ ) and lower limbs ( $p < 0.01$ ) than the (COW). When

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measurements were adjusted for total body fat mass, (SOW) had higher lumbar spine BMD ( $p < 0.05$ ), BMC ( $p < 0.001$ ) and femoral neck BMD, BMC ( $p < 0.05$ ) than (COW).

Tb LM was highly and positively associated with all BMD related variables in both the (SNW) and (CNW) (corr, 0.31 to 0.80;  $p < 0.001$ ). Likewise, Tb FM was positively correlated with all BMD variables in the same groups (corr, 0.30 to 0.59;  $p < 0.05$ ;  $p < 0.001$ ). In contrast, Tb FM was positively associated with the femoral neck BMC (corr, 0.56;  $p < 0.001$ ), only in (SNW). However, no statistical correlation was observed between BMD and BMC variables *vs.* Tb LM and Tb FM among the (SOW) and (COW).

### **Conclusion**

We conclude that soccer players in overweight do not have lower whole-body and lower limbs (BMD, BMC) when compared with leaner soccer players, even when adjusted for LM, and FM. Our results demonstrate more important associations between lean mass and bone parameters BMD and BMC than fat mass. Thus, these findings support the recommendation that emphasis on soccer and lean body mass in young players is more important than the exclusive concentration on fatness.

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# Magnus force of a spinning soccer ball in free flight

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## Introduction

The flight trajectory of a soccer ball is greatly affected by the ball's aerodynamic properties. Thus, determination of these aerodynamic properties is extremely important for both ball design and soccer techniques. In this study, we used a technologically advanced optical three-dimensional (3D) motion capture system and a conventional 32-panel soccer ball with a reflective surface to relate the lift force and spin parameters of a spinning soccer ball in a free flight. We also developed a 32-panel soccer ball model with a rear support capable of spinning to measure the lift force during wind tunnel testing and to subsequently evaluate the validity and reliability of the free flight test measurements.

## Methods

A conventional 32-panel soccer ball was developed with an infrared reflective sheet as its surface. The ball weighed 430 g and had a diameter of 220 mm. Five college soccer players possessing relatively sophisticated kicking skills and capable of differentiating curve kicks participated in this study. Each kick was filmed using 12 optical motion cameras in the 3D motion capture system (VICON MX, Oxford Metrics) capable of capturing 500 fps and one high-speed video camera (Photron Ultima; Photron, Ltd.) with a 1000 Hz frame rate. Coordinates of the ball were recorded every 0.1 s during mid-flight when the ball trajectory was relatively stable.

## Results & Discussion

Wind tunnel testing of the rear-supported soccer ball model revealed that the lift coefficient ( $Cl$ ) increased as the spin parameter ( $Sp$ ) increased for a  $Cl$  of 0.1–0.3, an  $Sp$  of 0.1–0.4, and a Reynolds number ( $Re$ ) of  $1.88 \times 10^5$ – $4.34 \times 10^5$ . In a prior wind tunnel test of a bottom-supported ball model, Passmore et al. (2011) reported that the  $Cl$  was greatly dependent on the  $Sp$  and  $Re$  for a  $Cl$  of 0.05–0.25, an  $Sp$  of 0.05–0.3, and an  $Re$  of  $2.74 \times 10^5$ – $4.56 \times 10^5$ . In a prior wind tunnel test of a rear-supported 14-panel ball model, Kray et al. (2014) reported that the  $Cl$  increased as the  $Sp$  increased for a  $Cl$  of 0.05–0.3, an  $Sp$  of 0.05–0.3, and an  $Re$  of  $3.42 \times 10^5$ – $4.62 \times 10^5$ . A comparison of the logarithmic regression curves for the free flight lift forces ( $Cl = 0.0642 \ln(Sp) + 3427$ ) and the wind tunnel lift forces indicated slightly higher free flight lift forces. One possible explanation for the lower wind tunnel lift forces is the trailing vortex interference caused by the supporting sting; in free flight, a clearer vortex is formed and the circulation area is enlarged.

## Conclusion

In this study, we used an optical 3D motion capture system and a conventional 32-panel soccer ball with a reflective surface to measure the lift (Magnus) force of a spinning soccer ball in a free flight. A comparison of the free flight and wind tunnel lift forces indicated slightly higher free flight lift forces. Test results also revealed a logarithmic relationship between the lift force coefficient and spin parameter.

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# The effects of structural and technical constraints on the profiles of soccer-based passing drill exercises: suggestions for periodization planning and skill development

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## Introduction

The aim of this study was to profile the physiological, time-motion and technical responses induced by passing drills formats commonly used in soccer training, and to analyze the influences elicited by specific constraints in terms of involved players and technical requirements.

## Methods

According to a *post-only cross-over design*, twenty-two elite male soccer players (age  $18.3 \pm 1.1$  years, height  $179.4 \pm 2.3$  cm, body mass  $74.3 \pm 4.1$  kg, maximal HR  $202.5 \pm 2.9$  beats min<sup>-1</sup>, and percent of body fat  $8.9 \pm 1.4\%$ ), participating at the Uefa Youth League during the Season 2015-16, performed 5 sets of intermittent passing drill bouts lasting 3 min interspersed by 1 min of passive recovery. The experimental protocols consisted in either a Diamond-shape or Y-shape passing drill formats in which the number of players (i.e. 8 vs 6) and technical demands (i.e. single vs double pass) were manipulated. The physiological responses (Heart rate (HR) and rating of perceived exertion (RPE)), external load traits (GPS related measures) and technical performances (pass speed and accuracy) were analyzed.

## Results & Discussion

The results highlighted specific profiles due to the experimental protocols: 1) higher number of involved players led to greater internal and external load responses and better technical scores; 2) additional technical requirements as for the double-pass task determined lower internal load responses, greater amount of acceleration and deceleration actions but *trivial or unclear* effects on technical performances.

## Conclusion

In light of this outcomes, coaches could schedule passing drills formats with variable number of players and technical demands within appropriate long-term programs addressing both physical adaptations and skills development.

# Effects of stretching modes on repeat-sprint-ability and changes of direction in young soccer players

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## Introduction

Repeated sprint ability (RSA) is considered a relevant fitness component in team sports. Many studies have shown decreased performance in repeated sprints due to static stretching compared to dynamic heating (McMillian et al., 2006), others have not found any effect (Little and Williams, 2006). Thus, we aimed to examine the effects of static and dynamic stretching during recovery between sets in football players.

## Methods

15 young footballers participated in our study (age:  $14.06 \pm 0.03$  years, Weight:  $47.80 \pm 2.07$  kg and height:  $164.53 \pm 5.68$  cm). Participants performed a standardized warm-up followed by either RSA or the Change of Direction test (COD) three times each. Between sets (4min), one of the following conditions was applied: without stretching (CON) or static stretching (SS) or dynamic stretching (DS). Static stretching is composed of five stretches, each targeting the muscles of the lower limbs. The same muscle groups are stressed by dynamic Stretching. The subjects performed the same movements, but they took two steps and then stretched one leg over 10 m.

## Results & Discussion

Total time (RSATT) using static or dynamic stretching is significantly better than without stretching. RSATT at the 2nd set in SS was significantly slower compared to the control test without stretching ( $P = 0.031$ ). The first RSApeak was noted during the first set in SS and DS were significantly ( $p < 0.001$ ) lower than those noted at the first set. RSA values recorded at 3rd set is significantly longer compared to the 1st set during CON and SS tests. Our results disagree with Beckett et al. (2009) who found lower performances of RSA-TT at the 2nd set compared to the 1st set for SS type. COD test performed with SS and DS were significantly ( $p < 0.016$ ) better than CON. No differences between SS and DS in COD performance. First set values was significantly better ( $p < 0.001$ ) than following set for the three recovery modes. For COD, our findings are in concordance with Kokkonen et al. (2007) who showed that chronic SS results to significant improvements in 20 m sprint (1.3%).

## Conclusion

For SS, the best time and first CODpeak are significantly slower in the 2nd and 3rd sets compared to 1st set. In conclusion SS and DS are significantly better than those achieved without stretching.



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# Effect of post potentiating stimuli and recovery on muscular power in soccer players

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## Introduction

Post potentiating activation (PAP) serves to improve muscular performance, potentially enhancing exercise performance (Judelson et al., 2010) by which the force exerted by a muscle is increased due to previous activation. Despite the potential benefits associated with PAP, a number of studies have found no significant performance improvements (Mangus et al., 2006). The aim of this study was to analysis the effect of two types of PAP stimulation and to study the effect of recovery duration on Jump performances.

## Methods

45 healthy soccer players volunteered to participate in the present study. Subjects were randomly assigned in a plyometric group (PG), isometric group (IG) and control group (CG). The first session was devoted to anthropometric measurements and familiarization. In experimental sessions, after 3 min of standardized warm-up, subjects performed isometric /or plyometric or control intervention. Subjects performed five jump test (5JT) and Squat jump test (SJT) after PAP intervention at many different recovery periods (i.e., 5min, 10min and 15min). Each test was performed in an independent session.

## Results & Discussion

They were lower at 5, 10, and 15 min for PG and only at 10th ( $p=.002$ ) and 15th min for IG. SJT at 10 min was higher in IG only after 5 min of rest. No significant SJT difference was seen after 5 and 15 min. An enhancement in jumping performance was observed immediately after a set of maximum isometric contractions or after a set of high intensity dynamic exercises (Gourgoulis et al., 2003). For PG, 15th min SJT was significantly higher than 5 min and 10 min. concerning 5JT, significant difference was found in both groups at 15 min compared to 5 min. The best performance was measured after 15 min in PG compared to IG. Similar performances among control and experimental trials indicate that heavy-load squats known to stimulate PAP in competitive athletes (Yetter et al., 2008). But, others studies fail to induce PAP in heavy-load squats induce PAP (Jo et al., 2010).

## Conclusion

Our isometric and pliometric exercises lead to improve jump performances without using loads. Performance increased using pliometric exercise and remained higher after 15 min of rest than rest values compared to isometric intervention. Reduction of muscle at potentiated state can

be seen in the isometric method wherein jump performances decreased at 15 min. It can be seen that fatigue or dissipation of PAP may have contributed to decreasing performance across time for Isometric exercises.

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# The Monopolization of Soccer in the U.S.

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## Introduction

The United States hasn't reached the world cup semi-finals in the world's most popular team sport, soccer, in the past 86 years of international competition. The U.S. is the most olympic medals winning country in history. The aim of this study is to understand the role the United States Soccer Federation (USSF) has played in this failure, particularly in the last 30 years.

## Methods

First, we investigate the history and legality of the establishment of the latest professional soccer league structure in the U.S and it's relationship with the sport's governing body. Taking a look at the economic and cultural impact this has had on the domestic market for professional players, coaches, and youth teams. We estimate the total cost for; a coach to achieve an "A" license and for a youth player to fully participate in U.S. youth soccer's development system, ages 6-18. We'll compare this with the childhood socioeconomic statuses of the top 50 players throughout world history.

## Results & Discussion

USSF and Major League Soccer (MLS) offer FIFA a uniquely powerful market position within the closed league system in the U.S. Allowing for the suppression of wages and rights for it's employees, as well as the systematic denial of competition at every level. In 2014, MLS ranked 22nd globally in average player salaries for pro soccer leagues. A mean skewed upward by outlier "designated player" salaries. In 2016, the top 20 player salaries in MLS made up nearly half of all the league's wages. As for coaches, to achieve an "A" license, one would need to spend an estimated \$9240, committing at least 268 hours over a minimum of 6 years, in courses alone. The average yearly cost to fully participate in U.S. Youth Soccer's Olympic Development Program (ODP) and MLS alliance competitive youth club system, ages 6-18 is, \$3277. Of the top 50 players in world history, 80% were raised in poverty or the lower-middle income class.

## Conclusion

The professional league's single-entity structure, leaves MLS investor-operators with little financial incentive to develop local youth talent, because any profits from the sales of players, via transfer fees, are split up amongst investors. USSF's financial relationship with MLS, via its marketing subsidiary (SUM), compromises the sport's governing body when protecting the country against anti-competitive policies. Leading to increased costs throughout youth soccer that neglect youth players & coaches with the most potential for competitive success.

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# Similarity of teammates' movement patterns in football matches against different opponents

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## Introduction

Team Sports refer to games played between two opposing teams. The players interact directly and concurrently to achieve an objective that involves teammates facilitating the movement of a ball, in order to score and to prevent the opposition from scoring. There are irreproducible multi-interactions of team and individual actions - a "coordination dynamics", according to Kelso (1995) - deeply intent on scoring more than the opponents. In this sense, sport teams are composed of different interacting individuals who develop cooperative relations to achieve successful performance outcomes (Sampaio & Maças, 2012). This work aims to explore the interactions from the players of a particular team against two different opponents, in two consecutive matches.

## Methods

Two full matches from the German Bundesliga 2015-2016 season were analysed. The X and Y positional coordinates of all players (24 in total) and the ball were collected with TRACAB Image Tracking System™ sampling at 25 Hz. For each intra- and inter-team pair, interactions were quantified based on highly correlated trajectory segments. Interactions in the match were calculated with directional correlation with time delay (Nagy et al., 2010) for each pair of teammates and opponents using a 6-second-long time windows. The momentary interactions of each pair were summed for intervals in a range from a minute to the whole duration of the match.

## Results & Discussion

Results reveal a consistent individual behaviour between matches with respect to opponents: from the 11 players, 9 players assume the same profile of interactions across the two matches.

## Conclusion

Football players assumed similar behaviour when interacting within both teammates and opponents in consecutive matches. Results shows that the method has the possibility to quantify characteristic behaviour of players and player's roles. This has potential application on players' (development, evaluation, etc.) and in teams' (tactical development, selecting team composition, etc.).

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# Heart rate monitoring definite performances and physical state during competitive period in soccer players

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## Introduction

Various methods are used to monitor football players during training with the overall goal of detecting symptoms of fatigue, so that the training volume and/or rest and recovery can be adjusted accordingly. Heart rate recovery (HRR) after exercise has been identified as a useful monitoring tool. It has been shown to be faster in trained subjects than in non-trained ones and differs according to changes in training status (Lambert et al. 2011). Thus, the aim of our study was to analyze the interest of the HRR as an indicator of the autonomic nervous system in the follow-up of the training and the footballers' performance during the period of competition.

## Methods

Twenty-one players were voluntarily participated to our study (age:  $18.5 \pm 0.5$  years, height:  $179.9 \pm 5.8$  cm, weight:  $73.1 \pm 6.2$  kg). They were randomly divided to: trained group (TG, n=13) and control group (CG, n=8). All participants were soccer players in sports association of Kairouan team (Tunisian first league). Study lasted 12 weeks during the competition period (January to March). The HIMS test (heart rate interval monitoring system test) took place every Tuesday in the morning. Fatigue index was evaluated before each session with Hooper questionnaire (Hooper et al. 1995). Then, The work-load as well as the fatigue index were respectively quantified by the RPE (rating scale of perceived Exertion) method after each training session. The subjects' performance is measured once a month using an intermittent yoyo test.

## Results & Discussion

There is a significant relationship between the change in HRR and the change in work-load ( $p < 0.05$ ;  $R^2 = 0.79$ ), and the Index Hooper ( $p < 0.05$ ;  $R^2 = 0.82$ ) and performance in yoyo intermittent recovery test ( $p < 0.05$ ;  $R^2 = 0.83$ ). Significant differences were observed in the HRR values between CG and TG ( $p < 0.05$ ). HRR varies according to whether subjects are trained or not.

## Conclusion

We can identify the role of HRR to monitor players' adaptation and to assess possible changes in fatigue and /or fitness level. Previous studies showed a decrease in HRR by increasing training load compared to keeping the same training load. Our study agrees with literature showing a close relationship between the HRR and athletes' performances (Lambert et al. 2009). The decrease in work-load applied to footballers is related to the decrease of Hooper index and to the increase of heart rate recovery. There was a significant and large correlation between changes in HRR and yoyo test performances. Indeed, Yamamoto et al. (2001) associated the increase of HRR with the increase of parasympathetic activity after 7 weeks of endurance training. HRR is a training monitoring tool. This enables any coach to manage training processes simply

and effectively and to get information on the state of the athletes' form.

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# Regional differences in anthropometric and performance variables in talented male football players in New Zealand

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## Introduction

Talent identification (TID) is a crucial process for national team selection and therefore possible progressive development for national youth football players. Due to geographical circumstances that may also lead to consequences in player development and selection, the purpose of the study was to investigate whether anthropometric and/or performance differences exists between players in different National Talent Centers in New Zealand.

## Methods

Talented youth field football players (N=608) from three national talent centers (NTC) in New Zealand (Auckland, Christchurch and Wellington) were tested for age, height, body mass, estimated age at peak-height-velocity (APHV), YoYo Intermittent Recovery Test Level 1 (YYIRT1), 10- and 20-meter sprint (10M, 20M) and horizontal jump (HJ) on four different occasions, each separated by approx. 6 month. An ANOVA with Bonferoni Post-hoc analysis was used to investigate differences between NTCs for each testing occasion.

## Results & Discussion

Depending on testing occasion there were differences in anthropometric and/or performance data between NTCs. Over all variables and testing occasions, 27 significant differences were observed between NTC with players from the Auckland NTC presented significant differences 25 times. 10M sprint time was the most prominent performance variable being different between NTCs on three different testing occasions. APHV was the second most prominent variable being different two times over four testing occasions.

## Conclusion

Depending on testing occasion and variables there were differences between NTCs in New Zealand. Most differences were observed between the Auckland and Wellington NTC, followed by Auckland and Christchurch NTC.

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# Measured versus estimated $\dot{V}O_2$ consumption during intermittent running

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We have previously shown that, monitoring the players' speed by GPS in soccer, and on the bases of the biomechanical equivalence between accelerated/decelerated running on flat terrain and uphill/downhill running at constant speed, it is possible to estimate metabolic power (MP), as given by the product of energy cost of running (EC) and speed. Furthermore, assuming a mono-exponential  $\dot{V}O_2$  kinetics, it becomes possible to estimate the time course of actual  $\dot{V}O_2$  from that of MP, on the basis of the player's  $\dot{V}O_{2max}$  (Patent n. 0001425417). We implemented this approach into GPS devices monitoring the players' speed at 20 Hz (GPEXE ©), thus obtaining the time course of MP and  $\dot{V}O_2$ . However, several recently published studies have criticised the above mentioned approach mainly because the energetic parameters estimated from GPS data do not match those obtained by means of portable metabolic carts. This disagreement may be due, at least in part, to the fact that the approach described so far can be meaningfully applied to running; however during a soccer match several walking episodes are interspersed among running spells. Therefore, we have recently implemented into the system a set of algorithms to take into account also the energetics of the walking phases, based on similar assumptions as for running. On these bases we have determined the overall energy expenditure, as obtained by the time integral of: i) MP and of  $\dot{V}O_2$  ii) as estimated from MP or iii) directly determined by a portable metabolic cart. Data were collected during constant speed walking at  $4.5 \text{ km}\cdot\text{h}^{-1}$  (W) followed by running at  $10 \text{ km}\cdot\text{h}^{-1}$  (R) and by 3 series of ten 50 metres runs in 10 seconds, each followed by a 20 s pause. Series 1 (S0): after every run the subjects continued running in the same sense; Series 2 (S90): after every run the subjects resumed running after a 90 deg turn to the right or left; Series 3 (S180): after every run the subject resumed running after a 180 deg turn. Five min pauses were interspersed between R, S0, S90 and S180. Preliminary results obtained on 4 subjects show that, if the progressive increase of resting  $\dot{V}O_2$  due to exercise is duly considered, the overall energy expenditure difference between estimated and measured  $\dot{V}O_2$ , at the end of the experimental period (47 min), ranges from + 3.7 to - 12.5 %. Part of this difference is probably due to individual differences in running technique and/or to changes in the  $\dot{V}O_2$  kinetics, such as a progressively increasing role of the slow component, with the exercise time. In conclusion, the use of GPEXE © is a powerful tool for estimating the energetic characteristics of soccer and for selecting appropriate training strategies.

# Soccer specific zig-zag run performance between natural and artificial turfs: a pilot study

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## Introduction

Recently, the use of artificial turf for soccer has become very popular. Although several cohort studies reported no clear differences for injury risk between artificial turfs and natural turf (Fuller et al., 2007a; 2007b), soccer players still had an overall negative impression of playing on artificial turfs and felt they required greater physical effort (Andersson et al, 2008). There is a possibility that some specific property of artificial turfs might be linked to that impression from players. The present study was designed to examine the effect of surface differences (natural and artificial turfs) on soccer specific zig-zag run performance and foot inversion/eversion motion during cutting.

## Methods

Five experienced university-level soccer players (height=171.5±4.5 cm; weight=65.0±4.0 kg) volunteered to participate in the present study. They were asked to complete a zig-zag run (approximately 32 m distance including 10 turns) on four different surfaces: natural turf (NT), two types of artificial turf with a shock pad (ATP1 and ATP2) and artificial turf without a shock pad (AT). All the players used the same type of a gyro sensor instrumented soccer boot with different sizes to measure foot inversion/eversion. Shock absorbency of each surface was also measured according to the procedure approved by FIFA Quality Programme for Football Turf. For each player, the running time was measured twice for each surface (8 runs in total) using a pair of photocells.

## Results & Discussion

The shortest running time was recorded on AT, followed by NT (+0.04s), ATP1 (+0.26s) and ATP2 (+0.30s). This ranking of the time corresponded with that of surface hardness (AT> NT> ATP1> ATP2), indicating that softer surface tended to restrain player's zig-zag run performance. This agrees with the findings of the study by Andersson et al (2008) who reported that soccer players felt greater physical efforts were required when they played on artificial turfs. From the comparison of the foot inversion angular velocities between NT and the three artificial turfs (ATP1, ATP2, AT), a clear trend was observed for the right foot motion during the first left turn. In most trials, players exhibited a higher foot inversion angular velocity when they ran on the artificial turfs (ATP1=7/10 cases; ATP2=8/10 cases; AT=9/10 cases). Different surface friction and deformability might account for it.

## Conclusion

Our results highlighted two trends: 1) softer artificial turf (typically with a shock pad) likely restrain zig-zag run performance and 2) foot inversion angular velocity appears to be greater when players cut on artificial turfs.

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# Effect of small sided football games on the efficiency of ball control and passing compared with isolated actions: high vs low contextual interference

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## Introduction

To control and pass the ball are fundamental and basic technical-tactical actions for an efficient communication between teammates during the game. These skills are essential contents in the teaching-learning process aimed to provide the young football player with a broad technical repertoire and to increase his motor experience (Ruiz & Arruza, 2005). We addressed these fundamental contents through a High Contextual Interference Practice. After Holmberg (2009), Contextual Interference is the relative amount of interference created by integrating two or more tasks into a particular aspect of a practice session, as is the case during Small Sided Football Games (SSFG). This approach differs from the conventional practice of only one task based on isolated actions with low contextual interference.

## Methods

Twenty football players were randomly assigned into two groups (mean 16 years, 56.7 kg, 1.65m). The experimental group practiced SSFG with High Contextual Interference (HCI Group) 2 sessions per week during 8 weeks. The control group practiced isolated actions under Low Contextual Interference conditions (LCI Group). The game performance of the players was assessed pre- and post-intervention with the 2 vs 2 test (Vegas, 2006).

## Results & Discussion

At baseline, in the pre-test, the HCI group made 83.1% correct controls and 64.6% correct passes and the LCI Group made 81.9% correct controls and 60.3% correct passes ( $p = 0.04$  and  $p = 0.23$  respectively). In the post-test, the HCI Group made 91.5 % correct controls and 76.2% correct pass while the LCI group made 81.9 % correct controls and 71.9% ( $P = 0.16$  for passes and  $X^2 = 11.61$ ,  $P < 0.001$  for ball control). The results showed statistical differences between groups in the post-test for the variable ball control. This is consistent with other studies such as Arias & Jiménez (2004), Ruiz & Ruiz (2014) and Sánchez et al (2014), which support the idea of SSFG as HCI practice of the football technical skills.

## Conclusion

The results support the idea of SSFG having the characteristics proposed by some authors to create situations of high contextual interference.

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# How the quality of tactical actions is related to high-intensity running?

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## Introduction

The physical demands of soccer are increasing over time (Di Salvo et al., 2007). This trend leads to higher intensity of play with respect to the distances covered by players, specially in high-intensity running, which is an useful indicator of physical performance (Krustrup et al., 2003). This indicator is related to tactical demands, which is essential to achieve high levels of performance (Garganta, 2001). This indicates the need of research to better understand how tactics and intensity running interact. Thus, the aim of this study is to verify the correlation between the quality of tactical actions and the distance covered in different intensity running.

## Methods

The sample was comprised of twenty-one U-21 Brazilian soccer players ( $18.6 \pm 0.7$  yrs) from a first division club. The System of Tactical Assessment in Soccer (FUT-SAT) was used to assess the tactical actions performed by the players according to the ten core tactical principles of soccer (Teoldo et al., 2011). Data regarding the quality of tactical actions was obtained through the calculation of the percentage of success of the actions performed during the field test. Intensity running data was obtained with GPSports SPI HPU, and was coded into the following categories: standing ( $< .7$  km.h<sup>-1</sup>) walking ( $< 7.1$  km.h<sup>-1</sup>), jogging (7.2–14.3 km.h<sup>-1</sup>), running (14.4–19.7 km.h<sup>-1</sup>), high-speed running (19.8–25.1 km.h<sup>-1</sup>) and sprinting ( $> 25.1$  km.h<sup>-1</sup>). Pearson correlation coefficient ( $r$ ) was performed to verify correlation between the intensity of the distance covered and the quality of tactical actions.

## Results & Discussion

There was a significant relationship between the quality of tactical actions and distances covered in standing ( $r = .67$ ,  $p < .001$ ), jogging ( $r = .58$ ,  $p < .01$ ) and high-speed running ( $r = -.46$ ,  $p < .05$ ). This data showed that higher quality of tactical actions is positively correlated to coverage of longer distances in low-speed running ( $< 14.4$  km.h<sup>-1</sup>), but negatively correlated to high-speed running. It suggests that players who are better able to manage the playing space also optimize the usage of their physical capacity and thus need to cover shorter distances in high-intensity running.

## Conclusion

Our results showed that the quality of tactical actions is positively correlated to distances covered in jogging and standing, but negatively correlated to high-speed running. Thus, players with superior tactical quality have less physical wear in high-intensity running to manage the playing space.

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# Coming back stronger: A case study of an athlete using sport psychology to work through an injury

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In an elite, competitive athletic program, athletes could feel pressure to push through the pain of an injury and choose not to disclose their symptoms in an effort to keep their spot on a team (Heil & Podlog, 2012). This course of action could lead athletes, especially at the developmental level, to hurt themselves more, possibly incurring lasting detrimental effects on their bodies. Competitive developmental athletic programs could therefore benefit from having sport psychology programs and practitioners who can intervene and educate athletes while helping them work through the injury psychologically. This presentation will discuss the case study of one student-athlete recovering from an injury. Over the course of his fall semester, this particular student-athlete prepared for a surgery while training with strength and conditioning coaches to remain in shape. He also participated in the sport psychology program, both through his school and through his academy soccer team, completing online sport psychology workbook chapters and attending group sessions with his team. In particular, he fully engaged in one-on-one consultations in preparation for his surgery. Further, members of the Sport Psychology Staff observed him during reconditioning sessions, remarking on his effort and progress and showing support. Presenters will discuss how to mentally prepare the student-athlete for surgery and recovery, what information can and cannot be shared with coaches, and the structure of the soccer program leading to the student-athlete feeling isolated doing reconditioning away from the team training sessions.



# The professional development of trainer at the French soccer federation: a new theoretical contribution

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## Introduction

This longitudinal case study examines professional development of an expert trainer in soccer within a cultural anthropology research program (Chaliès & Bertone, 2017). The subject of the work is part of the more general problem of vocational training by alternation and the difficulties it poses, both to trainers and trainees (Escalié & Chaliès, 2016). We are interested in a device that is the visit to the club which is a privileged moment of exchange between the trainer and the trainee on the professional activity of the latter. In this type of training situation, the activity of the trainers, considered as experts, is rarely the subject of an in-depth analysis, the focus being more often placed on the development of the novice.

## Methods

This longitudinal case study was conducted within the framework of a research program epistemologically grounded in ‘comprehension’ and not ‘explanation’ (Ogien, 2007). The data collection was based on audio-video recordings of the training sequence conducted by the trainee and observed by the trainer as well as the follow-up interview following the training sequence were carried out. Then the self confrontation (EAC) interviews with both players to access the meanings that actors associate with their experiences during the interview of that or others. The originality of the device is because during its self-confrontation, the trainer could have access to the meanings that the trainee associated with the counseling episode subject to the EAC.

## Results & Discussion

Professional development can be envisaged in two situations: first, if the trainee misinterprets the meaning of the trainer’s action : the trainer’s confrontation of the trainee’s meanings with his activity encourages a development activity, in particular by proposing alternatives and remedies on its own activity. Then, when the actors give the same meaning to the trainer’s action, the verification of this Interpretation agreement encourages the trainer in an activity of development (creative activity) in which the latter seeks to improve the reflection of the trainer trainee.

## Conclusion

Our results show that the professional development of the trainer can be encouraged by a posterior confrontation of the situations experienced and the meanings perceived by the trainee on the activity of the trainer. Self-confrontation interviews on the activity of the trainer and the meanings that the actors attribute on trainer’s activity can encourage a professional development of the trainer. These interview methods can contribute to the ongoing training of trainers.

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# Evidence of disturbed sleep in elite Rugby Sevens players during high training loads

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## Introduction

The aim of this study was to investigate the effects of high training loads on sleep among elite Rugby Sevens players.

## Methods

Nine international Rugby Sevens players participated in this study. During seven weeks, actigraphic sleep assessment was performed on a daily basis to measure sleep (total sleep time, sleep efficiency, fragmentation index). Internal load (session RPE) (1) and external load with GPS-derived running loads (Sensoreverywhere V2, 16Hz (Digital Simulation, Paris, France) were also recorded during the entire pre-season. Magnitude based inference approach and standardized change in the mean were used to quantify true difference between sleep parameters during highest and lowest work load recorded during preseason (2).

## Results & Discussion

Session RPE during high weekly training load were most likely higher compare with low weekly training load (sRPE high=5216 ± 674 vs sRPE low= 1984 ± 711; ES= 1.68 ± 0.59 ; % chances= 100/0/0). High intensity (HI) distance covered during high weekly training load were most likely higher compare with low weekly training load (HI high=3874±440 vs HI low= 644±280 ; ES= 8,13 ± 0.78 ; % chances= 100/0/0). Our preliminary results showed a likely negative effect of high sRPE load on total sleep time (ES= -0.60 ± 0.61 CL90% ; %chances= 2/1/87). Nevertheless no clear effects were found regarding sleep quality. While we compare with high intensity distance covered and low high intensity distance covered, no clear effects were found on sleep quality and quantity.

## Conclusion

High weekly sRPE load could likely impaired sleep quantity but not quality during preseason in elite Rugby Sevens players. To avoid excessive fatigue due to restricted sleep, adaptation in the training schedule during expected high weekly training load in order to promote sleep extension and allow day time napping might be beneficial for recovery and performance (3, 4).

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# Profile and skeletal age of elite U-16 male soccer players who attained professional level in contrast to dropouts and amateur level: a prospective study 1999-2017

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## Introduction

The current study was aimed to examine growth, skeletal maturation and functional capacities of 58 adolescent male soccer players aged 14.0-15.9 years who were selected for the preparation of the national team in the under-16 European Championship. The sample was divided into three groups (dropouts, amateurs, professionals) based on career follow-up.

## Methods

Anthropometry comprised stature, body mass, and fat mass estimated from skinfolds (Slaughter et al., 1988). Functional capacities included standing long jump (Council of Europe, 1988), repeated sprint ability (Bangsbo, 1994) and 20-m shuttle-run (Leger et al., 1988). Skeletal age was assessed from X-Rays of the left hand and wrist using Fels method (Roche et al., 1988). For the initial sample 27 dropped out, 20 attained amateur level and 7 players attained international Senior-A (Portuguese national team) or played in European leagues (including Tottenham, Chelsea, Sevilla, Valencia).

## Results & Discussion

At baseline, differences in skeletal age were not observed. Group differed for stature (elite > amateur and dropout) and elite players were fastest in the sprint (effect size = 0.480), although they attained poor performances in the shuttle run (elite: 95 runs; amateur: 99 runs; dropouts 104 runs). In summary, among the best under-16 soccer players, skeletal age (at late adolescent) is not a prediction of success in long-term soccer career.

## Conclusion

Those players who attained the highest level were taller and faster with no substantial advantages in skeletal age and endurance during adolescent years. This study supports the importance of sport selection based on other factors than body size, biological maturation and performance tests, at least during years of late adolescence.

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# Can a sport-specific decision-making task induce mental fatigue in soccer players?

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## Introduction

Mental fatigue (MF) is described as a psychobiological state characterized by subjective feelings of ‘tiredness’ and ‘lack of energy’ leading to an impairment of cognitive, behavioral and physical performance (Marcora et al., 2009). Most research used artificial and highly demanding cognitive tasks to induce MF in athletes, which might not be equivalent to typical fatigue in their sport. Thus, the aim of the present study was to induce MF via a soccer-specific decision making task and to assess effects on cognitive performance. **Methods**

22 soccer players (SP) completed a decision-making session in the ‘Footbonaut’ (Fb) and a control running condition (C) at intra-individually matched intensities. Fb is a soccer-specific training tool consisting of a 14x14 m field with 72 square targets arranged in 2 rows around the player who is positioned in the middle of the field. SP receive a ball from one of 4 possible directions along with an acoustic signal; concurrently 3 targets are illuminated (2 green, 1 blue). SP have to pass the ball to the green target positioned furthest away from the blue target. SP had to complete this task a total of 400 times (mean time: 30 min). C was a 30 min running task at the individually matched mean heart rate in Footbonaut-Session (F). Cognitive performance was measured via the Determination-Test (DT) before and after each task. Additionally, subjective measures of mental effort (VASME), mental fatigue (VASMF) and motivation (VASMO) were collected via visual analogue scales (VAS). Differences between F and C were analysed using a two-way repeated measures ANOVA.

## Results & Discussion

No differences between F and C were observed for correct (DTcor:  $p=0.85$ ,  $d=0.03$ ), missed (DTmiss:  $p=0.99$ ,  $d=0.00$ ) and wrong (DTwro:  $p=0.07$ ,  $d=-0.41$ ) answers in DT. Perceived VASMF ( $p=0.006$ ,  $d=1.04$ ) and VASME ( $p<0.001$ ,  $d=2.11$ ) were significantly greater after F, whereas no significant difference was found in VASMO ( $p=0.34$ ,  $d=-0.42$ ).

## Conclusion

A prolonged soccer-specific decision making task does not impair cognitive performance compared to a running task of equivalent intensity. Subjective feelings of MF and ME seem to be higher after F. MF is described as a phenomenon, that involves changes in mood, information processing as well as behaviour and is supposedly dependent on the potential reward. Thus, it might be speculated that the potential reward was higher during F due to its soccer specific nature. This might further raise the question if there is need for objective, task-independent criteria to define MF and to separate it from negative performance effects due to e. g. boredom.

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# High Lower Extremity Muscle Injury Rates Correlates with Opponent High Intensity Run Distance in Professional Soccer Matches

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## Introduction

Recently trying to predict muscle injuries is of utmost importance in soccer. Usually, preventive strategies are applied depending on external training load calculated with GPS & Accelerometer based technologies during the training sessions or via external measurements. However, most injuries occur during the game. Using optical tracking technology, these injuries patterns can be defined during the game and possible before they happen.

## Methods

The study is performed on Turkish Super League matches during the first half of 2016-17 season. A total of 50 injury occurrences were identified in 153 games. We differentiated the lower extremity muscle injuries that prohibited the player to continue (n=27). Grade 1 and Grade 2 strains occurred at quadriceps, hamstring, adductor and gastrosoleus muscles were included. (no grade 3 strain was present), independently from right left localization Spasm and cramps (grade 0 strains) were excluded. Diagnosis of injuries were confirmed by the medical teams of the clubs.

The physical data is generated by Sentio Sports optical tracking technology. For each injury, the games till the injury and the injury game were considered separately. 21 variables are identified to be important in predicting the injuries. Average covered distance per minute (DIST), high intensity run counts and distances per minute (HIR\_CNT, HIR\_DIST), sprint counts and distances per minute (SPR\_CNT, SPR\_DIST), number of passes (PASS), number of shots (SHOT), average and variance of metabolic power per minute when the ball is in team's possession (MP\_INPOS\_AVG, MP\_INPOS\_VAR) and out of team's possession (MP\_OUTPOS\_AVG, MP\_OUTPOS\_VAR), own team's average distance per minute (TEAM\_DIST), own team's high intensity runs (TEAM\_HIR\_CNT, TEAM\_HIR\_DIST), own team's sprints (TEAM\_SPR\_CNT, TEAM\_SPR\_DIST), opponent team's average distance per minute (OPP\_DIST), opponent team's high intensity runs (OPP\_HIR\_CNT, OPP\_HIR\_DIST), opponent team's sprints (OPP\_SPR\_CNT, OPP\_SPR\_DIST). We performed statistical significance analyses for both groups of injuries for the identified dependent variables.

## Results & Discussion

The list of variables that are significantly different for the matches that the injury took place are: TEAM\_HIR\_DIST ( $p < 0.0001$ ), OPP\_HIR\_DIST and OPP\_HIR\_CNT ( $p < 0.001$ ), TEAM\_HIR\_CNT, TEAM\_SPR\_CNT, OPP\_SPR\_CNT, OPP\_SPR\_DIST, TEAM\_SPR\_DIST and MP\_OUTPOS\_AVG ( $p < 0.01$ ). The significance is in increasing direction for all variables, i.e., these variables were significantly higher in the games that the injury occurred. The other variables are not found to be statistically significant. Moreover, no statistically significant variable was found for other types of injuries.

## Conclusions

Our results indicate the plausibility of predicting injuries during the game using the physical parameters such as HIR, accelerations and metabolic power especially when the ball possession is at the opponents. Injury risk is increasing against physically high opponents and special preparation towards these opponents may not only help to prevent injuries but also increase success. Prevention strategies could be associated with game model and opponent profile

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# Activity profile of 10-12-year-old Danish school girls participating in "FIFA 11 for Health" for Europe

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## Introduction

To evaluate activity profile of the girls in the health education programme, "FIFA 11 for Health" for Europe and to examine potential differences between girls involved in leisure-time sports club activities, i.e. football and other sports, and non-sport-club active girls. The 22 sessions were delivered during school time by trained teachers over 11-week-period, 2x45 min per week.

## Methods

A total of 34 girls were monitored. The activity profile was monitored using the ZXY tracking system (ChyronHego, Norway), during 4 of the 22 "FIFA 11 for Health" in Europe sessions for a total of 34 girls of which 8 were football club active, 15 were involved in other leisure-time sports and 11 were non-sport-club active. Distance covered in various speed zones (Walking (0-4 km/h), jogging (4.1-8.0 km/h), running (8.1-12.0 km/h), high intensity running (12.1-16.0 km/h) and sprinting (> 16 km/h) was determined.

## Results & Discussion

The mean distance covered during a session was 2271±971 m, comprising of walking (47.1%), jogging (29.8%), running (13.7%), high intensity running (8.2%) and sprinting (2.1%). No difference were observed in total distance covered for the three groups (football: 2502±928 m, other sports: 2203±882 m and non-sport: 2195±1034m), but the football club active covered more distance than other leisure-time sports with high intensity running (231±128 vs. 160±96 m) and sprinting (65±45 vs. 35±28 m), with intermediate values for the non-sport-club-active girls (197±129 and 57±53 m, respectively, NSCA> OS).

## Conclusion

The study indicates that the girls are highly active during the "FIFA 11 for Health" for Europe sessions, with more than 1 km of running and multiple brief high-intensity runs. It was also observed that both football club active and non-sport active performed more high-intensity running than the girls engaged in other leisure-time sports than football.



# Metabolic power profile determination based of GPS measurement

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## Introduction

Player profile determination is it an important point to obtain best benefits as possible managing the workload. Peronnet et al. indentified athlete's profile based on best average speed that there are able to maintain on time period [1]. Recently Pinot et al. developed "Record Power Profile" to assess performance in cycling [2] based on powermeter measurement. Regarding soccer, di Prampero et al. developed method permitting to obtain metabolic power (MP) during practice [3] based on high frequency speed data. The aim of the study is to investigate if such approach can be transferred to soccer to determine profile's player activity using MP provide by GPS technology.

## Methods

This study was performed based on measurement done during training follow up with GPS technology GPex Pro (Exelio, Udine, Italy). 20 players from 2 different levels; U17, U19 were integrated in this study to create match profile. For each session, speed and MP were collected at sampling rate of 20 hz and exported to spreadsheet to be computed. We determine MP match profile outputting the best average periods for duration of 1, 2, 3, to 5400 seconds. We performed comparison of those three group's profile using qualitative statistic approach [4] (0.2SD: small difference; 0.6SD: moderate; 1.2SD: Large difference)

## Results & Discussion

Comparison of both group highlight at least small difference for all duration between U17 and U19 players. We found large difference for duration between 2 and 40 minutes. We note at least small difference for duration between 10 second and 80 minutes. For all periods difference magnitude is small.

## Conclusion

MP player profile is sensitive enough to discriminate player categories based on match measurement. This method treatment appear promising to investigate fitness level, training load or training session content and can for player's follow-up. Nevertheless more investigation has to be performed to confirm those points and upgrade the background about this technique.

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# How gender affects kinematics of dribbling in soccer

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## Introduction

Dribbling skill is a key factor of performance for soccer players (Ali, 2011). However, no study has investigated the influence of gender on these skills while there exists a disparity between men and women (Kirkendall 2007). Our goal is to evaluate this influence of gender on the kinematics of dribbling. To this end, we propose to use both the juggling test that is the reference in federal system to evaluate players' level of expertise, and an "8" shape task used by Zago et al. to assess dribbling skills of young players (Zago et al., 2015).

## Methods

13 players (6 women and 7 men), from amateur to national level, took part in the study. They had to do a maximal number of juggles for the juggling task and to be as fast as possible for the dribbling task. They also performed reference trials in the "8" shape slalom without ball, just running as fast as possible. Motion were captured with a Vicon system and were also filmed. We analyzed the kinematical parameters such as dribbling time, stride cadence, shoulder and hips angles, height of center of gravity relative to subject's size.

## Results & Discussion

The comparison between juggling and dribbling time shows a negative correlation ( $p=0.0498$ ). The dribbling test is thus coherent with the reference juggling test. It also exists a strong statistical trend between during juggling test and the level of expertise ( $p=0.056$ ).

No statistical difference between men and women was found for the reference condition without ball, the two groups were homogeneous in term of global running performance. However, female players adopted a lower cadence than men ( $p=0.033$ ) and they had lower performance in juggling and dribbling tasks. This result show a difference of technical dribbling skills depending on gender.

Otherwise, on the kinematical parameters, we did not find significant difference neither on relative height of the center of gravity, angular movement of hips or shoulders. Only a most important variability in shoulders angle was found for women, contrary to walking and running patterns but it could be explained by the specific dribbling pattern: trunk fixed and preferred leg in front to increase accuracy. Further studies should be done to have a more in depth biomechanical analysis of the dribbling pattern to confirm or not this statement. This study is currently extended to a larger population to improve statistical results.

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# Training of visuospatial attention of professional soccer goalkeepers with multiple-object tracking

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## Introduction

Perception is a fundamental factor in decision making and soccer goalkeepers have to concurrently process multiple moving information to make the right choice. Their ability to perceive the situation correctly is directly linked to their expertise level (Williams 2000) and is based on their Covert VisuoSpatial Attention (CVSA) (Posner 1980) as the ball and the players are continuously moving. Our goal is to assess if an individualized training protocol based on Multiple-Object Tracking (MOT), which is a complex task involving several parts of one's visual field, can improve the CVSA of expert soccer goalkeepers.

## Methods

We designed a standardized training protocol to improve the DVA, based on MOT (Pylyshyn et al. 1988). In our study, the goalkeeper had to keep visual track of red balls moving amongst a set of green moving distractor balls (“MOT” condition). An additional blue ball had to be tracked with the mouse during half of the trials ( “MOT-Tracking” condition). After 1s, all the balls became green (except the blue one when present) and the goalkeeper had to retrieve them after each 4s session. Four professional soccer goalkeepers (first national league) underwent a training period of 13 weeks. One session of 15 minutes per week was completed. Improvement in goalkeepers' performance was ensured by an increase in training difficulty. 2 different numbers of balls to track (2 and 3) were set, with 5 to 8 distractor balls; and 3 ball speeds (18.5, 23 and 27.5°.s-1). To evaluate this improvement, the same reference assessment was performed at the beginning and at the end of the training period.

## Results & Discussion

Firstly, the results showed a strong ability of expert goalkeepers to track a large number of targets. Cavanagh et al. showed that up to 4 objects can be tracked depending on factors such as movement velocity (Cavanagh et al., 2005). Although we found no overall improvement for MOT condition, strong differences were observed for MOT-Tracking condition: improvement in overall performance, with increase whatever speed and number of balls to find. Indeed, initially, our subjects fully succeeded in 65±5% of the situations. At the end of the training period, they were able to retrieve balls in 81±7% of the trials. In a similar manner, improvement in performance was observed for each speed, with a stronger effect at the lowest speed (18.5°.s-1), showing an improvement of 19±4% after training completion.

Finally, participants showed better performance in MOT-tracking than in MOT, after period of training ( difference of 15±4%), whereas no difference was observed before training period.

## Conclusion

The high acuity to track multiple dynamic objects is essential for goalkeepers and a 13-week of MOT training showed improvement in this skill. Future works must include a larger set of

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subjects to confirm this result, and a more field-based approach (Romeas et al., 2016).

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# Investigating neurophysiological correlates of covert attention in soccer goalkeepers

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## Introduction

Soccer goalkeepers must process information from their peripheral vision at the same time they look towards the ball. This ability, committing attention to a position other than the fixation point, is called Covert Visuo-Spatial Attention –CVSA– (Posner, 1980). CVSA being essential to reach high performances, it is primordial to find innovative and efficient ways of improving it. Neurofeedback, which consists in training specific brain features in order to enhance a cognitive ability, has been proven to increase attentional abilities (Fuchs et al., 2003). Also, different studies have suggested the existence of a neurophysiological marker specific to covert attention: a lateralised modulation of the  $\alpha$  waves in the visual cortex (Sauseng et al., 2005; Thut et al. 2006). Moreover, it has been shown possible to compute this marker online, thus opening the door to a potential neurofeedback training procedure (Schmidt et al., 2010; Tonin et al., 2013; Trachel et al., 2015). In this view, we propose in a first instance to further investigate the relevance of this marker for soccer goalkeepers. The objective is to answer the following questions: Is this marker transferrable to goalkeepers? How stable is it across athletes? Does it depend on their expertise?

## Methods

Ten soccer goalkeepers (amateurs and professionals) take part in an ElectroEncephaloGraphy (EEG) study while they perform a CVSA task. They have to look at a fixation cross and then, based on the cue displayed, commit their attention to a target located on the left or right of the screen (without overt eye movements) (Tonin et al., 2013). The protocol includes two sessions so that we can assess the stability of the marker.

## Results & Discussion

An  $\alpha$  wave modulation in the visual cortex should be observed contralateral to the target (e.g., in the left visual cortex when the target is on the right). Moreover, professional goalkeepers should produce a greater  $\alpha$  wave modulation, reflecting a main effect of expertise. If our hypotheses are underpinned by the results, the next step will consist in proposing a new generation of EEG-based training tools for goalkeepers, with a neurofeedback training targeting this marker, and in evaluating the effect of these training tools on goalkeepers' performance.

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# Cardiovascular load and perceived experience during soccer training for children in same- vs. mixed gender games

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## Introduction

Soccer has been established as a health and performance enhancing activity in several populations (1). Yet, the cardiovascular demands and perceived experience of soccer played as small or large-sided games in school children organised as same gender or mixed genders is not known. This study aimed at comparing the cardiovascular load and perceived experience of soccer sessions for 12-16-year-old school boys and girls using small-sided (2v2 and 4v4) and large-sided games (12v12) in same gender and mixed gender game formats.

## Meethods

A total of 134 pupils (50 girls and 84 boys) were randomly assigned to same gender and mixed genders game formats, and each of the gender groups played 2x15 min artificial turf soccer games 2v2, 4v4 and 12v12, on separate days in a random order, using the same area per player and length to width ratio. Heart rates (HR), rate of perceived experience (RPE) and level of fun were determined for all game formats.

## Results & Discussion

Higher mean HR was found in 2v2 and 4v4 games compared to 12v12 for girls in mixed gender games ( $77 \pm 10\%$  ( $\pm$ SD) and  $73 \pm 12\%$  vs.  $63 \pm 11\%$ HRpeak;  $p < 0.01$ ), as well as for boys playing same gender ( $81 \pm 6\%$  and  $79 \pm 5\%$  vs.  $73 \pm 9\%$ HRpeak;  $p < 0.05$ ) and mixed gender games ( $76 \pm 9\%$  and  $77 \pm 8\%$  vs.  $69 \pm 8\%$ HRpeak;  $p < 0.05$ ). Correspondingly, more time was spent with HR above  $80\%$ HRmax in 2v2 and 4v4 games compared to 12v12 for girls in mixed gender games ( $42 \pm 34\%$  and  $37 \pm 36\%$  vs.  $9 \pm 19\%$ ;  $p < 0.01$ ), as for boys playing same gender ( $50 \pm 27\%$  and  $43 \pm 24\%$  vs.  $24 \pm 29\%$ ;  $p < 0.05$ ) and mixed gender games ( $38 \pm 35\%$  and  $38 \pm 32\%$  vs.  $20 \pm 19\%$ ;  $p < 0.05$ ). For girls and boys in mixed gender games, RPE was higher in 2v2 (girls:  $6.8 \pm 2.0$ , boys:  $5.3 \pm 2.4$ ) and in 4v4 (girls:  $5.7 \pm 2.7$ , boys:  $4.8 \pm 2.6$ ) games compared to 12v12 (girls:  $4.0 \pm 2.5$ , boys:  $3.4 \pm 3.0$ ;  $p \leq 0.05$ ). Moreover, boys playing mixed games reported more fun in 2v2 ( $5.7 \pm 2.4$ ) and 4v4 ( $4.9 \pm 2.8$ ) games than in 12v12 games ( $3.2 \pm 3.1$ ; AU, 0-10 scale;  $p < 0.01$ ).

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**Conclusion**

In conclusion, aerobic exercise intensity is much higher with small-sided games compared to large-sided games for adolescents, which is also reflected in the RPE. Moreover, when boys are playing mixed gender games, small-sided games are considered more fun.

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# A standardized system to evaluate reactive agility depending on anticipation time

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## Introduction

Reactive agility is a key factor of performance in soccer (Knoop et al. 2013). It allows the players to manage quick changes in opponents' motions and ball trajectory. In their daily training practice, many exercises are proposed to evaluate and train this reactivity (Ricotti et al. 2013; Trecroci et al. 2016). However, no study has been proposed to objectively explore the influence of the anticipation duration, the time the player has to anticipate, on the rapidity of reaction.

In this work, we propose a new evaluation system to investigate player's reactive agility in standardized and controlled conditions, mimicking real sport situations in which the player has to run quickly toward a direction, as soon as this information is revealed.

## Methods

30 elite soccer players took part of this study. They are initially standing on 2 force plates (AMTI BP600-1200) in the middle of an 8m square and have to perform a vertical jump before running toward a corner as fast as possible. A wide screen located in front of the player displays an overview of the scene and shows which target must be reached out of the 4 corners. 2 conditions are randomly proposed: either the target is already displayed before jumping, or it appears only 50ms after player's takeoff. This second condition ensures the player only knows the direction he must run to just before landing. 3 repetitions of each condition were realized leading to a total of 24 trials per player. The evaluation method then consisted in measuring and analysing the 6 degrees of freedom of ground reaction forces applied under each foot of the player when he started to run toward the target.

## Results & Discussion

Preliminary results showed an adaptation of the motor scheme depending on the condition. When target is fully defined before jumping, a rearward turn is carried out by a first support on the external foot (left foot for a backward right turn) followed by a support on the internal foot, with or without short intermediate double support. This full rearward turn is thus performed in just one stride. On the opposite, when target is shown after takeoff, the rearward turn is generally carried out with one more stride, increasing the turn-on time and distance covered. Moreover, ground reaction forces provide relevant variables carrying both temporal and dynamic information such as reaction time and amount and direction of force under each foot. These data provide an individualized evaluation of the player highlighting his strengths and weaknesses such as laterality, anticipatory skills, field position or post-traumatic recovery. A personalized training could then be considered.

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# The association between the acute:chronic workload ratio (ACWR) and countermovement jump performance in elite academy soccer players

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## Introduction

Within professional soccer players are often exposed to year-long training and high match frequencies, with periods of a congested calendar, which sometimes reduces neuromuscular performance and elevates injury risk (Malone et al., 2015; Gabbett et al., 2016). Use of the acute:chronic workload ratio (ACWR) revealed that a ratio range of 1.00 to 1.25 appears to offer protective effects for players from injury risk within soccer players (Malone et al., 2016). Less understood however is the potential dose-response association of the ACWR to neuromuscular performance. Therefore the aim of the current investigation was to understand the association between the ACWR (7:21 day) and neuromuscular performance (CMJ) within elite youth soccer players.

## Methods

The current investigation was a prospective cohort study of elite soccer players competing for an elite academy team. Data were collected for 29 players (Mean  $\pm$  SD, age:  $19.3 \pm 3.1$  years; height:  $173 \pm 7$  cm; mass:  $62 \pm 7$  kg) across 8 x 5 week competitive cycles. Players training load across the period was monitored through the use of s-RPE (RPE x Time). With a 7:21 day ACWR used to determine spikes in training load.. Multiple linear regressions were used to understand the changes in load across phases and the association between ACWR and neuromuscular performance.

## Results & Discussion

The weekly load was  $3168 \pm 374$  AU with an ACWR of  $0.99 \pm 0.26$ . Players CMJ performance was  $39.5 \pm 1.3$  cm. There was a non-significant change in training load and ACWR across the phases ( $p \geq 0.05$ ). 7:21 day ACWR showed a significant dose-response relationship with neuromuscular performance ( $p = 0.039$ ). Specifically ACWR showed a *moderate* association with CMJ performance ( $r = -0.41$ ; 95%CI: -0.32 to -0.65; moderate). Moderate- high ( $\geq 1.00 - 1.35$ ) ACWR resulted in *likely* larger reductions in CMJ performance when compared to low-moderate ACWR (0.75-1.00).

## Conclusion

This to the author's knowledge is the first study to observe a dose-response relationship between the ACWR and neuromuscular performance. Practitioners should be cognisant of the fact that higher ACWR result in increased reductions in neuromuscular performance.

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# Objectively-measured sleep behaviours of English Premier League players during training and competition

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## Introduction

The increased technical and physical demands of English Premier League (EPL) soccer highlight the importance of adequate recovery for players between training and competition (Barnes et al. 2014). Sleep is generally reported by players as being important for coping with the demands of training and competition, yet little is known about sleep behaviours in EPL players. The aim of this study was to quantify sleep behaviours in EPL players from varying cultural backgrounds (Steptoe, Peacey, and Wardle 2006) during a period which encompassed a match.

## Methods

Sleep/wake behaviour was recorded for 26 EPL players from the same team, comprising 16 players of UK origin, 4 of European/non-hispanic origin and 5 of Hispanic/South American origin. Players wore wrist activity monitors (measuring sleep: duration, onset, latency, disturbance, consistency and quality) for a median period of 8 days (range 4-13), including one weekend EPL match at 15:00 or 17:30 h. Differences according to country of origin were quantified with general linear models. Pre-and post-match changes were quantified with paired t-tests.

## Results & Discussion

Overall during the competitive phase, mean (range) time of sleep onset was 00:40 h (11:15–02:39 h), sleep duration was 7:36 h (5:42–8:48), sleep latency was 25.8 min (7–47), total number of times awake was 4 (1–7), proportion spent asleep was 82.3% (72.6–89.5) and sleep onset consistency was 65.8 min (18.9–143.2). Pre-match sleep duration was 1:04 h longer (95%CI 0:14–1:53) than post-match duration (ES 0.89, P=0.013). Generally, mean sleep onset of the Hispanic/South American players was 0:50 h (95%CI 0:03–01:44) later than non-hispanic/EU players (ES 1.8–large; P=0.067), and 1:26 h (95%CI 0:45–02:08) later than UK players (ES 11.3–large; P< 0.001).

## Conclusion

In this small yet elite sample of players, Hispanic/South American players showed evidence of later sleep onset than UK/Non-hispanic European players, but this did not translate to poorer sleep or substantially shorter sleep duration. Irrespective of country of origin, sleep duration was approximately 1 h less immediately following a match. The present findings provide novel insights into the descriptive sleep behaviour of EPL players from varying cultural backgrounds during a training and competitive phase.

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# Kinetic determination of salivary myeloperoxidase profile in professional soccer players participating in a soccer match

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## Introduction

Exercise induces a multitude of physiological and biochemical changes in blood and tissues affecting their redox status. A systemic activation of neutrophils occurred after strenuous and intense exercise leading to their degranulation and an increase in plasma concentration of myeloperoxidase (MPO). This enzyme has pro-oxidative and pro-inflammatory properties and may play a role in the exercised-induced muscular damage. Very recently a correlation between plasma and saliva MPO has been reported (Kossaify et al., 2013), which allows our team to develop a new salivary test to measure saliva MPO activity in sport medicine.

## Methods

The aim of this study was to assess the effect of exercise intensity on salivary MPO activity in 18 professional male soccer players, who participate in the premier French soccer championship. Unstimulated whole saliva was collected at rest, and 24 h, 48h, and 60h after a soccer match during the recovery phase. A sterile cotton swab was placed in the mouth during one minute, then, transferred into a buffer solution where saliva MPO was released. A specific strip was dipped into the buffer allowing MPO to oxidize its substrate resulting in a color change obtained after one minute. Results were expressed in  $\mu\text{Mol/L}$  corresponding chart to increased MPO concentration.

## Results & Discussion

MPO activity measured at rest was  $1.5 \mu\text{Mol/L}$  among 88.9% of players. Therefore, the range of MPO (1.5 to 2.5) of this soccer players was considered as the baseline value. The match induced marked increases in MPO activity in all players from  $1.5 \mu\text{Mol/L}$  to  $3.5 \mu\text{Mol/L}$ . A progressive decrease in MPO was observed during the recovery phase, starting at  $3.3 \mu\text{mol/L}$  after 24h, then 2.5 after 48h and a return close to baseline  $1.88 \mu\text{Mol/L}$  after 60h. Salivary MPO as a non-invasive, easy to perform and giving immediate result. It is a promising test to modulate exercise intensity and duration, as well as recovery efficiency. However, more experiments must be performed to confirm our preliminary results.

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# Talent identification: current research, trends and directions for identifying the next superstar

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## Introduction

The central premise of talent identification is to identify young athletes with the potential to excel and become a successful professional senior athlete. To date, there has been an accumulation of research detailing the skills that differentiate skilled and less skilled football players, including physical/anthropometric attributes, perceptual-cognitive skills, and in-game activity profiles. Although these findings provide an indication of the possible skills and attributes which may contribute to skilled performance, there is limited understanding of how this information influences the talent identification process. Therefore, the aim of this presentation is to share current recruitment practices of key talent identification stakeholders and stimulate discussion on how this may influence future talent identification research.

## Methods

This study was a qualitative investigation whereby discussions were held with key talent identification stakeholders including academy and technical directors, Federation members, youth coaches, national and elite club recruiters and scouts. Individuals discussed their current talent identification and recruiting processes, what key aspects they consider important when identifying talent and how they measure key talent indicators.

## Results & Discussion

Results provided the suggestion that in practice, individuals involved in the talent identification process use psychological and socio-cultural information to inform their decisions. These included determination, resilience, character and familial structure, which talent identification stakeholders valued as important aspects which may influence a player's ability to transition to elite adult competitions. Participants indicated that this information was obtained via player and family interviews. This demonstrates a potential shift from traditional talent identification processes which have been based on psychical or technical skill proficiency. The findings will be discussed in relation to how researchers may be able to provide evidence and/or develop measures to assess psychological and socio-cultural information within the talent identification process.

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# Relationship between female soccer players and their trainers nowadays in France

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## Introduction

In France, feminine soccer is becoming more and more mediatized and an important issue for the federal authorities. Historically, soccer practice has been marked by a masculine imprint, whether at the level of players or coaches (Knoppers, Anthonissen, 2003, Prudhomme-Poncet, 2002, Héas et al., 2004).

What about girls practicing in this androcentric environment (Nneme Abouna, Lacombe, 2003, Héas, 2010)? Are there any specific feminine expectations from them? Do they express themselves? Are they heard? Does the manager impose expertise and soft skills in line with his many expectations from these players?

This research work aims to understand better this situation nowadays in France. During interviews, players reported an inadequacy between their quests in terms of soccer performances and the behaviors and/or speeches of the trainers. Can we deduce, based on these experiences that the management of the feminine soccer teams needs to be adjusted in order to improve the players' well-being and to optimize their performances?

## Methods

Following exploratory interviews (n=44), an online questionnaire, inspired by Jowett's (2009) works, is available since January 2017 (n=130, still in progress). This questionnaire collects information about feminine soccer regardless the level or the region of practice. Later, the validity of this measure will be questioned by the means of structural modelings and significant discussion elements will be extracted.

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# Biological response comparisons of a competitive microcycle vs. congested fixture periods in elite level European champions league soccer players

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## Results & Discussion

Continual stressors placed upon elite level players through training, travel and competitive match play demands can lead to significant changes in the physiological capability and biochemical profile of players. The aim of this investigation was to explore the evolution of biochemical responses during the in-season competitive phase, and analyse differences between congested (CP) vs. non-congested (NCP) competitive phases in relation to player's post-match fatigue kinetics.

## Methods

Twenty-three elite male professional soccer players with a mean±SD age of 24.4±4.1 years, height of 182.5±2.9 cm, and body mass of 77.8±5.4 kg (61.2 to 93.5) kg were assessed across this investigation. Testing procedures included the assessment of creatine kinase (CK) and salivary cortisol (sCort) were performed across the first phase of the 2016-2017 season and the data set included 12 separate training microcycles, inclusive of 14 competitive matches. CP was determined as a microcycle including 2 competitive matches within 4 days or less whereas NCP was determined as a microcycle including 2 competitive matches within 5 days or more.

## Results & Discussion

Results from the NCP analysis revealed significantly higher CK values from one day after match day (MD+1) than values found in MD-4 (ES: 1.11), MD-2 (0.89), MD (0.82) and MD+2 (0.93) ( $p < 0.01$ ); higher CK values in MD-3 than values on MD+2 (0.82,  $p < 0.01$ ) and MD-4 (0.81,  $p = 0.05$ ); and higher sCort values on MD-3 than values in MD-2 (0.45), MD+1 (0.60) and MD+2 (0.44) ( $p < 0.05$ ). During the CP, no significant differences were observed across days for either CK or sCort, and moreover, CK values were higher from MD+2 in CP than those from MD+2 in NCP.

## Conclusion

Conclusion of the current investigation suggests that congested competitive periods induce significant fatigue related issues (i.e. muscle damage, mucosal immunity, anabolism activity) in elite soccer players. As a result of these findings individuals involved with the physical preparation of such players should understand the demands imposed on players in congested fixture periods and adequately adjust preparation and squad rotation accordingly.

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# Preventive training reduces injury in a season youth soccer

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## Introduction

Sport is the main cause of injury in young. Injury is often difficult to treat and normally expensive. Thus, preventive strategies play an important role and are justified on physiotherapists, medical and economic areas.

Risk factors, etiology and injuries mechanisms need to be identified before starting a preventive programme for sports injuries. Injury prevention generally focuses on risk factors like: power, flexibility, coordination and balance. Thus, this study aimed evaluated effects of a prevention program on soccer injuries incidence in male youth, based on a previous assessment of risks factors in a Brazilian soccer club.

## Methods

An assessment of risk factors for commons soccer injuries was proposed: muscle lesion (groin, hamstrings and quadriceps), sprains (ankle and knee) and tendinopathies. This assessment was composed of an anamnesis to track previous injuries and risks habits. Physical evaluation presented specific tests to mobility, flexibility and pain. Dynamic assessment to analyze running and landing mechanism, dynamic valgus, lower limb power and potency. Preventive Strategy (PS) was drawn from the assessment and applied at least 3 times/week focusing on functional and balance training, proprioceptive, mobility and flexibility

All non traumatic (NTI) or traumatic (TI) injuries was recorded and observed the differences during two periods: season 2015 (January to December/2015 – S15) and 2016 (January to December/2016 – S16)

Was considered Injury any physical complaint sustained by a player that result from a soccer training (ST) or a match play (MP). Injuries were reported if a player was unable to take full part in future ST or MP for at least 24h. A clinical injury such as fever wasn't considered an injury. ST and MP were considered together (ST+MP). For this study, clinical injuries such as fever were ignored. During S15, no was preventive training. The team was composed of 52 athletes, category under 15.

## Results & Discussion

During S15 and S16, occurred 26 and 19 injuries respectively, being that S15 was 17 NTI and S16 occurred 8 NTI, resulting in 23% of difference between season.

General number of injury/ST+MP was 0.05 injury/ ST+MP in U15 and 0.04 injury/ ST+MP, in U16 and the rate was similar between seasons. Incidence of NTI/TS+CG was higher (0.03) to S15 compared with S16 (0.01). This represented that our PS could be responsible for injuries reduction. Development and application of PS which should be continued throughout the sporting season, are recommended on literature.

## Conclusion

Soccer injuries can be reduced by preventive interventions. Coaches and players need better education about prevention strategies and should include SP as part of their regular training.

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# Match-running in elite female soccer: Match-to-match variation and the effect of match-factors

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## Introduction

An understanding of the match-to-match variation of common metrics is important to provide appropriate conclusions when analysing match-running performances. Further, a variety of match factors, such as altitude or the opposition ranking, may affect the movement of athletes. Therefore, the purpose of this study was to examine the match-to-match variation of match-running in elite female soccer players utilising global positioning system (GPS) and to examine the effects of select match-factors on match-running performance of common GPS metrics.

## Methods

Elite female soccer players (n=45) from the same national team were observed during 55 international fixtures across 5 years (2012-2016). Data was analysed as full-matches and using a rolling 5-min analysis periods. Co-efficient of variation was calculated for all players who played 90-min matches (files = 172). Separate statistical analyses were completed on all players who played > 75 mins (files = 606) for all match activities using a negative binomial mixed model to account for altitude, temperature, match outcome and opposition rankings.

## Results & Discussion

Total distance per minute exhibited the smallest variation when both the full-match and peak 5-min running periods were examined (CV = 6.8-10%). High-speed running per minute exhibited the greatest variation in the post-peak 5-min period (CV = 143%). Variability of Accelerations (CV = 17%) and Player Load (CV = 14%) was lower than that of high-speed running (CV = 33%). Positional differences were also present, with centre backs exhibiting the greatest variation in high-speed movements (CV = 41-65%). Altitude (> 500m) and heat (> 20°C) had a small negative effect on total distance (-4.0% and -2.5%, respectively). A small positive effect on accelerations (6.8%) was observed at altitude, whilst temperature observed a moderate decrease (-14%). Playing a higher ranked team, compared to a lower ranked team, in a win resulted in a moderate and small increase in total distance (4.7%) and accelerations (9.5%), respectively. Whilst a win against higher ranked opposition, compared to a draw, saw a moderate increase in total distance (5.6%) and low-speed running (5.2%).

## Conclusion

Within player variability should be considered when examining match performances. Whilst awareness of performance declines at altitude or in high temperatures should be considered.

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Lastly, practitioners should aim at preparing players for winning matches against higher ranked opponents, where match-running may be the greatest.

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# Effects Of Pre-Season Period On Muscle Damages And Inflammation In Professionnal Soccer Players

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## Introduction

The aim of this study was to evaluate the impact of the preseason period on the evolution of blood markers of muscle damages and inflammation in French professional soccer players.

## Methods

A multi-parametric monitoring has been implemented during two preparation periods (P1 and P2) over two seasons (80 training sessions) with thirty-eight professional soccer players (2nd French division). Weekly physical and physiological training load was monitored using Global Positioning System (SPI-Pro GPSports) and using rate of Perception Exertion (RPE) respectively. Concerning physical training load, distance traveled between 12 and 16 km/h, between 16 and 20 km/h and distance traveled over 20 km /h were measured. Markers of inflammation (CRP) and muscle damages (LDH and CK) were analyzed using blood venipuncture at the beginning of the two preseason (T1) and after the end of the period (T2).

## Results & Discussion

No significant difference was found concerning distance traveled at different intensities between P1 and P2. Indeed, distance traveled weekly between 12 and 16 km/h were  $1282.7 \pm 573.7$  m for P1 and  $1107.9 \pm 365$  m for P2. Distance traveled weekly between 16 and 20 km/h were  $386.2 \pm 172.7$  m for P1 and  $405.3 \pm 179.7$  m for P2. Distance traveled weekly  $> 20$  km/h were  $352.9 \pm 157.8$  m for P1 and  $213.3 \pm 122.4$  m for P2. No difference was also noted concerning mean RPE/week between P1 and P2 ( $2745 \pm 221.3$  UA for P1 and  $2640.7 \pm 405.1$  UA for P2). The preseason period affected significantly muscle damage markers only for P2 since 1)- LDH increased significantly from  $175.8 \pm 23.5$  UI/L to  $215.3 \pm 31.9$  UI/L between T1 and T2 respectively ( $17.7 \pm 8.6\%$ ;  $p < .0.05$ ), 2)- CPK increased significantly from  $283.3 \pm 179.7$  UI/L to  $333 \pm 159.9$  UI/L between T1 and T2 respectively ( $15.4 \pm 31.2\%$ ;  $p < 0.05$ ). However, the preseason period has no effect on inflammation since CRP did not change significantly whatever the studied period (P1 or P2).

## Conclusion

Our results demonstrated that preseason period could impact biological markers and more especially muscle damages markers (LDH and CK).

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# The utility of a novel team-sport specific heat acclimation protocol to increase plasma volume and performance in elite female soccer players

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## Introduction

Heat acclimation training (HA) protocols in laboratory have been shown to enhance aerobic capacity in hot and mild conditions, but remain have mostly involved steady state aerobic training. The primary purpose of the current study was to investigate the efficacy of a 5-day soccer specific HA training circuit based protocol and its effects on PV in elite female players. We hypothesized that this novel high intensity circuit training approach, mimicking existing soccer training, would provide an adequate thermal strain for HA induced adaptations to occur. As a secondary outcome, we were in a position to assess the impact of HA on soccer specific performance in mild thermoneutral temperatures ( $\sim 20^{\circ}\text{C}$ ).

## Methods

Eighteen non-HA players trained for 5 days in the heat ( $34.8 \pm 0.2^{\circ}\text{C}$ ; 36.6%rh). Heart rate (HR), core temperature ( $T_{\text{c}}$ ), sweat rate (SR) and perceptual ratings were recorded during all sessions, with pre and post HA measurements of PV and thermoneutral performance (30-15 Intermittent Fitness Test (IFT) completed at  $20^{\circ}\text{C}$ ). Plasma volume was determined using the optimized CO-Rebreathing (CO-method) and Dill and Costill (D&C) methods. Magnitude-based inference statistics were used to quantify effects.

## Results & Discussion

Session average time spent at target  $T_{\text{c}}$  ( $\sim 38.5^{\circ}\text{C}$ ) was  $43 \pm 21$ min across the 5 days. Plasma volume showed a typical robust, but variable, increase (Standardized effect;  $\text{SE} = 0.51$ ; 90% CL: [0.31, 0.70]) pre-to-post HA by 9.5% (CL: [5.8, 13.4]). Inferential statistics showed a 99% chance of very likely positive PV change. The regression model demonstrated that average percentage of HRmax from 20-90min of the workouts as well as total 5 day heat load best predicted the change in PV ( $R^2 = 0.45$ ). There was a small meaningful change post HA in the 30-15 IFT ( $\text{SE} = 0.50$ ; CL: [-0.12, 1.12]).

## Conclusion

The implementation of a unique short-term HA circuit specific to soccer was successful at inducing heat specific physiological adaptations and enhancing soccer specific performance in thermoneutral conditions.

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# Developing strength abilities through two models of training with a woman's football team in Slovan Bratislava

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## Introduction

This study focused on the development of strength abilities in women football players (ŠK Slovan Bratislava – Slovak 1st league) in the transition and preparation period of the 2006/07 and 2007/08 seasons. The main goal was to discover the efficiency of developing strength abilities through models of combined and complex training methods in our observation periods. The study also helped to obtain more information about developing the strength abilities of woman football players.

## Methods

Our experimental sample was a single group (Slovan Bratislava) – inter individual (13 players time unparalleled for 9 weeks (2006, 2007) quasi experiment with a gradual independent variable characterized by complex and combined models of strength training and dependent variable level strength abilities.

## Results & Discussion

In terms of work results, we found that both models of training have a different impact on the development of various kinds of strength abilities. After using the combined model we can expect better improvements in performance indicators during submaximal weights up to the maximum weight. In a complex model, we achieve greater development of velocity force and better performance indicators with medium and low resistances weights.

## Conclusion

From these results, we can conclude that a complex model is more efficient for the development of the limiting factors of strength abilities and thus it could increasingly affect game performance in football. On the contrary, the combined model gives certain preconditions for future achievement of high level of explosiveness.

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# The effects of 8 weeks static stretching on jumping in soccer players

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## Introduction

The aim of this study was to investigate the effects of 8 weeks static stretching training on jump performance.

## Methods

18 volunteer male amateur soccer players (age:  $21,78 \pm 4,25$  year; height:  $180,11 \pm 6,38$  cm; weight:  $76,19 \pm 7,73$ ) are participated in this study. Participants were randomly diverted into two groups as Stretching (n=10) and Control groups (n=8). Flexibility measurements, horizontal jump distance, anaerobic power and vertical jump length were determined to Sit and Reach Test, Standing Long Jump Test, Wingate Anaerobic Power Test and Countermovement Jump technique respectively. In pursuit of first measurements, participants performed 10 static stretchings exercises throughout 3 days a week for 8 weeks which comprise biomechanics of jump movement muscles and aim to improve flexibility. In order to analyze differences, similar measurements were conducted, after eight static stretching sessions were performed. In order to analyze gathering datas, Paired t test was used for determination of intragroups differences and Independent t test was used for determination of intergroups differences. ( $p < 0.05$ )

## Results & Discussion

As a result, flexibility measurements, horizontal jump distances and vertical jump lengths increases are determined as percentagely and statistically on Stretching group. Although this increases were not statistically significant, when compare between control group, these datas are showed differences as percentagely.

## Conclusion

In conclusion, it could be suggested that chronic static stretching traning could effect flexibility, horizontal jump distance and vertical jump length positively in amateur soccer players.

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# Analysis of technical participation of U-12 and U-10 football players in 8-a-side match play

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## Introduction

Technical performance is, besides physical and psychological, an important aspect for success in football (Liu et al., 2016). Technical performance of elite teams during match play according specific positions has been evaluated to assess team performance and enhance the training process (Taylor et al., 2004). However, there is a lack of studies analysing technical performance of young football players in competition. Therefore, the aim of this study was to analyse the technical participation of young players in competition according to their specific position on the pitch.

## Methods

A total of 2738 individual moves were analysed (1328 from eight U-12 matches and 1410 from eight U-10 matches) from football players during matches of different tournaments in the Valencian Community in 2015. Using an observational methodology, the specific position and the technical participation of players were analysed. Intra- and inter-observer agreement were calculated to assess reliability of variables. Players were classified as forwards, midfielders, defenders, and goalkeepers according to their specific position on the pitch. To assess the technical participation of players, the following variables were analysed: clearance, set piece, first touch pass, shot/header, reception, reception + pass/shot/header/clearance/run with the ball/dribble, reception + run with the ball + shot/header/pass, reception + dribble + shot/header/pass.

## Results & Discussion

The results showed significant differences in the technical participation of U-12 ( $\chi^2$  (9, N = 1328) = 25.95,  $p < 0.01$ ) and U-10 ( $\chi^2$  (9, N = 1410) = 86.22,  $p < 0.001$ ) players according to their specific positions. U-12 and U-10 midfield players showed a higher technical participation (53.1% and 53.3%) in comparison with defenders (29.3% and 28.7%), forwards (9.4% and 10.9%), and goalkeepers (8.2% and 7.5%) respectively. Midfield players also employed a higher number of one action, two actions, three actions and more than three actions moves in comparison with defenders, forwards and goalkeepers.

## Conclusion

The results showed that the specific position influences notably the participation with the ball of U-12 and U-10 players. Therefore, we consider that coaches should carefully evaluate the minutes that each player participates in each specific position. These results suggest the need to avoid early specificity of young players in the first stages of their development.

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# Sports injury during a young soccer season in Brazil: an epidemiological study

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## Introduction

According to FIFA, soccer is the most practiced sport in the world. Soccer practice depends on the development of tactical, technical, psychological and physical factors developed, in Brazil, approximately since the age of 12. Around 6000 athletes between 12 and 20 years are competing in Brazil. All soccer activity can generate an overload mainly in lower limbs (LL). Increase of the sports practice also causes a considerable increase injury incidence. The objective of this study was observed the incidence of lesions occurred for each category of a training club located in the city of São Paulo, Brazil.

## Methods

Survey of injuries occurred in the period between January and December 2016. 255 athletes were assessed, divided into categories by age: under (U) 20, U17, U15, U13. Was considered Injury just any physical complaint sustained by a player that result from a soccer match or a soccer training. Injuries were reported if a player was unable to take full part in future soccer training (ST) or match play (MP) for at least 24 h. Clinical injuries such as fever or flu weren't considered an injury. Data were organized and analyzed for category, injured segment and missed days (MD) due to injuries.

## Results & Discussion

72% of lesions were non-traumatic (NT). Traumatic injury (TI) incidence is similar to that found in the literature, around 27%. In addition, 76% of all injuries occurred during ST. Lower limb injuries (LLI) were the most disabling represent 88% MD. Ankle and knee trauma and sprains account 42% of all LLI. Muscle injury (groin, hamstrings or quadriceps) represented 48% of all LLI.

During season, U20 completed 272 ST and played 67 MP; U17 participated in 459 ST and 84 MP; U15 was the category that played more MP, 107 and 377 ST. U13 realized 115 MG and 366 ST. Studies have shown that the younger players become professionals, higher training exposition, corroborating our finds.

Older category presented a rate of 0.7 injury/player, while U17 was 0.6. U15 and U13 showed 0.36 and 0.33 injury/player rates, respectively.

The injury rate/player for each category demonstrates that the younger the athlete the lower the injury rate. Taking into account amount of injury and the number of sessions of ST and MP, rate amount of injuries/ST+MP, we found a rate of 1.15 injury/ ST+MP for U20; 1.77 injury/ ST+MP to U17; 0.63 In U15 and 1.03 in U13. This is an interesting fact and it is probable that the preventive measures that were only used for category U15 were effective.

## Conclusion

NT injuries are more common than TI, occurring during training session and the most frequently was muscle LLI. Prevention strategies can decrease these injuries.

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# Efficacy of the shortystrap in the treatment of groin pain

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## Introduction

The main objective of this study was to evaluate the efficacy in maintaining a sporting activity in athletes with groin pain of an elastic compression device called Shortystrap, which made of a tight pair of shorts, similar to those worn by cyclists, on which are sewn two elastic straps that tightly hug the lower limbs and induce an adductor effect of the lower limbs.

## Methods

It is a prospective, monocentre, non controlled, non randomised, open-label study on a single group of men aged between 18 and 50 years who regularly practise a team sport involving a large portion of running, and who present with a groin pain which appeared at least 4 weeks prior while practising their sport.

The Shortystrap was used at each sports session after the inclusion. The maintaining a sporting activity by the Ferretti scale and the evaluation of the pain were collected for 60 days.

## Results & Discussion

The primary outcome was the evaluation of sporting practice-related pain at 15 days of use of the shortystrap by the Ferretti scale. At that time, 41 patients had a Ferretti score strictly lower than 3. The theoretical success threshold according to the exact method described by A'hern which was set to 34 patients has therefore been reached.

Concerning the evolution of pain as a function of time, a tendency towards improvement was also reported, with a significant gains at the time of implementing the shortystrap and after 15 days of physical activity.

This study provides new arguments in favour of a new therapeutic option in the treatment of groin pain.

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# The effect of the early introduction of ‘friendly’ matches on the preseason training load and aerobic conditioning of soccer players at a Scottish premiership club

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## Introduction

Pre-season training in soccer typically introduces a series of non-competitive ‘friendly’ matches during late preseason in the build up to the beginning of a competitive season. Recently this model has been challenged due to shortening pre-season periods and an increase in commercial activity. Therefore, the aim of this study was to examine the early introduction of ‘friendly’ matches on aerobic capacity during an elite soccer club’s pre-season.

## Methods

14 professional soccer players (age  $22.6 \pm 3.2$  years, height  $181.6 \pm 7.0$  cm, weight  $77.1 \pm 7.9$  kg) were observed for 4 weeks during this research. Before pre-season training aerobic capacity was predicted by the YoYo IRTL2 test. Pre-season training comprised of 23 training sessions (average duration  $83.3 \pm 23.5$  minutes) in addition to 5 ‘friendly’ matches. The distance, velocities and player load of these training and ‘friendly’ matches were analysed by means of global positioning system technology.

## Results and Discussion

Results from this data show that match play is able to produce a significantly higher relative distance in m.min<sup>-1</sup> ( $p < 0.001$ ), maximum velocity ( $p = 0.001$ ) and average velocity ( $p < 0.001$ ) compared to training. Distance covered during a YoYo IRTL 2 test at the end of pre-season period was greater than the start of pre-season ( $1625.7 \pm 302.0$  vs  $1994.3 \pm 296.4$  m;  $p = 0.003$ ) with a predicted increase in VO<sub>2</sub> max from  $67.2 \pm 4.12$  ml.kg<sup>-1</sup>.min<sup>-1</sup> to  $72.1 \pm 3.9$  ml.kg<sup>-1</sup>.min<sup>-1</sup>.

## Conclusion

Therefore, the results of this study suggest that coaches and strength and conditioning professionals can introduce ‘friendly’ matches early within their pre-season schedule.

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# Comparing of technical skills of young football players according to preferred foot

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## Introduction

Soccer successful performance is a norm requiring an enormous number of capacities and one of them is technique. Technical skills including such as long passing, shooting, dribbling, ball control (Stølen, T. et. al., 2005; Abdullah, R. M. et. al., 2016).

Human beings use their limbs differently, showing preference for the use of one of the symmetrical parts of the body. In the soccer domain, systematic training which players are exposed to during their career influences the use of one or both limbs, as the player's decisions are influenced by the specific motor skills proficiency (Teixeira L. A.& Paroli R., 2000; McMorris T. & McGillivray, W.W., 1998)

The purpose of this study is to compare technical skills of youth soccer players according to foot preference.

## Methods

A total of 61 amateur football players (Under 15) were selected and were classified into right-footed (n= 31), and left-footed (n= 30). In this study, dribbling, juggling, long pass and shooting tests were applied for football technical skills on syntetic field.

Mann Whitney U test for paired comparison of the groups and Spearman test for the relationship between the technical skills were used.

## Results & Discussion

There were not statistically significant difference between the left-and right footed players in technical skill tests ( $p \geq 0.05$ )

A negative and significant relationship was found between dribbling and juggling ( $r = -.365$ ,  $p \leq 0.05$ ) and pass ( $r = -.514$ ,  $p \leq 0.01$ ) skills in right-footed players.

There were not statistically significant relationship between performance of technical skills in left-footed players ( $p > 0.05$ ).

Findings may not generalize to other age categories and competition levels and may be specific to the football under 15 teams.

## Conclusion

In conclusion, although there were not difference between left-and right footed players in technical skills juggling and pass skills related with dribbling skill. The present study may contribute to the literature on the specific skills related performance profile of youth football players.

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# Relationship between body composition and intermittent endurance of soccer players

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## Introduction

Body composition (BC) is an important indicator of the physical fitness and health of athletes. (Mala, L at al., 2015). The purpose of this study was to investigate the relationship between body composition and intermittent endurance.

## Methods

Fourteen healthy amateur male soccer players (Age:  $25.23 \pm 5.6$  years, height:  $179.85 \pm 6.1$  cm, body weight:  $75.53 \pm 8.7$  kg,) voluntarily participated in this study. Soccer team were assessed for whole body and regional estimates of body composition using dual-energy X-ray absorptiometry (DXA). Intermittent endurance was diagnosed with Yo-Yo Intermittent recovery test, level 1. Relationships of intermittent endurance with body composition parameters were analyzed with pearson correlation coefficient probability level was  $\leq 0.05$ .

## Results & Discussion

According to result of the study, there was no statistically relationship between intermittent endurance percentage of body fat ( $r = -0.293$ ,  $p > 0.05$ ), body fat weight ( $r = -0.412$ ,  $p > 0.05$ ) and fat free mass ( $r = -0.361$ ,  $p > 0.05$ ).

## Conclusion

The results of this study showed that there were no statistically correlations of body composition and intermittent endurance. There are much more correlation studies are necessary with body composition and intermittent endurance.

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# Relationship between body composition and explosive power of soccer players

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## Introduction

The measurement of body composition is now a fundamental component of sport science support in elite level soccer (Milsom, J et al., 2015). The purpose of this study was to investigate the relationship between body composition and explosive power.

## Methods

Sixteen healthy amateur male soccer players (Age:  $25.78 \pm 2.7$  years, height:  $180.0 \pm 6.1$  cm, body weight:  $76.80 \pm 3.4$  kg,) voluntarily participated in this study. Soccer team were assessed for whole body and regional estimates of body composition using dual-energy X-ray absorptiometry (DXA). Squat Jump (SJ), and Counter Movement Jump (CMJ) test were performed. Relationships of squat jump, and counter movement jump with body composition parameters were analyzed with Pearson correlation coefficient. probability level was  $\leq 0.05$ .

## Results & Discussion

According to result of the study, there was no statistically relationship between SJ and CMJ percentage of body fat ( $r = -0.426$ ,  $r = -0.432$ ,  $p > 0.05$ ), body fat weight ( $r = -0.293$ ,  $r = -0.319$ ,  $p > 0.05$ ), fat free mass ( $r = 0.363$ ,  $r = 0.313$ ,  $p > 0.05$ ) and lean leg fat ( $r = 0.428$ ,  $r = 0.364$ ). However there was a significant correlation between, SJ and CMJ percentage of leg fat ( $r = -0.602$ ,  $r = -0.643$ ,  $p < 0.05$ ) and leg fat weight ( $r = -0.441$ ,  $r = -0.503$ ,  $p < 0.05$ ).

## Conclusion

As a results SJ and CMJ is correlated with percentage of leg fat and leg fat weight. Results indicated that increased body fat might be a detriment to the SJ and CMJ Performance. There are much more correlation studies are necessary with body composition and explosive power.

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# Behavior of external and internal loads in the preparation of professional soccer players in a competitive microcycle of the Brazilian soccer

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## Introduction

Sport performance is a complex situation and is determined by many variables.

Considering this complexity, it is recommended that preparation for a soccer match consider physical, tactical and technical aspects. And just like in the competition, the training sessions presents some performance indicators that can show us the measurement or control of training loads. The objective of this study was to follow some physical, tactical and technical indicators during a preparation microcycle with duration of one week and its consequent result in an important match for the team at the end of the period.

## Methods

21 athletes were followed during this period, with training sessions and game volume recorded, covered distance evaluated by GPS System (BT-Q1300ST, 5Hz, Q-Starz), training intensity measured by heart rate variability (Firstbeat Sports System) and technical scout measured with Statsoccer – Statistic and Technical Analysis Software and Standard Datafolha Institute. The data were collected during the preparation of a professional soccer team in the final phase of the Professional Brazilian Soccer Championship – B Series.

## Results & Discussion

A number of 5 training sessions were recorded in the period with average intensities of 1.7 to 3.9, with high intensities observed in groups of full size field or small sided games. However, these marks are far from the averages observed in an official match, located above 4.0 level. When considered just the principal players group, a great number of players had below-average training intensities recorded from the group. The distance covered in the game was closer to the observed for this level of high performance athletes, being 4,785.5 meters in the first half and 4,396 meters in the second half; Intensities (above 18 km/h-1) accounted for 10.2% of the total. Athletes who presented more than 12% of the movement in high intensity did not show a decrease of physical performance in the second half. It happens because they presenting high training intensities. The accuracy of right passes was good (85.4%) with many disarms (82 complete disarms and 64 incomplete disarms), without any association with physical or training indicators. The team was successful in the match winning the opponent by 4x0.

## Conclusion

We concluded that isolated analysis of the training in a microcycle does not present correlation to the final result of a soccer match, modality in which competition period is continuous and long. Analysis of specific and individual situations may suggest satisfactory performances in competition. Offensive technical indicators are valid, but the ability to recover the ball possession or disarms from the opponent is a decisive factor for success.

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# Squat jump performance is not affected by skeletal maturity status in youth soccer players

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## Introduction

Within the field of soccer, assessing jump performance to evaluate anaerobic power is well established and have previously included various vertical jumps protocols such as the squat jump (SJ; Comfort et al. 2014). At present, however, the literature regarding the development of jump performance has not considered variation associated with skeletal maturational status in a youth soccer population. This study evaluates the contributions of age, growth, skeletal maturation and training to longitudinal changes in SJ performances of male soccer players aged 11-17 that can be described as a developmental pool for potential talent identification.

## Methods

Eighty-three youth soccer players 11-13 years at baseline were annually followed 3-5 times, resulting in 366 measurements. Measurements included chronological age (CA), skeletal age (Roche et al., 1988), stature, body mass, four skinfolds, SJ (Bosco et al., 1983) and annual volume training. Longitudinal changes in SJ height across age were predicted using multilevel random effects regression analyses.

## Results & Discussion

Skeletal maturity status had a negligible effect on SJ performance. The SJ protocol emphasized CA, growth in stature and the decrease of subcutaneous adiposity as longitudinal predictors. The best fitting model could be expressed as follows:  $-0.24 + 0.79 \times CA + 0.22 \times \text{stature} - 0.12 \times \text{sum of skinfolds}$ .

## Conclusion

This study showed that the longitudinal development of SJ performance in young soccer players is related to age, growth and reduced subcutaneous adiposity. The use of the SJ protocol is recommended in youth soccer identification and selection programs because skeletal maturity status has no effect on its development through adolescence.

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# Biomechanics in soccer on 21st century. A review.

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## Introduction

Biomechanics in sports, particularly in Soccer, emerged as a result of technological evolution and the constant need to achieve perfection and excellence. According to Amadio (1996) Biomechanics refers to the externally observable characteristics of movement structure. Some important applications of sports biomechanics in soccer is to understand the general mechanic effectiveness of the movement, the detailed description of the skill and the analysis of the factors underlying successful performance. The purpose of this study was to systematically synthesize the scientific literature related with the topic, in order to systematize information for future studies.

## Methods

The articles were searched through online database research: PubMed, SPORTDiscusTM, Web of ScienceTM and Scopus. Papers were selected in three stages. On the first, the keywords used were: "biomechanics", "football" and "soccer", excluding the term "NOT "American Football"". Then, papers were excluded for the following reasons: no full text available; data below the year of 2001 and papers related with injuries. Lastly, has been excluded papers for the following reasons: duplicate articles and irrelevant information like Clinical papers. Then, the remained papers were divided in different types: "Systematic Review", "Case Study", "Transversal Sample Study" and "Longitudinal Sample Study". Afterwards, were sub grouped according different biomechanical areas, including "Kinematics", "Anthropometry", "Dynamometry" and "Electromyography".

## Results & Discussion

A total of 1442 papers were identified and was prepared for screening (PubMed- 128; Web of ScienceTM- 373; SportsDiscusTM- 716; Scopus- 225). Then, were excluded 1050, which allowed to identify 392 papers (PubMed- 43; Web of ScienceTM- 116; SportsDiscusTM- 125; Scopus- 108). Thirdly, has been excluded 204. At the end were obtained 188 full-text papers (PubMed- 25; Web of ScienceTM- 63; SportsDiscusTM- 97; Scopus- 3). About this number, we have 9 Systematic Reviews, 7 Case Studies, 118 transversal sample studies and 54 longitudinal studies. Therefore, we have 24 studies about Electromyography, 65 about Dynamometry, 20 about Anthropometry and 79 about Kinematics.

## Conclusion

It's possible to state that Sample Studies are the type of articles more used, that Kinematics is the biomechanical field most studied and that Motor Skills and Technical Skills are the soccer areas where more research is carried out. This review showed that, although there is a fair amount of existing articles related Soccer and Biomechanics, there are still many interesting topics to be more explored. Biomechanics is, then, an important area to quantitatively analyse soccer, especially when using statistical criteria.

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# Development of explosive leg power in young soccer players

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## Introduction

In young male soccer players, explosive leg power has been identified as one of the factors contributing to soccer performance (Reilly et al., 2001). Vertical jump performance improves with increasing somatic growth and maturation (Deprez et al., 2015). Skeletal age (SA) assessment is considered the most accurate maturity indicator (Malina et al., 2004) and information on the relationship between skeletal maturity status and vertical jumping is still lacking in the literature. The current study provides a developmental model of explosive leg power across age in young soccer players of contrasting skeletal maturity status.

## Methods

Eighty-three youth soccer players 11-13 years at baseline were annually followed 3-5 times, resulting in 366 measurements. Measurements included chronological age (CA), SA (Roche et al., 1988), stature, body mass, four skinfolds, counter-movement jump (CMJ; Bosco et al., 1983) and annual volume training. Longitudinal changes in CMJ height across age were predicted using multilevel random effects regression analyses.

## Results & Discussion

Skeletal maturity status had a significant effect on CMJ performance. The best fitting model for late-maturing players on CMJ could be expressed as:  $11.84 + 1.59 \times CA + 0.14 \times \text{stature} - 0.12 \times \text{sum of skinfolds}$ . For players on time in maturity status, the best model was the same as for late maturing players plus 2.18 cm, while that for early-maturing players was the same as for late maturing players plus 3.53 cm.

## Conclusion

The current study demonstrates that the longitudinal development of explosive leg power is related to growth and decreased subcutaneous adiposity. Maturity-related variation in the development of CMJ seems to benefit the early and on time maturing players. Youth coaches should approach the development of countermovement explosive leg power on an individual basis according to young athletes maturational status.

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# Speed endurance vs repeat sprint training in competitive soccer players

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## Introduction

Soccer involves the reiteration of acyclical intense actions throughout the game (Bradley et al. 2009). Thus, high-intensity training is important for team sports athletes. For example, in a study (Ferrari Bravo et al. 2008) it was shown that repeated sprint training induces superior athletic gains compared to traditional aerobic interval training, whereas more recently also speed endurance training was reported to improve repeat sprint ability and the Yo-Yo IR2 test performance in trained soccer players (Iaia et al. 2015).

The purpose of the present study was therefore to compare the effect of additional in-season speed endurance training versus repeat sprint training on physical performance in competitive male soccer players.

## Methods

During the last part of the competitive season, twelve male sub-elite young players carried out either speed endurance production (SEP: 4-8 bouts of 15 s all-out with 10 5s of recovery) or repeat sprint (RS: 2-4 series of 6 bouts of 5 s all-out with 15 s of recovery between bouts and 180 s between series) training twice a week for 4 wks. Before and after the intervention, players performed the Yo-Yo Intermittent Recovery 2 (YYIR2), a 200-m sprint and the Mognoni (6 min at sub-maximal speed 13.5 Km/h) tests.

## Results & Discussion

The distance covered in the YYIR2 was 14.9% ( $793 \pm 111$  m vs  $953 \pm 174$  m  $p < 0.05$ ) and 15.8% ( $820 \pm 103$  vs  $973 \pm 178$  m  $p < 0.001$ ) higher after SEP and RSE training, respectively. No differences between groups were found. No Pre-to Post differences were observed in the 200 m sprint time and Mognoni test.

## Conclusion

Both SEP and RSE improved high-intensity intermittent exercise capacity in competitive soccer players indicating that these two different training regimes target similar determinants of soccer-related physical performance.

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# Acute: Chronic workload ratio and injury incidence in professional football players.

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## Introduction

Acute:chronic workload ratio (A:C ratio) have been identified as being more useful to discriminate players at risk of injury among different field-based team sports, including football (Malone et al., 2016). One of the tools to quantify the training load in football is the rate of perceived exertion (RPE). The aim of this study was to analyse the effects of different A:C ratios on the risk of injury.

## Methods

One hundred thirty four elite professional football players, from 5 teams playing european competitions, have been followed up during a complete season. The RPE, training load and non contact injuries, defined according to the UEFA consensus (Fuller et al., 2006), were recorded during the whole season.

The 4-weeks, 3-weeks, 2-weeks and week-to-week workload ratios have been calculated retrospectively. The relative risk, the sensitivity and specificity, the positive and negative likelihood ratios, and receiver operator characteristic (ROC) curve have been calculated to analyse the link between the A:C workload ratio and the injury risk.

## Results & Discussion

The results indicated that the relative risk was higher when the 4-weeks A:C ratio was under 0.85 (RR=1.31, CI95%: 1.02 to 1.70), the 3-weeks A:C ratio was above 1.3 (RR=1.37, CI95%: 1.05 to 1.77), the 2-weeks A:C ratio was out of the 0.85 to 1.25 range (RR=1.55, CI95%: 1.20 to 1.99) and the week-to-week ratio was under 0.85 in comparison with a ratio above 0.85 (RR=1.78, CI95%: 1.34 to 2.37) and in comparison with a ratio included in the 0.85 to 1.25 range (RR=1.33, 1.01 to 1.75). However, none of these ratios present both high sensitivity and specificity. Positive and negative likelihood ratios were close to 1 or included 1 in the 95% confidence interval.

## Conclusion

Even if some ratios presented an increase in the relative risk of injury, the sensitivity, specificity, positive and negative likelihood ratios did not allow these ratios to discriminate players at risk and to predict reliably the injury risk.

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# Profile of soccer injuries at the 19th Nigeria university games hosted by university of Ibadan, Ibadan, Nigeria

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## Introduction

Soccer, one of the most popular team sport (Dvorak & Junge, 2000) is associated with high rate of injury (Hawkins et al., 2001). Soccer, described as a "collision sport" due to its physical nature. Sports injuries are very common, though it is an unwanted aspect of participation in sports (Lower, 1996). The aim of this study is to determine the profile of soccer injuries at the 19th Nigerian University Games including incidence, causes, locations, severity, mode of treatment and effect of play position on injuries.

## Methods

Observational research technique was used to obtain data during the competition and 16 matches were played and studied. Consent was obtained from individual players with injury before they were allowed to participate in the study. Data was collected using the Soccer Injury Assessment form. The researcher and assistant were present at soccer matches played during the 19th Nigerian University games and sitting in a vantage position near the sideline where an uninterrupted view of the length and breadth of the soccer pitch can be viewed. Data for every injured soccer player on the field of play such as causes, locations and severity of injuries, mode of treatment received on the sideline, player's position of play and the stage of the competition were recorded. Descriptive statistics of frequency, percentage mean, pie chart and bar chart were used for data analysis.

## Results & Discussion

Fifty seven players were injured and 113 incidence of injuries. The ankle was most frequently injured with 25 (22.12%) cases, while the groin and the foot regions were the least injured body part (1 case, 0.88%). The incidence of injury to the knee joint was 22 (19.47%). The most frequently injured body segment was the lower extremity, while the least injured body segment was the trunk. Minor injuries recorded were 48 (42.48%), while 2 (1.77%) serious injuries were observed. Most of the injuries sustained were due to direct trauma. Physiotherapy treatment included cryotherapy, massage and passive stretching of muscles. Midfielders recorded the highest number of injuries, while the highest number of injuries was recorded among University of Ibadan soccer players. Federal University of Technology, (FUTA) players sustained 5 (8.8%) the least injury.

## Conclusion

In conclusion, the most frequently injured segment of the body and body part were the lower extremity and the ankle respectively. Existing rules of the game should be enforced or modified to reduce the incidence of injuries.

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# Activity profile for 10-12-year-old Danish school children participating in "FIFA 11 for Health" for Europe

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**Introduction** The "FIFA 11 for Health" Europe is a football-based 11 week health education program consisting of 2x45 min football-related activities delivered by trained teachers. The program has been evaluated and during the 11-week study period systolic blood pressure (−3.5 vs 0.9 mmHg), mean arterial blood pressure (−1.9 vs 0.4 mm Hg) and body fat percentage (−0.83% vs −0.04%) decreased more ( $p < 0.05$ ) in the football group (FG) than in the control group (CG) (Ørntoft et. 2016). The aim of this study is to describe the activity profile during 11 weeks of "FIFA 11 for Health" Europe.

## Methods

45 10-12-yr-old pupils were monitored during 8 of the 22 "FIFA 11 for Health" in Europe sessions. The activity profile was monitored using the ZXY tracking system (ChyronHego, Norway) and heart rate was monitored with the Team 2 system (Polar, Finland). Distance covered in various speed zones (Walking (0-4 km/h), jogging (4.1-8.0 km/h), running (8.1-12.0 km/h), high intensity running (12.1-16.0 km/h) and sprinting ( $> 16$  km/h) was determined.

## Results & Discussion

The mean distance covered during a session was  $1987 \pm 315$  m where distance covered included: walking (42.1%), jogging (31.7%), running (15.5%), high intensity running (8.9%) and sprinting (2.0%). The average heart rate was  $64 \pm 4\%$  of maximal heart rate (HRmax). The average time spent with a heart rate  $> 80\%$  HRmax was  $17.7 \pm 8.2\%$ .

## Conclusion

The study shows that the activity level is high during an average "FIFA 11 for Health" for Europe session and includes both high intensity running and periods with high heart rate. Further studies are needed to investigate the exercise intensity and distances covered for various subgroups of children, boys vs. girls, fit vs unfit and sport club active vs. non sport club active.

# Prevalence of positive Clarke's sign in amateur undergraduate soccer players of the University of Ibadan, Ibadan, Nigeria

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## Introduction

Patellofemoral joint pain syndrome (PFPS) is known in the general population but more often in athletes and the knee is the most common site of pain presented for treatment in sports medicine clinic (Levine, 1995) Retropatellar pain in PFPS can be so severe to the extent of denying sportsmen full participation in sports and leisure activities (Levine, 1995) and some may have to abandon sports (Janice et al., 1993). For early detection there is a need to carry out Clarke's test to identify athletes that are prone. The purpose of this study was to determine the prevalence of positive Clarke's sign in amateur soccer players.

## Methods

This study involved 100 randomly selected apparently healthy undergraduate amateur soccer players with no history of knee pain and musculoskeletal diseases. Consent was obtained from each soccer player before they were allowed to participate in this study. Height, weight of each participants were measured and their age was obtained as well. Clarke's sign test was carried out on each participant and when test is positive, the level of pain was measured using visual analogue scale.

## Results & Discussion

Participants were aged between 18 and 30 years with mean age of  $24.30 \pm 2.93$  years, their mean weight was  $67.20 \pm 7.06$  kg. and height was  $167.60 \pm 17.37$  cm. The percentage prevalence of positive Clarke's sign for amateur soccer players was 82%. The average pain level was 4.8. The prevalence of positive clarke's sign among amateur soccer players is high

## Conclusion

The prevalence of positive Clarke's sign in asymptomatic knees of amateur football players is however high. There is need for routine examination, assessment and screening of soccer players for positive Clarke's sign. This will allow for early therapeutic intervention.

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# Agreement between Adidas smartball and 3d motion analysis for measuring ball velocity and spin during soccer kicking

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## Introduction

The Adidas Smartball (ASB) is an inexpensive and commercially available tool that can be used to quantify the efficacy of soccer kick training. The ASB uses an internal accelerometer to provide immediate measures of kicking performance (i.e. ball velocity and spin) direct to a smartphone or tablet device. However, to be useful for training intervention and feedback purposes in the field, the ASB should agree with established laboratory techniques. Therefore, the purpose of this study was to assess agreement between ASB and 3D motion analysis (3D) methods of determining ball velocity and spin during soccer kicking.

## Methods

Nine men ( $29 \pm 8$  yrs) each performed 10 kicks into a catching net placed 10m away with the ASB. Maximum resultant ball velocity (Velmax) and spin (Spinmax) were recorded concurrently from the ASB paired with the proprietary Smartball App for iOS (V3.4.3) and a 14 camera motion analysis system (240Hz, Vicon, Oxford, UK). No information regarding the ASB accelerometer specifications is publicly available. For 3D, six markers defined the ASB's geometric centre and Velmax was determined as the average of the ball centre resultant velocity values from the first five airborne frames. Spinmax was determined as the resultant angular velocity about an orthogonal axis defined at ball centre relative to the global (lab) axes. Values from the ASB were converted to SI units and 95% limits of agreement (LOA) between the two methods were calculated (Bland and Altman, 1999).

## Results & Discussion

Mean Velmax from the ASB was  $24.1 \pm 4.3$  m/s compared to  $23.3 \pm 3.9$  m/s from 3D (Mean difference =  $0.9 \pm 1.2$  m/s, 95% CI = 0.6-1.1 m/s). The ASB is likely to produce Velmax values that are 3.27 m/s (95% CI = 2.87 to 3.66 m/s) greater and 1.57 m/s (95% CI = 1.18 to 1.97 m/s) less than those from 3D. Mean Spinmax from the ASB was  $24.0 \pm 11.2$  Rad/s compared to  $25.3 \pm 10.0$  Rad/s from 3D (Mean difference =  $1.3 \pm 2.9$  Rad/s, 95% CI = 0.7-2.0 Rad/s). The ASB is likely to produce Spinmax values that are 4.3 Rad/s (95% CI = 3.4 to 5.3 Rad/s) greater and 7.0 Rad/s (95% CI = 6.1 to 7.9 Rad/s) less than 3D. The ASB tended to overestimate Velmax compared to 3D and underestimate Spinmax compared to 3D. Underestimation of Spinmax was exacerbated when spin was less than 20 Rad/s.

## Conclusion

Bias was present for measures of both ball velocity and spin. Therefore, where possible, the ASB and 3D methods should not be used interchangeably. However, the ASB can be implemented as a viable and easy to use field-based method of measuring kicking performance, should researchers and practitioners carefully consider these limitations.

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# Could be protected? Corellation among self-evaluation and burn out on soccer coaches

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## Introduction

One of the most "dangerous" opponent for coaches is their self and the feelings about their job. Participating in soccer is the personal ambition for them, and especially to be succeeded. But, sometimes they feel the stress of their job at a high level and finally the symptoms of burn out. The most common work stressors have been identified over a number of years in stress research (1) and summarized into six work stressor themes: demands (work patterns, work pace, working hours, working environment), control (how much say the person has in the way they do their work), support (encouragement, sponsorship and resources provided by the organization, line management and colleagues), relationships at work (positive working practices without conflicts), role (whether people understand their role within the organization and whether the organization ensures that the person does not have conflicting roles). Burn out is defined as a psychological syndrome of emotional exhaustion, depersonalization and reduced personal accomplishment (2). For the researchers, the ability to know and manage your self could probably help coaches in their job and empowerment them to avoid negative feelings and situations. Self-evaluation would be a factor that could contribute to know their selves and deal with stressors.

## Methods

The sample consisted of 156 soccer coaches aged 26-62 years. They completed a Self-Evaluation questionnaire (2) with 60 items five subscales: organizational ability, transmissibility, communication ability, relationship with partners and personal development. Burn out was measured by Maslach Burnout Inventory (3) which consists of 22 items and three factors: emotional exhaustion, personal accomplishment and depersonalization.

## Results & Discussion

The results demonstrated that there is a correlation among the factors of self-evaluation and burn out. Especially, all the factors of self-evaluation demonstrated positive correlation with personal accomplishment and negative with emotional exhaustion and depersonalization. In some cases correlations were statistically significant.

## Conclusion

According to the results, coaches who know their self, their strengths and weaknesses, could have the ability to deal with stressors who should lead them to burn out.

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# Third Zone Attacking Organization Analyses of European Football Leagues

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## Introduction

The aim of this study was to examine pre-assist passes, assists and goal scores of different zones for different national leagues (England premier league, France Ligue 1, Spain Laliga Santander and Turkish Spor Toto Super Lig).

## Methods

All highlights of the matches (totally 1446 matches) were analysed on LIG TV websites by the two scientists.

## Results & Discussion

According to the normality test (Kolmogorov Smirnov Test), non-parametric Kruskal Wallis (KW) Test was used for the analyses. Kruskal Wallis test results showed that the pre-assist passes made by the teams in corner kick during the games, the assists made in corner kick, the goals scored from carom positions, the goals scored from the short pass made into penalty area varied significantly with regard to the different leagues. In brief, when the offense diversity in the 3rd zone which is one of the biggest problems of the teams in today's soccer is considered, the research findings are suggested to be a guiding light for trainers and players. According to results of study, it is shown that Turkey leagues third zone attacking organization quality is far away from the European league standards such as England, Spain and France.

# Interrelationship between skeletal maturation, body size, jumping and running performances among elite soccer players aged 14-15 years

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## Introduction

Growth and maturation are reasonably described in the general population and also in young athletes (Malina et al., 2004; 2015), and are implicit characteristics of talent identification and development (Reilly et al., 2003; Williams et al., 2000). The current study was aimed to examine maturity-associated variation obtained from assessments of skeletal age on body size, fatness, standing long jump, 35-m running sprint and 20-m shuttle run test among elite adolescent soccer players who were selected by the Portuguese Soccer Federation to participate in the under-16 1999 European Championship

## Methods

The sample was composed of 58 male adolescent players aged 14.0-15.9 years. Skeletal age (SA) was assessed using the FELS method (Roche et al., 1988). Skeletal maturity status was estimated as SA minus CA: late (delayed), SA younger than CA by > 1.0 year; average (on time), SA within  $\pm 1.0$  year CA; early (advanced), SA older than CA by > 1.0 year. Stature was assessed using a stadiometer (Harpender stadiometer, model 98.603, Holtain Ltd, Crosswell, UK). Body mass (BM) was measured using a digital scale (SECA balance, model 770, Hanover, MD, USA) to the nearest 0.1 kg. Triceps and medial calf skinfolds were measured following international protocols (Lohman et al., 1988) and fat mass was estimated (Slaughter et al., 1988). Lower limb explosive strength was given by the standing long jump protocol. Additionally, a 34.2-m sprint test with a slalom and an aerobic endurance test assessed using the 20-m progressive shuttle-run (PACER) were also performed.

## Results & Discussion

The mean heights and body masses of this sample of late adolescent elite soccer players exceeded the age-specific 50th percentiles of US reference data (Center for Disease Control and Prevention, USA) which is consistent with other data for youth soccer players (Malina et al., 2000). Four players were already skeletally mature and the others classified based on the difference between skeletal and chronological ages were on time (n=29) and advanced (n=25). Comparisons among groups contrasting in skeletal maturity categories showed a small effect size for the standing long jump ( $\sim 4$  cm;  $d=0.25$ ; not significant), velocity ( $\sim 0.23$ s;  $d=0.45$ ; not significant) and PACER ( $\sim 160$  m;  $d=0.48$ ; not significant). Additionally, early maturing players are, on average, taller

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(2.0cm) and heavier (6.5kg) than players maturing on time.

### **Conclusion**

Previous research noted sexual maturity status as the primary contributor to the variance in the intermittent shuttle run, whereas body mass and stature were the primary contributors to the explained variance in the 30-m dash and vertical jump, respectively (Malina et al., 2004). It seems that the proportion of late maturing soccer players decrease with increasing chronological age (Malina et al. 2000). By inference, it is hypothesized that late maturing boys selectively dropout from soccer as age and sport specialization increase suggesting that the sport systematically excluded late maturing boys and promoted average and early maturing boys. In this study, among an elite group of late adolescent soccer players who were selected for the Portugal national team, biological maturation corresponded to a small source of inter-individual variation. A larger effect size would possibly occur at younger ages and in studies comprising players classified as local and regional participating at club level.

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# A holistic approach: Merging mental and physical skills training in a developmental academy

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The benefit that sport psychology programs can have on performance is noted in sport psychology literature (Williams & Krane, 2001). Thus, it could be in the best interest of an athletic team or organization to utilize sport psychology training. This presentation will discuss implementing a sport psychology program into an elite soccer development academy for approximately 60 male players ages 13 to 18. When implementing a sport psychology curriculum, there are several factors practitioners should consider, including service delivery methods, developing relationships and ethical boundaries with organization staff, and establishing a presence with the team. There are also barriers practitioners are likely to face that could hinder the program's effectiveness. Examples including being flexible with scheduled group and individual consultation times, earning the trust of the coaching staff and players, and maintaining ethics in the face of inevitable dual-role relationships. Presenters will explain how they managed these concerns when implementing their program. The program includes mental skills training materials as well as group and individual consultation. In particular, this presentation will discuss the creation and administration of an online sport psychology workbook, focusing on deciding which skills to include, in what order to present them to players, and alternatives to costly materials. Further, presenters will examine the structure of group and individual meetings with players, describing the frequency, duration, and location of meetings, effective scheduling, meeting with coaches, and how to present materials. Field observations will also be described, with presenters discussing the benefit of observation, how to apply observation to consultation, and how to handle oneself on the field among team staff and players. The Staff's successes and hardships will be reviewed, along with practical issues such as funding for materials, traveling with the team, and balancing staff commitments to other programs.

# The effects of Olympic simulated game schedule on mucosal immunity, muscle damage, inflammatory response, and sleep quality.

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## Introduction

Footballers generally have three games in a week with three days' recovery (72 h) between the matches in football at Summer Olympic Games. However, to the best of our knowledge, the effect of this schedule on physical condition, sleep quality, and football performance is unclear. Thus, the purpose of this study was to examine the effect of 3 consecutive games in one week with three day's recovery between the matches on physical condition, including mucosal immunity, muscle damage, and inflammatory response, sleep quality, and football performance.

## Methods

Six male collegiate soccer players took part in this study. During 7days study period, we measured body weight, took blood sample, and collected saliva besides assessing subjective condition using visual analog scale every morning. All meals were controlled to contain about 7g of carbohydrates per kg of body mass per day. Subjects played 90 minutes game three times (Game 1, 2, and 3) with three days' recovery (72 h) between matches. Before each game, glycogen of the thigh muscle was measured by <sup>13</sup>C-magnetic resonance spectroscopy.

## Results & Discussion

No significant changes were seen in morning saliva secretion rate. However, that of the end of game 3 was significantly decreased compared to that of game 1. In addition, serum creatine kinase was changed significantly during experimental period ( $p < 0.05$ ). High sensitivity C-reactive protein was significantly increased in day 2 and day5 compared to day 1 ( $p < 0.05$ ). No significant changes were seen in body mass between pre and post values. Sleep arousal during sleep was significantly changed during the study period. There was significant increase in total distance covered in game 3 compared to that in game 1 ( $10335.0 \pm 753.6$  m,  $10571.3 \pm 601.7$  m, and  $11398.2 \pm 358.6$  m, respectively,  $p < 0.05$ ). However, the changes of muscle glycogen concentration were not significant.

## Conclusion

In conclusion, our present results suggested that having three games in one week had an effect on player's physical condition, sleep quality, and game performance. These results provided a clue to optimal conditioning for footballers, who play 3 consecutive games in one week, such as Summer Olympic Games.

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# Investigation of a Point of Care Salivary Testosterone Test Prototype

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## Introduction

The use of tests to measure salivary biomarker responses has become increasingly popular in professional football. At present rapid tests exist to measure antimicrobial proteins sIgA and alpha amylase, as well as the catabolic hormone cortisol on a Point of Care (POC) device available in the soccer setting. The ability to measure an anabolic hormone such as testosterone would be of great benefit for the creation of T/C ratios, which could be used as a marker of readiness to train either in combination or as individual markers.

This first study examines the feasibility of measuring salivary testosterone on a platform already validated for sIgA and cortisol (MacDonald et al., 2017).

## Methods

A total of 16 saliva samples using the SOMA oral fluid collector II (OFCII) kits (SOMA Bioscience Ltd, Wallingford, UK), with collections at different times of day to also investigate diurnal patterns. The samples were assessed immediately for salivary testosterone using the concentrations in the field using the POC platform of a Lateral Flow Device (LFD) and a reader. The incubation time for running an LFD is ten minutes and the scanning time 4 seconds. The same samples were then analysed on ELISA using a commercial assay kit (Salimetrics LLC, PA, USA) and the concentrations determined. The assay calibration range on the POC platform is 31-4000pg/ml; whilst on the ELISA it is 6.1 – 600 pg/ml.

## Results & Discussion

The absolute values reported were lower on the POC platform than the commercial ELISA kit ( $105 \pm 62$  pg/ml v  $168 \pm 68$  pg/ml, respectively). The testosterone values ranged from 68 – 301 pg/ml on ELISA and 18 – 216 pg/ml on the POC test. However, the Pearson correlation between test types was very strong,  $r = 0.86$  (95% CI, 0.64 – 0.95), showing good validity of the POC. Furthermore, both assays demonstrated the expected circadian pattern of testosterone, typically higher in the morning and lower in the evening.

## Conclusion

The prototype POC salivary testosterone test showed good agreement with a commercial ELISA kit. Given the considerable time advantage of a POC test over traditional laboratory methods, this new show great potential in being able to determine rapid salivary testosterone values in the sports training environment, giving immediate feedback to sports scientists and coaches for successful intervention.

## References

MacDonald L, *et al.*, (2017) Reliability of salivary cortisol and Immunoglobulin A measurements from the IPRO before and after sprint cycling exercise. *Journal of Sports Medicine and Physical Fitness* (in Press).

# Validity and reliability of a Point of Care salivary IgA and Cortisol Test used in a Professional Football Club

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## Introduction

The use of tests to measure salivary biomarker responses has become increasingly popular in professional football. A Point of Care (POC) platform using lateral flow (LFD) technology, which takes just over 10 minutes to measure salivary IgA has previously been validated (Coad et al., 2015) and been found useful for monitoring purposes (MacDonald et al., 2017). The ability to multiplex sampling would save processing time and speed up the delivery of data in the applied setting when assessment of more than one marker is desired. Salivary cortisol is a catabolic hormone that is measured to determine stress levels (from training load and other factors). This study examines the use of a dual salivary IgA / cortisol POC test at a professional football club.

## Methods

A total of 25 saliva samples were taken from a cohort of professional soccer players, using SOMA oral fluid collector II (OFCII) kits (SOMA Bioscience Ltd, Wallingford, UK), during routine monitoring procedures. The samples were assessed immediately for sIgA and cortisol concentrations in the field using the POC LFD kits and reader. The same samples were then taken to a laboratory for subsequent analysis by ELISA. The measurement range on ELISA was 18.5 – 600 µg/ml for IgA and 0.5 – 40 nM for cortisol; on the POC platform it was 25-800 µg/ml for IgA and 1.5 – 40 nM for cortisol.

## Results & Discussion

The sIgA values ranged from 81 – 699 µg/ml on ELISA and 37 – 444 µg/ml on the POC test; whilst cortisol values ranged from 2.1 – 19.1 nM on ELISA and 1.5 – 23.8 nM on the POC test. The Pearson correlation between test types was  $r = 0.91$  (95% CI, 0.79 – 0.97) for IgA and  $r = 0.90$  (95% CI, 0.75 – 0.96) for cortisol, showing good validity of the POC method for both assays. Reliability was better for IgA with the mean within CV for triplicates at below 7% for a range of concentrations and below 12% for cortisol.

## Conclusion

The dual analyte IgA & cortisol POC test showed good agreement with ELISA and good reliability. Given the considerable time advantage over traditional methods, this new test is of benefit to applied practitioners in sports and exercise science who need rapid data from two biomarkers, to act upon for successful intervention within the hour of sample collection.

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# Ball possession during professional football games and the relationship with the score.

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## Introduction

Technical aspects during football games have been well analysed in sports science. Zubillaga et al. (2007) have demonstrated that the number of completed passes and the accuracy was the main difference between successful and unsuccessful teams. Lago (2010) explained that the difference between high and small level teams is in technical and tactical aspects as goals, shots, assistances and ball possession. Hughes (2005) explained that successful teams have the capacity to transform the ball possession into finishing actions. The best teams have better technical and tactical capacities as ball possession, number of finishing actions and defensive capacity to stop the opponent offensive actions (Vazquez et al., 2015). The performance in football is directly related with ball possession (passes and ball lost), effective finishing actions and defensive capacities.

## Methods

In this study, technical aspects were analysed (ball lost, completed passes, missed passes, goals and finalisations) in 12 professional top level football games. There are 24 teams and each game was analysed during 4 different periods: 0-15, 30-45, 45-60 and 75-90 minutes. The aim of this study was to observe the evolution of the ball possession during the game, to see if there are differences among these periods, and to see if technical aspects are related with the result.

## Results & Discussion

59,3% of successful teams made a lower number of missed passes, 83,3% had lower ball lost during the game, 25% completed more passes and 59,3% finished more actions. 91,7% of the teams who completed more passes, made a higher number of missed passes and 66,7% had more finished actions. 66,7% of unsuccessful teams has increased completed passes during the second half. In 92% of the games, there is a clear dominant in ball possession with a significant difference in ball possession with the other team. The highest number of goals has been scored during the last 15 minutes of the game.

## Conclusion

Unsuccessful teams lost more balls and made more completed passes than successful teams. The higher passes the players completed, the more missed passes they made. When the team has the ball during more time and make more passes than the other team, the possibilities to loose the ball increase significantly. The need to score a goal increases the ball possession, goals and finishing actions during the second half. The victory in a football is directly related with the effectiveness in finishing actions but not in the ball possession.

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# Activity profile, perceived exertion and flow from 4v4 street soccer for homeless women

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## Introduction

Exercise intensity during street soccer for homeless men is high (Randers et al., 2012) and 12 weeks of street soccer training led to improved physical fitness and cardiovascular health (Randers et al., 2012) and resulted in a substantial anabolic response in bone metabolism and improved postural balance (Helge et al., 2014). Street soccer for homeless women has not been investigated, thus, the purpose of this study is to describe the activity profile of homeless women playing street soccer.

## Methods

Fifteen homeless women (30.3±5.0 yrs (±SD), 1.65±0.08 m, 65.1±11.0 kg, 5±4 yrs of prior soccer experience) played street soccer (3v3+goalkeepers) at Women's Homeless World Cup. Games were 2x7 min interspersed with 1 min halftime break. The pitch was 22x16 m surrounded with 1.1 m high boards and goal size was 4.0x1.3m. During games heart rate (HR) and activity profile were measured using Polar team 2 and Catapult Minimaxx S4 units. After each game rating of perceived exertion (RPE) for lower limbs and total body was individually rated on a visual analogue scale (0-10), and flow and worry were measured on the 13-item Flow Kurz Skala. Only data on field players are analyzed.

## Results & Discussion

The mean playing time was 11.1±2.6 min. The mean HR was 174±7 bpm and peak HR during matches reached 188±10 bpm. Time spent in HR zones as percentage of total playing time was: < 120 bpm: 1±2%, 120-160: 23±22%, 160-180 bpm: 45±21%, HR > 180 bpm: 31±28%. The total distance covered was 757±214m equal to 69±9m per min. 82±14% (54±2m/min) of this distance was covered with low-speed running (< 9 km/h), 15±6% (11±6m/min) with moderate-speed running (9-13 km/h) and 3±3% (2±3m/min) with high-speed running (> 13 km/h). 44±5% of the total distance covered was covered with forward running, 44±3% covered with sideways running and 12±3% with backward running. Player Load was 103±31 AU equal to 9.3±11.7 AU/min. The number of high, moderate and low accelerations were 1.7±0.8, 3.4±0.7 and 10.2±2.0, respectively. Mean RPE was 4.8±2.5, total flow score was 5.5±0.8 and total "worry" score was 4.6±1.3.

## Conclusion

Our results demonstrate that street soccer for homeless women led to high mean heart rates. The high heart rate response may be due to a significant number of specific movements and accelerations/decelerations.

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# Kinetics of internal load and relationship with external load in soccer games with 48 hours of interval

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## Introduction

Modern football requires a high physical demand of their athletes during the matches. Matches with very short periods of rest may generate in the athletes a Non-Functional Overreaching or even an Overtraining. The monitoring of internal and external loads can be useful for the prevention and detection of these phenomena. Therefore, the present study aims to verify the kinetics of internal and external loads in order to observe kinetics that tend to Overtraining or Non-Functional Overreaching.

## Methods

Youth players of the U-20 category of a Brazilian club, were studied during a national competition. The players played three matches with the 48-hours interval between them. Internal load variables (biochemical markers) and external load (High Intensity Actions, HIA) were monitored. For the internal load, blood samples were collected to measure the variables: Testosterone (T) Cortisol (C) C-Reactive Protein (CRP), Interleukin 1 $\beta$  (IL1 $\beta$ ) and Interleukin 6 (IL6). For external load was used GPSs (Catapult, Australia) with 15Hz of sampling frequency for data acquisition. The variable measured was the number of high intensity actions (HIA) during the matches. For the statistical treatment, ANOVA was used with post hoc of Tukey to verify the differences between the variables in the three games and Pearson's correlation to correlate the biochemical variables with the AAI.

## Results & Discussion

The present study verified that the CRP increased gradually after the three matches and the other variables remained. In addition, only CRP showed a strong correlation with the external load. All biochemical variables demonstrated an incremental behavior from the first to the second game ( $p < 0,01$ ). However, from the second to the third this increase dynamics was repeated only for CRP ( $p < 0,05$ ). The other variables did not present significant differences between values from the second game for the third match. Correlations between biochemical variables and HIA presented weak to moderate correlations ( $r = 0,31$  to  $r = 0,55$ ) with  $p < 0,05$  in the first, second and third match, except for the correlation between HIA and CRP in the third match, which presented  $r = 0,79$  ( $p < 0,01$ ).

MOHR. et al (2015) verified that, in matches with 48-hour intervals, a significant increase of CRP ( $p < 0,05$ ) between the first and second game, but after the third match the increase did not maintained and presented a slight fall, however, not significant. Still according to MOHR. et al (2015) the levels of cortisol, testosterone and interleukins presented some differences that deserve attention: Cortisol levels increased proportionally and significantly ( $p < 0,05$ ) in the first two games, however, fell after the third match; Testosterone levels had a minimal difference; The levels of interleukins (IL-1, IL-6) remained after the first game. Knowing the various physiological changes in the body, new cases of Non-Functional Overreaching and Overtraining can be

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avoided, however, more studies regarding the physiological responses need to be presented.

There is still a need to find out if players can take risks if they keep the weekly pattern of the calendar demonstrated in the present study or if in certain periods of the calendar this may be applicable to the players. In future studies, the values of the internal loads in the recovery period should be observed to identify whether the values return to basal levels or remain elevated.

### **Conclusion**

This study concludes that there are variations between the internal load as a response to the matches besides maintaining an incremental kinetics. This dynamic according to the observed values can be great indications that athletes who maintain the presented schedule tend to enter into a Non-Functional Overreaching state and can later evolve to Overtraining. In addition, as a response to the external load, not all internal load variables present a good relation, so it is necessary to observe these variables and their dynamics better.

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# Effects of the Olympic match schedule on football performance, dehydration level and muscle glycogen in hot environments.

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## Introduction

Football players are supposed to play 3 matches in 7 days in the Summer Olympic Games, which means having only 3 days (72 hours) of recovery between the matches. Mohr et al. (2016) showed that the inflammatory response of the 3-days-recovery schedule was greater than that of the 4-days one. Another study focused on a setting of 2 games with a 3-days-break. (Andersson et al., 2010). However, there is no research investigating the effects in the special setting of 3 following matches with only 3 days off in between, respectively. Moreover, it is well known that exercise performance is limited in hot environments (Nybo, 2008). Therefore, the present study was conducted to examine effects of a 3 days' recovery in between the games for a total of 3 matches, which is equivalent to the group stage match schedule of the Olympic Games, on muscle glycogen, dehydration level and football performance in hot environments.

## Methods

Six male collegiate soccer players competed in 3 matches (M1, M2 and M3) in 7 days with a 3 days' break each in hot conditions (WBGT:  $24.2 \pm 2.3$  °C). The nude body mass was measured before and after the matches to evaluate the dehydration level. High time-resolution GPS (15 Hz; GPSport) was utilized to monitor the activity profiles during the matches. Changes in the muscle glycogen concentration of the players were measured by the <sup>13</sup>C-magnetic resonance spectroscopy in the morning on match days.

## Results & Discussion

The body water loss during the matches was comparatively high, but it did not change significantly between the 3 matches (M1:  $3.0 \pm 0.3$  %, M2:  $3.2 \pm 1.1$  %, M3:  $3.8 \pm 0.7$  %). It has well known that exercise performance will be impaired when a player is dehydrated by at least 2 % of the body weight, and that a dehydration level exceeding 3% of the body weight, as shown in this study, can decrease the football performance. However, the physical performance did not significantly decrease in the 3 matches, neither did the concentration of muscle glycogen measured in the morning of match days. The reason for the recuperation to this constant level of muscle glycogen may be due to all players consuming a carbohydrate diet containing 7 g carbohydrates/kg/day during recovery days in between the 3 matches.

## Conclusion

The physical performance in the 3 matches separated only by 3 days each did not decrease as the players could take a sufficient carbohydrate diet during recovery days.

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# Stress coping mechanisms linked to the test situation and its impact on the motor adaptive capacity in young footballers

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This report deals with the relationship between the coping processes linked to the stress and the capacity of motor adaptation of young football players. In fact, the studies done aims at showing whether the relationship between the coping processes and the motor performance varies significantly in relation to the nature of stressful circumstances linked to the pedagogical situation. The subjects have been evaluated by a usual observer and by an exterior observer. The comparison between the observed performances in the two cases shows That there is a close relationship between the independent variable (nature of stressful circumstances) and the dependent variable (motor performance).

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# Quantification of elite soccer referees training loads across a season

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## Introduction

To provide a detailed analysis of MLS referees' training loads across their first season as full-time employed referees with the overarching aim of advancing our understanding of elite soccer referees' physical training.

## Methods

Eighteen match officials from within the Professional Referee Organization and Major League Soccer (MLS) in North America were observed during this season-long study, and data were collected as part of the on-going sports science support provided to the match officials. Referee activities were broken into three categories: matches, physical training, and rest. To further understand the referees' training loads, physical sessions were subsequently divided into ten distinct categories (Match, Speed, Repeated Sprints, High Intensity, Endurance, Strength, Speed + Strength, Repeated Sprints + Strength, High Intensity + Strength, Endurance + Strength). Following each session, referees reported session ratings of perceived exertion (sRPE, CR10 scale) and the scores were subsequently multiplied by the session duration to provide the RPEload (arbitrary unit, AU) (Foster et al., 2001). To provide a detailed quantification of the referees' training, the effects of session type (i.e., categories listed above), day of week (Monday to Sunday) and time of season (five training cycles of six weeks) on RPEload data were then analysed using magnitude based inferences. A total of 3670 sessions were analyzed, with cycle 1 starting including the first 6-weeks and cycle 5 representing the final 6 weeks of the season.

## Results & Discussion

RPEload was greatest for matches, with large differences when compared to Speed, Repeated Sprints, Endurance, and Strength (range 314 to 413 AU) and moderate differences compared to High Intensity and all combined training sessions (154 to 251 AU). Using the regular match day (Saturday) as reference, there was a small difference in RPEload for Sunday (-123 AU; 90% confidence limits  $\pm 23$  AU) with trivial differences for all other days (range -54 to 23 AU). RPE load was greatest in cycle five, with small differences when compared to all other cycles (148 AU to 272 AU).

## Conclusion

In this group of referees, RPEload was highest for matches and the distribution of load was relatively consistent across training weeks and cycles.

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# Disassociation of peak periods of speed and acceleration during elite football

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## Introduction

Soccer is an intermittent team sport, where temporal fluctuations in running intensity are evident throughout the course of a match. Such deviations have been described by dividing match-play into discrete blocks, usually lasting 5-15 min <sup>1</sup>. However, a rolling average technique has been shown to be most sensitive to the most demanding periods of the game <sup>2</sup>. Furthermore, given the importance of acceleration ability amongst soccer players, it may be beneficial to discriminate the peak acceleration of intensity from traditional speed-based analyses.

## Methods

Competition activity profiles were obtained using global positioning system (GPS; 10 Hz Catapult S5) devices from 24 elite-level Australian soccer players ( $24.4 \pm 5.4$  yr) during 40 matches. The proprietor's software provided a speed trace (m.min<sup>-1</sup>), from which average acceleration (AveAcc; m.s<sup>-2</sup>) was also derived as the absolute value of all acceleration and deceleration data. A rolling average technique was applied to establish the maximal 5-min period of the match for both measures (Speedroll and AveAccroll), which were then compared to the predefined block (0-5 min, 5-10 min etc.) method (Speedblock and AveAccblock). Speedroll and AveAccroll were considered to have occurred independent of each other if no part of the 5-min periods overlapped.

## Results & Discussion

There were *most likely* small increases in running intensity for both measures when using the moving average technique, compared to the pre-defined block method (ES =  $0.62 \pm 0.12$  and  $0.48 \pm 0.09$  for speed and acceleration, respectively). Peak periods occurred independently (i.e. did not overlap) in 71% of match files.

## Discussion

This primary finding of this study is that a rolling average technique is more sensitive to the peak periods of competition than using predefined blocks, for both speed and acceleration metrics. Therefore, when prescribing and monitoring specific technical and tactical training drills (such as small-sided games), running intensity should be reported relative to the peak demands of competition. If athletes are exposed to these intensities during training, when faced with such situations within competition they will be perceived as less strenuous. In addition, it seems that in the majority of cases (71%), the peak periods of each of these metrics occur at different stages of the match. This would indicate that training drills that overload these capacities independently should be included in an appropriately periodised athletic preparation program.

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# Placebo effects on recovery kinetics after exercise-induced muscle damage

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## Introduction

When the target is to reduce the time to fully recover from muscle damage, some recovery strategies are effective. However, the effects of these recovery strategies on reliable performance markers are commonly small and may also be linked to a placebo effect (Poppendieck et al., 2013). Wager et al. (2004) found that placebo analgesia was related to decreased neural activity in pain processing areas of the brain. In addition, mental function and psychological states seem to play an important role in the recovery process. Stults-Kolehmainen et al. (2014) showed that subjects with a higher stress levels had slower recovery kinetics than subjects with lower levels. To our knowledge, no study has compared the effects of a placebo with a control condition on recovery kinetics following exercise-induced muscle damage. The aim of this study was to investigate the placebo effects on recovery kinetics following exercise-induced muscle damage.

## Methods

A placebo pill was explained to 12 soccer players ( $24.8 \pm 5.5$  years) as improving the recovery process by means anti-inflammatory and antioxidant properties. Participants performed single-leg hamstring eccentric exercise comprising 75 repetitions to induce muscle damage. Immediately post-exercise, subjects consumed the placebo pill or recovered passively in a balanced and randomized cross-over design. Knee flexor strength, single and double-leg countermovement jumps, muscle soreness, perceived recovery and creatine kinase concentrations were assessed every 24h through a 72h period.

## Results & Discussion

A likely beneficial effect of condition was found in favour of placebo for eccentric force (ES = 0.69; 90% CI = 0 to 1.40). A likely small effect of condition was found in favour of placebo for double-leg countermovement jump (ES = 0.46; 90% CI = -0.20 to 1.10) and soreness (ES = -0.50; 90% CI = -1.20 to 0.2) 72h post-exercise. A very likely moderate effect was found in favour of placebo 48h (ES = -1.19; 90% CI = -1.90 to 0.50) and 72h post-exercise (ES = -1.20; 90% CI = -1.70 to -0.30) for perceived recovery.

## Conclusion

These results showed that the administration of a placebo improves the recovery process after exercise-induced muscle damage in comparison with a control condition.

# The factors determining the profile of physical and morphological capacities of young footballers (U13 and U15).

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## Introduction

The determination of the factors determining the physical and morphological capacities of young footballers (U13 and U15) capable of excelling at the high level of competition, makes it possible to highlight the qualities required for the practice of this discipline and contributes to the Correct resolution of the questions inherent to the sporting qualification and therefore, help to make a precise prognostic or anticipate the evolution of the training process. The aim of this work is to verify whether, for the same age category, some physical and morphological capacities are different when taken at different levels of competition, and therefore to highlight the determinants of the physical and morphological capacities of the competitive soccer player in The U13 and U15 categories.

## Methods

180 young footballers took part in this study: 1) National teams (U13 = 18; U15 = 16) - 2) national league 1 (U13 = 33; U15 = 29) - 3) regional league 2 (U13 = 45; U15 = 42). Two main categories of measurements are carried out (Anthropometric measurements and Tests of evaluation of physical capacities). The statistical analysis of the results ("F" of Fischer-Senedecor) is carried out using the software (SPSS).

## Results & Discussion

The results of this study show that it is impossible, today, to claim on the high level of sporting competition without having particular physical qualities. Conversely, the morphological capacities are not essential to play on high level of competition.

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# A pilot study into the effects of two eccentric strengthening exercises on agility in elite youth soccer players when performed as part of a six week injury prevention program.

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## Introduction

The hamstring muscles are one of the most commonly injured muscles in the body for professional soccer players. Eccentric exercises have been suggested as the optimal way of avoiding injury to the hamstring muscles. Two of the most popular ways to perform this type of exercise are called the Nordic hamstring lower method and the single leg Romanian dead lift method (SLRDL). Agility is a key element of soccer. Agility is practiced and encouraged to enhance soccer performance.

## Methods

Sixteen elite youth soccer players were recruited and baseline testing was undertaken for the 505 agility test. Using an experimental design, subjects were randomly allocated into either a Nordic exercise group (n=8) or a SLRDL exercise group (n=8). Subjects then undertook a six week injury prevention program according to their group allocation. The exercises were performed three times per week and increased in intensity by incrementally adding repetitions and load. Baseline scores were retested after six weeks.

## Results & Discussion

There was no significant difference ( $> 0.05$ ) between intervention groups for the agility tests after completion of the six week intervention program. The 505 agility test recorded a significant time effect ( $P= 0.002$ ) showing that performance on the 505 agility test significantly improved in both groups pre to post intervention.

Conclusion: The results suggest no difference between eccentric intervention method (Nordic or SLRDL) when performed over a 6 week injury prevention program on agility. However, both eccentric intervention methods could produce favourable results in improving prescriptive agility times.

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# Repeated Sprint Ability in Young Soccer Players at Different Game Stages

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## Introduction

The purpose of this study was to determine young ( $16.9 \pm 0.5$  yr) soccer players' repeated sprint ability (RSA) at different game stages.

## Methods

Players performed repeated sprint test (RST) (12X20 m) after warm-up prior to a game, at half-time and after a full soccer game, each on a different day, in random order. Ideal (fastest) sprint time (IS) and total (accumulative) sprint time (TS) were significantly slower at the end of the game compared to after the warm-up prior to the game ( $p < 0.01$  for each). Differences between IS and TS after the warm-up prior to the game and at half-time, and between half-time and end of the game, were not statistically significant. There was no significant difference in the performance decrement (PD) during the RST after warm-up prior to the game, at half-time, or the end of the game.

## Results & Discussion

Significant negative correlation was found between predicted VO<sub>2</sub> and the difference between TS after the warm-up prior to the game and the end of the game ( $r = -0.52$ ), but not between predicted VO<sub>2</sub> and the difference in any of the RST performance indices between warm-up prior to the game and half-time, or between half-time and the end of the game. The findings indicate a significant RSA reduction only at the end but not at the half time of a soccer game. The results also suggest that the contribution of the aerobic system to soccer intensity maintenance is crucial, mainly during the final stages of the game.

# A novel training efficiency index for monitoring team-sport athletes

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## Introduction

Within team sports, coaches and practitioners are interested in monitoring how their athletes are responding to a prescribed training program, to track changes in fitness and fatigue, or to assess the efficacy of said program. Commonly, this is achieved through the application of maximal or submaximal field-based running tests. However, there is a need for a simple, non-invasive method for tracking athletes' responses to training.

## Methods

Prior to and following a 7-week intensified training period, a subset of 21 professional rugby league players ( $23 \pm 3$  yrs) completed a 1.2 km shuttle test, from which the average speed (m.s<sup>-1</sup>) was taken as their performance score. Throughout this time, 38 players' ( $23 \pm 3$  yrs) internal and external loads were monitored using heart rate (HR; Polar, Finland) and global positioning system (GPS; 5 Hz SPI HPU, GPSports, Australia) technology, respectively. Internal load was assessed using the Banister TRIMP model<sup>1</sup>, whilst external mechanical work was calculated as; Work = acceleration (absolute change in speed)  $\times$  mass  $\times$  distance. Due to the inability of these technologies to accurately assess non-locomotor activity such as tackling and wrestling, training drills predominately comprising of these events were removed from analysis.

A novel training efficiency index (TEI) was established, using the formula Work/TRIMP<sup>0.87</sup>, where 0.87 represents the average slope of the log-log linear relationship between internal and external training load for each player, which was then compared to changes in fitness.

## Results & Discussion

There was a  $9.5 \pm 3.3\%$  increase in 1.2 km shuttle performance across the 7-week period, accompanied by a  $31.6 \pm 9.1\%$  increase in TEI. This resulted in a *possibly* large correlation between changes in fitness and changes in TEI ( $r = 0.52$ , 90% CI = 0.19 to 0.75).

The primary finding of this study was that the TEI is sensitive to changes in fitness across a 7-week training period, suggesting this index is a useful tool for monitoring an athlete's response to training. Field-based fitness tests are often logistically difficult to implement during periods of heightened competition loads. Provided HR and GPS data are collected routinely, the TEI can be used to monitor athletes during training and competition with no additional burden imposed. Due to the spatial limitations typical of team sports, acceleration/deceleration contributes substantially to the training load imposed. As such, a variable that encompasses both speed- and acceleration-based movements (i.e. Work) may be the most appropriate method for calculating the TEI amongst team-sport athletes.

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# The relationship among Psychological Needs, Motivation, and Intention to Sport Continue in Educational Soccer Environment

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## Introduction

Based on Basic Psychological Needs Theory (Deci & Ryan, 2002), the purpose of this research was to examine the relationships among satisfaction and thwarting of basic psychological needs, Motivation, and intention to Intention to continue sport in soccer sport educational environment. 200 soccer learners (12-17 years) who participated in Summer Educational soccer Sport classes in Urmia city.

## Methods

They selected in cluster sampling way and completed series of assessments of psychological needs satisfaction and thwarting, motivation, and intention to sport continue.

## Results & Discussion

Results by analyzing Pearson Correlational Coefficients and Track Analysis showed that needs satisfaction negatively and needs thwarting positively predicted autonomous motivation, in turn, autonomous motivation predicted positively intention to continue sport and negatively nonadaptive outcomes sport devaluation. In addition, needs thwarting predicted strongly nonadaptive outcomes, but needs satisfaction predicted strongly adaptive outcomes.

## Conclusion

At whole, these finding by confirming the potential utility of the basic psychological needs theory in Soccer educational environment, suggest that basic psychological needs is an effective variable in learners motivation, and intentions at sport educational environments.

# A Comparison Between Hip Neuromuscular Training and High Intensity Treadmill Sprinting on Knee Injury Risk and Performance in Elite Adolescent Female Soccer Players

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## Introduction

Hip neuromuscular control deficits lead to increased knee valgus loads and contribute to the 4-6 times higher non-contact anterior cruciate ligament (ACL) injury risk in female athletes [1]. Hip neuromuscular training programs improve ACL injury risk as measured through reduced knee abduction angle in biomechanical tests such as single-leg squats and vertical drop jumps [1,2]. However, coaches may not wish to sacrifice time spent on overall fitness and soccer specific training when designing training programs. Our aim was to compare the effect of a hip neuromuscular strengthening program and a treadmill sprinting training program on ACL injury risk and overall athletic performance as measured through biomechanical and performance-based tests.

## Methods

18 elite female adolescent soccer players ( $14.1 \pm 0.78$  years) were recruited from three competitive teams and randomly assigned into one of three groups (hip strengthening, treadmill training, and control). Performance measures included a counter movement jump (height), 35-meter sprint (time), and the Yo-Yo intermediate recovery test, level 1 (stage). Biomechanics tests included i) treadmill running at a self-selected speed for 7 minutes [3], ii) 10 (5/leg) single-leg squat trials consisting of 3 consecutive squats completed to a depth of 65 degrees of knee flexion [2], iii) and 5 vertical drop jumps from a height of 30 cm [1]. Kinematic data (Qualisys, Sweden) was used to create an eight segment 6-degrees of freedom model (Visual3D, C-Motion) to assess frontal plane knee motion. Training programs were 6 weeks, 2 sessions/week. Treadmill training focussed on interval training with increasing incline and sprint speed. Hip strengthening focussed on hip neuromuscular control through improved strength, agility, and functional movement.

## Results & Discussion

The treadmill training significantly improved the yo-yo intermediate recovery test score (Pre  $14.9 \pm 1.0$ , Post  $16.1 \pm 1.0$  stage:  $p < 0.05$ ). The hip strengthening group significantly reduced peak knee abduction angle during single-leg squats (Pre  $12.89 \pm 2.13$ , Post  $6.93 \pm 2.0$  degrees:  $p < 0.05$ ), while the treadmill-training group reduced knee abduction angle in the vertical drop jump (Pre  $12.11 \pm 3.73$ , Post  $4.68 \pm 1.70$  degrees:  $p < 0.05$ ).

## Conclusion

Treadmill training offered more improvement in athletic performance as compared to hip neuromuscular training, while both training programs produced similar reductions in ACL injury risk. Coaches and trainers may be able to maintain knee injury prevention through more traditional training methods such as high intensity sprinting as opposed to specific hip neuromuscular training programs.

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# Comparison of acceleration ability of players using a novel visualization method - Difference between attackers and defenders -

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## Introduction

In the performance analysis of soccer, the acceleration ability of a player is as important as the total distance covered or the number of sprints in a game. We have already proposed the basic method for modeling and visualizing the maximum acceleration ability of a player, by capturing each moving direction and moving speed of the player at every moment (Hirato 2015, Mizutani 2016). By combining these methods, we show the difference of acceleration ability between forward players and defense players three-dimensionally.

## Methods

In our method, a moving velocity and an acceleration vector of a player at each moment are calculated from a time series data of two-dimensional positions of the player. The direction of this acceleration vector is defined not in the absolute coordinate system like the pitch coordinate system but in the relative coordinate system with the moving direction of the player as the reference. Subsequently, the two-dimensional acceleration vector of a player is decomposed into the acceleration/deceleration component and the direction-change component, and then, it is classified according to the moving speed of the player at that time. By this process, one acceleration vector can be expressed as one point in the three-dimensional space. By collecting a lot of such points from actual games, it is possible to build the acceleration pattern of the player.

## Results & Discussion

In the experiment, we built acceleration patterns of two forward players and two defense players, and compared their characteristics. As the result, the forward players had large acceleration to the every direction even if the moving speed was high, as compared with the defense players. Also, in the comparison of the two forward players, one forward player who had large acceleration when high moving speed scored many goals, as compared with another forward player. Therefore, we can say that it is meaningful to analyze the acceleration pattern of a player who is moving at high speed, as one of performance analysis.

## Conclusion

By using the three-dimensional visualization method we proposed, we can observe the differences in the acceleration patterns among the players, and the characteristics in acceleration of forward players or defense players. Furthermore, quantitative evaluation of acceleration ability is also possible with a mathematical modeling.

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# Interaction of ball possession, physical performance and success during the EURO2016

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## Introduction

Soccer is a complex sport with different constructs contributing to the team success (Ribeiro da Mota et al., 2015). Different technical/tactical and/or physical factors - mostly in isolation - have been identified so far for success in soccer. The aim of this study was to evaluate how technical/tactical factors, physical performance and success during the group stage of the EURO2016 interact.

## Methods

Data were collected during 35 games of the group stage from 24 different teams with an optical tracking system (INSTAT). The percent time-proportion of ball possession (%BP), number of completed passes (NoP) and physical performance parameters was compared between the teams ranked on 1st and 2nd place versus ranked on 3rd and 4th place of each group using a t-test and effect sizes (ES). Furthermore, the teams of every game were allocated to either high (HBP: > 55%, n=25), equal (EBP:45-55%, n=20) or low (LBP:< 45%,n=25) percent ball possession group. The physical performance of the 3 groups were compared using a one factorial ANOVA.

## Results & Discussion

The difference between better and worse ranked teams was significant ( $p < 0.05$ ) for NoP ( $447 \pm 148$  vs  $379 \pm 115$ ) with small ES (0.52). For %BP ES was also small ( $52.1 \pm 10.5\%$  vs  $47.9 \pm 9.6\%$ ; ES:0.43). Only trivial ES were found for physical performance parameters. Also no physical performance differences were found between HBP and LBP teams. In contrast, in games with an EBP teams covered less total distance/min (EBP:  $106.7 \pm 4.8$  vs LLBP:  $110.7 \pm 4.5$  and HBP:  $109.5 \pm 3.6$  m/mi) but a higher high speed/ total distance relation (EBP:  $9.2 \pm 0.9\%$  vs LBP:  $8.2 \pm 1.9\%$  and HBP:  $8.6 \pm 0.8\%$ ).

## Conclusion

The difference between more and less successful teams was probably more related to technical/tactical (e.g. number of completed passes) than physical factors. In games with similar percent ball possession between the two teams, the proportion of high speed running was higher than in games with opponents with different technical/tactical strategies or capabilities.

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# The use of the Gol Scale to evaluate the soccer athletes recovery

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## Introduction

The perceived exertion is well recognized variable associated to the integration of psychological and physiological response over stress level related to the exercise. However, there are not relevant data associated to the perceived exertion in moments after of maximal field test in soccer players. So, the purpose of this study was to test the Gol Scale at recovery response after maximal efforts in soccer players.

## Methods

Thirteen professional soccer players ( $18.8 \pm 0.77$  years old, stature  $177 \pm 8.0$  cm, body mass  $70.8 \pm 7.53$  kg, % body fat  $13.42 \pm 3.19$ , lean mass  $60.49 \pm 4.75$  kg and fat mass  $9.60 \pm 3.19$  kg) were evaluated by Yo-Yo IRT1 Level 1. The cartoon Gol Scale, Borg Scale 6-20, Cavasini Exertion Effort Scale, Heart Rate (HR) and Blood Lactate Concentration ([La]) were determined in five moments: immediately pre, immediately post, 10, 20 and 30 minutes rest. The Perceived Recovery Scale (PRS) was analyzed at post, 10, 20 and 30 min after effort. For the statistical analysis, it was done descriptive analysis and Spearman's correlation among Gol Scale and other variables. The significance level adopted was  $p < .05$ .

## Results & Discussion

All psychological and physiological variables showed reduction in three moments post field test (10, 20 and 30 min). It was very interesting to note that there was a significant correlation among Gol Scale and physiological parameters during these moments (HR  $r = .78$ ; Lactate  $r = .70$ ). Similarly, there was a significant correlation between Gol Scale and PRS ( $r = .61$ ). The Gol Scale is a specific perceived exertion instrument validated to measure training load in soccer athletes. However, the present data shows that this instrument can be used to analyze the reduction of the psychophysiological stress in applied evaluations, contributing with a practical instrument for professional and researchers of this modality.

## Conclusion

Our results presented that Gol Scale is a well related scale to identify the psychophysical stress after maximal test in soccer players. Also, seems to be associated to effort recovery in soccer players, up to 30 minutes after efforts. The next step of this research is to evaluate the Gol Scale validity and applicability to measure the recovery state of soccer players before the training sessions.

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# The effects of differential-learning and traditional-learning trainings on technical development of football players

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## Introduction

There are several different methods of learning motor skill, like traditional and differential-learning training. In motor learning literature, variability of practice is believed to be an effective method producing successful learning, retention and transfer of learned motor skills (Lee, T & Simon, D., 2004; Shoenfelt, E et al., 2002). Classical(traditional) motor learning approach proposes that learners improve a skill just by repeating it. According to the teaching principles, exercises are selected along continua from easy to hard and from simple to complex. Once these exercises have been chosen for an intervention program, every exercise is repeated several times (Sch'ollhorn et. al. 2010).

One method to include variability in teaching is differential learning pertaining maximum variability between single repetitions (Sch'ollhorn et. al. 2010).

The purpose of this study is to examine the effects of differential and traditional training on technical development of 15 years old football players who have been continuing football education.

## Methods

Twelve (12) football players from youth football team (U15) of Istanbul Kavacik Club whose were tested as voluntarily in this study. In this study, agility/dribbling, feet-juggling, Mor&Christian soccer passing tests were applied on football field with synthetic of the Istanbul Kavacik Sports Club in 2016.

Both groups that performed exercises as differential and traditional learning training third a week for four weeks in addition to their normal football training.

Mann Whitney U test for paired comparison of the groups and Wilcoxon test for the comparison of pre- and post-tests of the groups were used.

## Results & Discussion

There were statistically significant difference dribbling performance ( $Z=-2.83$ ;  $p< 0.01$ ) and agility performance ( $Z=-1.97$ ;  $p< 0.05$ ) between the pre-and post-test in differential-learning group.

A significant differences was found agility performance ( $Z=-3.07$ ;  $p< 0.01$ ) between the pre-and post-test in traditional-learning group.

There were not statistically significant difference between performance of tests in differential and traditional groups ( $p> 0.05$ )

## Conclusion

In conclusion, third a week for four weeks differential and traditional trainings produced no significant difference in technical development of players.

However, in this study also showed that while traditional training improved agility performance and differential training improved not only dribbling performance but it also dribbling performance in twelve training session.

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# Manipulating number of players in small-sided and conditioned games: effect of inside floater on tactical performance of soccer players

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## Introduction

Small-sided and conditioned games (SSCG) are considered important in training of soccer players to able to create, by modifying or inserting of rules, situations with variability and high contextual interference (Williams & Hodges, 2005). Previous researches with SSCG evaluated use of inside floater identifying the effect on demands technical, physical and physiological of players. However, inside floater creates situations that can helps players to understand the way to play on tactical setting in numerical superiority and inferiority. Furthermore, assess tactical performance in SSCG can helps coaches to know for who apply games with inside floater according level of tactical performance. Thus, this study aims to verify effect of inside floater on tactical performance of soccer players.

## Methods

The sample was composed for 18 national level soccer players of U-20 (18,44±1,09 years). The instrument to assess tactical performance of soccer players was FUT-SAT (Teoldo et al., 2011). Tactical performance was obtained by tactical performance index (TPI) of tactical principles of soccer (Teoldo et al., 2009). TPI was assessed in a field with 36m long by 27m wide during 4 minutes with official rules of soccer, except the offside. The first game was realized in configuration (GK+3vs3+GK). In second game was added the inside floater that helped team with ball possession (GK+3vs3+GK)+1.

## Results & Discussion

In (GK+3vs3+GK)+1 there was significant increase ( $p < 0,05$ ) of tactical performance (Depth Mobility 76,6±10,67; Width and Length 52,9±6,32) than (GK+3vs3+GK) (Depth Mobility 50,06±21,59; and Width and Length 47,45±7,18). However, in (GK+3vs3+GK)+1 there was significant reduce of tactical performance (Delay 26,37±7,09) than (GK+3vs3+GK) (Delay 32,28±9,14). In offensive phase, inside floater allowed that actions of move to a safer space and actions to disrupt opponent's defensive organization to create possibilities of progress through the opponent's half and shoot on goal. In defensive phase, actions of marking on player in possession didn't allow that team can recover ball possession.

## Conclusion

Inside floater exercised effect on offensive and defensive tactical performance of soccer players. Use of inside floater can be considerate important to improve player's performance has difficulties in width and length and depth mobility. Furthermore, can increase difficulty of players has high performance values in delay.

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# Coordination patterns in scoring opportunities of the german team in the 2014 FIFA World Cup

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## Introduction

Analysis of actions leading to scoring opportunities helps coaches and researchers to identify and employ the most effective playing methods (Hughes and Franks, 2005). Numerical dominance is key to create defensive stability or shooting opportunities. A new method of analysis was proposed to detect and analyze numerical relations between teams (Vilar, Araújo, 2013). Accordingly, the aim of this study is to examine the emergent coordination patterns from the goal-scoring opportunities of the German Team in the 2014 FIFA World Cup.

## Methods

We analyzed video sequences of scoring opportunities (8 goals, 16 saved shots and 9 intercepted shots) in open play of the German Team in the 2014 FIFA World Cup. Teams' numerical relations were examined taking into consideration the definition of effective play-space (EP-S), defined by Gréhaigne, Mahut (2001) as the polygonal area obtained through the imaginary line linking all involved players located at the periphery of play at a given instant. Editing of video footage was performed through Video Observer® software. From the location of all outfield players in each frame, the EP-S was calculated through a MatLab® convex hull computation. The EP-S was divided into seven sub-areas, according to the classification proposed by Vilar et al. (2013). Numerical relations were examined in four moments: i) when the assisting attacker received the ball; ii) when the assisting attacker passed the ball to the shooting attacker; iii) when the shooting attacker received the ball; iv) when the shooting attacker shot at goal (Vilar, Araújo, 2014). Numerical uncertainty between the teams across subareas was calculated through Shannon's entropy,  $H$  (Shannon, 1948), in MatLab®.

## Results Discussion

Results indicated that the numerical uncertainty between teams was higher within the German Central Offensive sub-area, in comparison with the other sub-areas, for all three situations: goal (2.41 bits), saved shots (2.34 bits) and intercepted shot (2.33 bits). Considering the EP-S as a whole, we also found more numerical uncertainty in goal situations (2.31 bits), when compared to both of the other situations.

## Conclusion

Findings showed that Germany generated more numerical uncertainty in the sub-area closer to the opposing goal in all situations. It is possible to infer that higher numerical uncertainty is related to scoring success, whereas intercepted shots appear to be a byproduct of defensive stability.

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# Hand-notation approach for the analysis of team dynamics

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## Introduction

The identification of principles that underlie team dynamics has become a growing interest among sport scientists. Although technological advances have pushed coordination dynamics by providing positional raw data from players and ball over the course of the match, an unsolved task is still determining ball possession independently of its current location. If the appropriate method is not adjusted to the purpose of the study, principles underlying complex behavior might be missed or misconceived. Previous methods have used criteria that are too strict for identifying changes in team possession. Here, we aim to provide scientific-based evidence by comparing two methods for determining ball possession.

## Methods

We determined ball possession during the first half of a friendly match between two professional European soccer teams, using two methods. Method 1 (Reis et al., 2013) involves counting number of passes and touches. We developed method 2 (López-Felip et al., 2017), that accounts for ball possession based on only a single touch.

We did two synchrony analyses based on the goal that is being attacked, one for each possession method. We divided the match into sections where methods agreed and where they did not. Team synchrony was assessed for attacking and defending teams during these sections.

## Results & Discussion

The two methods identified different possessing teams for 22% of the match. During disagreed sections average synchrony according to method 1 was 0.94 for the attacking team and 0.92 for the defense, whereas for method 2, average synchrony was 0.97 and 0.96 respectively. A repeated measures ANOVA on synchrony of disagreeing sections found a significant interaction between method and ball possession,  $F(1,386) = 125$ ,  $p < .001$ .

Synchrony analysis reveals that the two methods used to determine ball possession have distinct tendencies. To better understand coordination dynamics in soccer, it is important to have a sensitive method for describing the context of the game. The dynamics of a team when quickly changing from attacking to defending might not be revealed by less flexible methods.

## Conclusion

Conclusions drawn by sophisticated dynamical techniques require the ability to capture these fast changes in game situation. The method proposed in this study meets such requirements. Implications for software development and video analysis will be discussed.

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# Reference values for BMD in footballists of category U15

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## Introduction

The BMD values in young adolescents of the general population indicate differences in the specific population, whose values are different for reference normalization of the footballer population. Thus, the purpose of this study was to determine bone mineral density (BMD) reference values for the sites: total body, column and femoral neck in young players of category U15. Thus, the purpose of this study was to determine bone mineral density (BMD) reference values for the sites: total body, column and femoral neck in young players of category U15.

## Method

We investigated 83 footballers of category U15, with age  $14.4(\pm 0.55)$ , body mass of  $57.18 (\pm 8.71)$  Kg, height of  $169 (\pm 9.71)$  cm, and a fat percentage of  $15.55 (\pm 2.85)\%$ ; And for the peak of growth rate  $13.7 (\pm 0.58)$  years. Evaluations were performed on the Dual energy x ray absorptiometry (DEXA) (Lunar Prodigy; General Electric: Fairfield, CT, USA) equipment. Data from the BMD of the total body, lumbar spine (L1-L4) and right and left femoral neck were collected according to the factory procedures. The BMD values were presented in  $\text{g} / \text{cm}^2$ . For the descriptive statistical analysis procedure, the mean and standard deviation of the respective Z scores were used.

## Results & Discussion

For the femoral neck, Z scores were 2.60 ( $\text{BMD} = 1.334 \pm 0.15 \text{ g/cm}^2$ ) for the right femur and 2.61 ( $\text{BMD} = 1.333 \pm 0.16 \text{ g/cm}^2$ ) for the left femur. Regarding the column, the values of 0.55 ( $\text{BMD} = 1.035 \pm 0.12 \text{ g/cm}^2$ ) were presented. For total body, values of 1.36 ( $\text{BMD} = 1.134 \pm 0.13 \text{ g/cm}^2$ ) were found. Compared to the general population of the reference values, the results of this study showed Z scores higher than 1 standard deviation normalized by NHANES/Lunar.

## Conclusion

It is concluded that the values presented in this study, show to be higher than the NHANES / Lunar reference standard.

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# Effects of in-season concurrent muscular strength and small-sided game maintenance training frequency in young male soccer players

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## Introduction

Strength and endurance training are necessary for young football players to make them physically well prepared for competitions and especially in a worldwide reference event for kids' football approved by the FIFA and the French federation of football at the end of the season. During the in-season, the strength training is usually intended to maintain the initial gain during the preparatory period (Rønnestad et al. 2011). Moreover, small-sided game (SSG) has become a popular method of developing technical, tactical and specific aerobic fitness for soccer players (Impellizzeri et al., 2006). Therefore, the purpose of this study is to examine the effect of in-season concurrent strength and SSG maintenance training frequency on endurance, speed, agility, explosive performance and repeated sprint ability in young male soccer players.

## Methods

Thirty-one young elite male soccer players (age  $10.5 \pm 0.3$  years) were divided on an experimental group (EG,  $n = 17$ ) and a control group (CG,  $n = 14$ ). The EG performed the same strength and SSG training program twice a week during 8 week preparatory period. During the 8 week of the in season training, the EG performed the same training one session per week, whereas during the 8-week on the off-season, the EG performed one session every second week.

## Results & Discussion

The preseason concurrent training resulted an increased in Yo-Yo IET, 30-m sprint and explosive MB throw ( $p < 0.05$ ) in the EG. After 16 weeks of in-season concurrent training, the initial gain in endurance and 30-m sprint performance was maintained in EG, whereas the explosive strength, sprint and agility-15 m performance were reduced in CG. Only the performance of the agility ball-15m and the explosive MB throw were statistical improved ( $p < 0.05$ ) after the in-season training. After the preseason training, the EG demonstrated a great improvement in Yo-Yo IET and S-decrement in  $6 \times 20$  m repeated sprint ( $p < 0.001$ ) versus the CG, a considerable change in 30 m sprint, ball-15m, worst-sprint, fatigue index ( $p < 0.05$ ) compared with the CG.

## Conclusion

Performing 1 weekly strength and SSG maintenance training during the first 8 weeks of the in-season and 1 session maintenance session every second week during the last 8 weeks of the in-season may be sufficient to maintain initial gain in endurance, explosive strength and sprint performance achieved during a preceding preparatory period in young soccer players.

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# Relation of corrective exercise training on the vertical thrust and functional movement system' test

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## Introduction

Performing physical and motor tasks depends upon an optimal functioning of the muscle-skeleton system. The present study pretends to investigate the relationship between the improvement of joint capacity and vertical thrust after a five-months corrective training program in young soccer players.

**Methods** The sample comprises eight U15 soccer players from a Brazilian team. Data were collected from club archives. Among the tests performed, were the Counter Movement Jump (Optojump 3 cm, Microgate, Bolzano, Italy) and the tests of the Functional Movement System®, which in turn it's made of seven tests to evaluate the joint mobility/stability (Cook, 2010).

Between May and November, the players were submitted to exercises to stimulate the joint mobility/stability and myofascial release. A type of exercise was planned for each individual, accordingly with the needs identified a priori during evaluation made on May.

**Results & Discussion** A descriptive analysis was performed to obtain average, standard deviation and Spearman's bivariate correlation. It was possible to attest that the players' motion ability increased after the intervention ( $\rho = 0.880$ ;  $p = 0.004$ ). The vertical thrust ability also increased, but it was not possible to find any statistically significant differences ( $\rho = 0.619$ ;  $p = 0.102$ ).

## Conclusion

It is possible that the players' have improved the capacity to produce strength over time through the benefits of the training program. Meanwhile, it is possible to speculate that the improvement has occurred in the ergonomic of the movement, providing a better vertical thrust ability through improvement of the joint mobility/stability.

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# Predicting Team Standings in Professional Soccer

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## Introduction

The main purpose of match analysis is to identify areas of strength and weakness in a teams' performance and highlight those factors that critically impact game outcomes. To date, much of the research in football match analysis has focused on discrete variables related to goal scoring (goals for and against, total shots and shots on goal and shots per goal) or offensive characteristics (ball possession, assists, crosses, offsides, fouls received, etc.). The aim of this study was to identify a set of comprehensive, yet strategic, performance indicators that can be; 1) used to help explain what occurs on the pitch, and while also being used, in combination, to 2) create a composite in order to rank team performance independent of points earned.

## Methods

One entire season of games from the English Premier League (EPL), Bundesliga (BL) and La Liga (LL) were used for data analysis. Seven data points relating to passes, shots and goals were collected for each team and for each game and analyzed using Microsoft Excel and Mini Tab. Additional statistics were derived for 1) possession percentage, 2) passing accuracy 3) penetration percentage 4) shots on goal percentage, and 5) goals scored per shots on goal percentage. From these variables an Attacking, Defending and Composite Index was created and those indices were correlated to final points earned in the league standings. This index is called Composite Possession with Purpose ©(CPWP).

## Results & Discussion

The EPL, BL and LL showed correlations of 0.94, 0.93 and 0.94 (all  $p < 0.01$ ) respectively. For the BL and LL, the highest calculated Composite Index was achieved by the points leader in that league. While in the EPL the points leader, Chelsea, had the second highest composite index score. The lowest index scores were associated with the EPL and BL last place team while in the lowest scoring team in LL finished second to the bottom in points scored.

## Conclusion

This study shows that the CPWP index produces a robust index upon which team outcomes can be described across different professional leagues. Since points scored across a season ultimately determines overall seasonal success, this CPWP index and the factors that contribute provide a more in depth picture of successful and unsuccessful teams the world's best soccer leagues. Not surprisingly, these results are consistent with the previous publication of the Index using the Major League Soccer (US) (Gluck and Favero, 2015) albeit the correlations are higher in the European leagues likely due to a higher passing percentage. These indices can be used for seasonal or game-by-game analysis for each team, and with modifications may be used to identify individual player success or failure relative to team performance.

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# Association of force indicators, muscle area of lower members and bone mineral density in youth soccer

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## Introduction

Studies in young male soccer players demonstrate that the process of increased bone compaction is occurring at a very early stage of puberty, and is related to actions of stimuli from the combination of physical exercise and biological maturation than only one of these factors alone. However, little is known about the relationship between bone structure and strength development in children and adolescents, despite the fact that soccer practice usually begins before puberty. Therefore, the aim of this study was to establish a relationship between the impact force and the bone mineral density (BMD) values for the total body, femoral column and femoral neck sites in young U15 players.

## Methods

We investigated 83 footballers of category U15, with age 14.1 ( $\pm 0.3$ ), body mass of 57.18 ( $\pm 8.71$ ) Kg, height of 169 ( $\pm 9.71$ ) cm, and a fat percentage of 15.55 ( $\pm 2.85$ ) %; and for the peak of growth rate 13.7 ( $\pm 0.58$ ) years. Evaluations were performed on the Dual energy x ray absorptiometry (DEXA) (Lunar Prodigy; General Electric: Fairfield, CT, USA) equipment. Data from the BMD of the right femur neck and amount of muscle mass of the lower limbs were collected according to the factory procedures. Impact force measurements were performed using the vertical jump countermovement jump (CMJ) technique using the Double force platform (GLOBUS, Italy). Force indicators were Coupling Time Force, Concentric Force Peak, Impact Force, Eccentric Force Stabilization, and Isometric Force Stabilization. The BMD values were presented in g / cm<sup>2</sup>, and for the force, Newton has / meters (N / m). For muscle mass values of lower limbs, they were presented in grams (g). The statistical analysis procedure of multiple regression was used, with the level of significance of  $p < 0.05$ .

## Results & Discussion

In the multiple analysis, results of coefficient of multiple determination  $R^2 = 0.5057$  ( $P < 0.0001$ ) were found. Multiple correlation coefficients were found for the following variables: BMD femoral neck and lower limb muscle mass ( $r = 0.6718$ ;  $P < 0.0001$ ); Coupling Force Time and Impact Force ( $r = 0.6609$ ;  $P < 0.0109$ ); Concentric Force Peak and Eccentric Force Stabilization ( $r = 0.617$ ;  $P < 0.0001$ ); Concentric Force Peak and Isometric Force Stabilization ( $r = 0.7102$ ;  $P < 0.0001$ ); Eccentric Force Stabilization and Isometric Force Stabilization ( $r = 0.7129$ ;  $P < 0.0001$ ).

## Conclusion

The determinants of femoral neck BMD changes are associated with stability strength, concentric force production, and the amount of muscle mass of the lower limbs.

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# Reference values for BMD in Chinese soccer players category U14

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## Introduction

The BMD values in young adolescents of the general population indicate differences in the specific population, whose values are different for reference normalization of the footballer population. Thus, the purpose of this study was to determine bone mineral density (BMD) reference values for the total body, column and femoral neck in young Chinese soccer players of category U14.

## Method

Thirty-two Chinese soccer players of category U14, age  $14.1(\pm 0.27)$ , body mass of  $55.68 (\pm 7.00)$  Kg, height of  $169.96 (\pm 7.44)$  cm, and fat percentage of  $15.13 (\pm 2.53)\%$  were investigated; And for the peak of growth velocity of 13.4 years. Evaluations were performed on the Dual energy x ray absorptiometry (DEXA) (Lunar Prodigy; General Electric: Fairfield, CT, USA) equipment. Data from the BMD of the total body, lumbar spine (L1-L4) and right and left femoral neck were collected according to the factory procedures. The BMD values were presented in  $\text{g} / \text{cm}^2$ . For the descriptive statistical analysis procedure, the mean and standard deviation of the respective values of the Z scores were used.

## Results & Discussion

For the femoral neck, Z scores were 2.28 ( $\text{BMD} = 1.263 \pm 0.11 \text{ g} / \text{cm}^2$ ) for the right femur and 2.29 ( $\text{BMD} = 1.264 \pm 0.13 \text{ g} / \text{cm}^2$ ) for the left femur. Regarding the spine, the Z score values of 0.37 ( $\text{BMD} = 1.001 \pm 0.11 \text{ g} / \text{cm}^2$ ) were presented. For total body, Z score values of 1.18 ( $\text{BMD} = 1.102 \pm 0.10 \text{ g} / \text{cm}^2$ ) were found. Compared to the general population of the reference values, the results of this study showed Z scores higher than 1 standard deviation normalized by NHANES / Lunar.

## Conclusion

It is concluded that the values presented in this study, show to be higher than the NHANES / Lunar reference standard.

# Effects of functional balance training on passing and dribbling performance of amateur soccer players

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## Introduction

The balance ability plays a vital role and could be considered as an indicator of soccer performance (Paillard et al., 2006). In this manner, the purpose of the study was to investigate the effects of functional balance training on passing and dribbling performance of amateur soccer players.

## Methods

Twenty four amateur soccer players (Control Group: age  $22.58 \pm 1.62$  years, height  $178.83 \pm 5.04$  cm, body mass  $74.10 \pm 7.79$  kg; Training Group: age  $22.50 \pm 1.24$  years, height  $176.17 \pm 5.65$  cm, body mass  $73.76 \pm 7.71$  kg)) randomly divided into 2 groups and players with no history of upper or lower extremity injuries participated in this study. Participants were divided into two groups as functional balance training group (n=12) and control group (n=12). While control group (n=12) followed the regular soccer training (3 days a week), the training group (n=12) performed a functional balance training program (6 weeks, 3 times per week, 35 minutes per session) in addition to regular training. The balance trainings were performed on both stable ground and unstable surface (BOSU ball). For passing evaluation, Loughborough Soccer Passing Test (LSPT) which its validity and reliability was proven by Ali et al. (2007) and for dribbling evaluation, Zigzag Agility Test (ZAT) have been performed by the players.

## Results & Discussion

Paired Sample T test was used to evaluate differences between groups ( $p < 0,05$ ). The LSPT scores showed statistically significant differences in pre and post-test for training group ( $p=0,01$ ). However, there were no statistically significant differences in control group for LSPT scores ( $p=0,52$ ). Unlikely, the ZAT scores did not show statistically significant differences for neither training group ( $p=0,07$ ) nor control group ( $p=0,79$ ) .

## Conclusion

Our results showed that there was an improvement on passing performance in training group but not for the dribbling test. The functional balance training did not comprise direct sprints or technical skill development. This has been thought as a reason for not to observe dribbling performance improvement in training group. As a conclusion, functional balance training performed three times a week positively affect the passing performance, but not dribbling performance of amateur soccer players.

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# Gaze behavior of soccer players under specific-exercise

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## Introduction

The purpose of the present study was to examine the physiological arousal and gaze behavior under low- and high-intensity in elite and non-elite soccer players.

## Methods

Sixteen soccer players were separated in two groups. Elite (age=24.6±3.9yr; semi and professional 5.1±2.4yr); and Non-elite (age=26.3±2.9yr; amateur=2.1±2.4yr). Eye tracker (ASL 3000 system) was used during an intermittent exercise protocol (Drust, Reilly, & Cable, 2000). Players were asked to anticipate the player in ball possession's action in four different moments. Gaze behavior data comprised the number of fixation per locations (NFL; i.e.: *ball, teammate, opposition and player in possession of the ball*), and mean fixation duration per trial. To analyze differences in heart rate (HR; bpm), blood lactate concentration (La; mmol.L-1l) and view time fixating locations we used separate Factorial Two-way ANOVA. Partial eta squared ( $\eta_p^2$ ) values were provided as a measure of effect size for all main effects and interactions. The significance level was set at  $p < 0.05$ .

## Results & Discussion

Main effect in the Group for HR ( $F_{2,188}=4.99$ ,  $p=.27$ ,  $\eta_p^2=.03$ ) and La ( $F_{2,188}=7.59$ ,  $p=.01$ ,  $p=.04$ ). In addition, differences in the intensity level for HR ( $F_{2,188}=38.02$ ,  $p < .001$ ,  $\eta_p^2=.67$ ) and La ( $F_{2,188}=20.74$ ,  $p < .001$ ,  $\eta_p^2=.52$ ). Elite players displayed lower values of HR ( $p=.031$ ) and La ( $p=.001$ ) in low-intensity than Non-Elite. Both groups increased HR and La from low to high-intensity (Elite:  $p < .001$ ; Non-Elite:  $p < .001$ ). For low-intensity level, Elite players showed significantly less time to set the Ball ( $p=.004$ ) and Player in possession of the ball ( $p < .001$ ), compared to Non-Elite. In contrast, Elite spent more time setting the Opposition when compared to Non-Elite ( $p < .001$ ). In addition, for high-intensity Elite players maintained less time spent fixating the Ball ( $p=0.008$ ) than Non-Elite players.

## Conclusion

Both groups increased the HR and La from low to high-intensity. Elite players displayed less fixations in the ball and player in possession of the ball, in low-intensity. However, for high-intensity they spend more time fixating in opposition. Also, Elite players spend less time to fixate the ball compared to Non-Elite players.

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# Technique characteristics associated with kicking distance in elite youth soccer goalkeepers

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## Introduction

Goal kicking can lead to attack in soccer, therefore, goalkeepers are required to produce longer and more powerful kicks. Many studies have investigated maximal effort instep kicking (e.g. Kellis and Katis, 2007) which is one of the most fundamental techniques used when more powerful shots and passes are needed. However, few studies have actually reported on kicking for distance, and it remains to be determined which technique factors can be linked to kicking further. The purpose of the present study was to evaluate kicking techniques that maximise the ball distance achieved.

## Methods

Six male elite youth soccer goalkeepers (weight  $88.82 \pm 3.81$  kg, height  $1.89 \pm 0.03$  m) participated in the testing. Kicking motions were captured using an 8-camera Qualisys system at 500 Hz and retro-reflective markers were placed on the pelvis and lower-limbs. Ground reaction forces for the support leg were recorded simultaneously at 1000 Hz by a Kistler force platform, flush with the floor. After a self-selected warm-up, players were instructed to perform 10 maximum effort instep kicks of a stationary ball using their preferred leg. The data was tracked and exported into Visual 3D where joint kinematics and kinetics were computed. Phases of the kick were defined by the events of kicking leg max hip extension (KLHE), kicking leg max knee flexion (KLKF) and ball contact (BC). Multiple regression analysis was conducted with ball distance as the dependent variable, and with kinematic and kinetic parameters as independent variables for all six players at different phases of the kick ( $p < 0.05$ ).

## Results & Discussion

During back swing phase, more lean kicking leg and reduced flexion of knee angle was an important technique to increase ball kicking distance ( $R = 0.60$ ). In addition, enhanced foot velocity that was caused by high acceleration of knee extension at ball contact is considered to have improved the ball distance ( $R = 0.70$ ). Moreover, keeping the knee extended after BC, and reducing knee flexion and hip adduction velocity were important and might be indicators of kicking success.

## Conclusion

The present study clarified the effective contributors to ball distance in kicking. Kicking leg lean angle and knee flexion angular velocity during KLHE and KLKF, foot velocity and knee flexion angular velocity at BC were the major contributors to kicking distance ( $p < 0.05$ ). Future use of feedback regarding these phases could improve ball kicking distance for goal keepers and perhaps sub elite outfield players.

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# Intra-seasonal Dispositions of Injury-risk Among First Division Bundesliga Soccer Players

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## Introduction

The study objective was to audit the effect of the period of the season on overall match and training injury incidence and severity.

## Methods

Exposure and injury data from 1444 players over six consecutive seasons was collected from a media-base register. The competitive season was divided into four quarters; in addition, the pre-season and the winter break were included in the analysis. Due to lack of information regarding actual training time per player, for the calculation of injury incidence and injury incidence rate ratios of overall and training injuries, player-week was taken as the denominator. For the calculation of injury incidence and injury incidence rate ratios, the player actual number of minutes played was used as the denominator.

In total, 3248 injuries were documented, comprising of an incidence rate for overall, match and training injuries of 95.6 /100 player-season (95% Confidence Interval [CI]: 92.3 – 98.9), 10.7 per 1000 match-hours (95% CI: 10.10 – 11.32), and 60.1 /100 players-season (95% CI: 57.5 – 62.7) respectively. Despite no difference in the injury incidence across the two halves of the season, the risk of sustaining a match injury appear to be significantly higher in the second and third quarters of the season compared to the fourth quarter (IRR=1.18, CI: 1.01-1.40; IRR=1.35, CI: 1.14-1.60) respectively.

## Results & Discussion

Among training injuries, significant differences were observed between the periods of the season regarding injury incidence, with the second half of the season sustaining significantly higher incidence rate compared to the first half (IRR= 1.16, 95% CI: 1.06 -1.29). Specifically, the injury incidence in the third quarter was significantly higher compared to the preceding quarter (IRR=1.31, 95% CI: 1.14 -1.49). There were also statistical significant variations among training injuries in the interaction effect comprising the pattern different types of injuries exhibit across the periods of the season ( $X^2 = 31.96$ ,  $df=20$ ,  $p< 0.05$ ). That is a trend showing an increase in incidence rate following a muscle strain marked by a decrease in the incidence rate from a joint/ligament sprain was evident in the third and fourth quarters of the season.

## Conclusion

Injury-risk seems to vary substantially across the periods of the season. Identifying intra-seasonal variations in injury-risk may be of major importance to medical practitioners when considering preventive measures.

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# Functional movement screening in soccer. A review

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## Introduction

The functional movement screen (FMS) has been widely implemented in soccer to assess muscle flexibility, strength imbalances and movement proficiency (McCall et al., 2014). Concomitantly, the research interest on the application of FMS in this sport has been growing, aiming to analyse the FMS ability to predict injuries and its association with performance, as well as the factors that are linked with the FMS scores. The purpose of this study was to systematically synthesize the scientific literature conducted on the topic.

## Methods

An electronic search via the SPORTDiscus<sup>TM</sup>, CINAHL<sup>®</sup>, MEDLINE Scopus<sup>TM</sup>, Academic Search Complete, ISI Web of Science and PubMed<sup>TM</sup> databases was performed (last search date: 15 January 2017). No time restrictions were applied and the keyword search was performed by applying a combination of following words: "functional movement screen\*" or "FMS" and "soccer" or "football". Papers were selected in three stages (after evaluation of the title, abstract and full text) and were included (English language only) if the research topic was related to the usage of FMS to predict injury, performance, and FMS scores influential factors in soccer players. Conferences, narrative reviews, editorials, notes and letters to the editor were excluded.

## Results & Discussion

A total of 219 studies were identified (127 duplicates) and after title and abstract assessment, 46 full-text papers were selected. From the potential articles identified only 11 studies were selected that met the inclusion criteria. Five studies (46%) assessed whether the FMS scores could predict the incidence of injury in professional (3), veterans (1) and amateur (1) male soccer players. Three studies (27%) analysed the association between FMS and athletic performance (Collegiate female players) and maturation (adolescent players), and combining both (young players). Three studies (27%) analysed the changes in FMS scores over a season (NCAA Division II male and female players), between two in-season occasions (1yr apart) (Slovak female players of different categories) and between two consecutive seasons (professional male players).

## Conclusion

This review showed that the number of studies conducted on the application of FMS in soccer to predict injury, performance, and FMS scores influential factors is still limited. Overall, the FMS ability to predict injuries was the topic most considered. The identified studies on the association between FMS and injury and performance were conducted with a cross sectional design, evidencing the need for further longitudinal studies.

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# Comparison of the FMS and soccer field test values of some U15 age categories in North Cyprus

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## Introduction

For identification of talented players, some clubs planning to apply a series of physico-technic tests. With this approach, we studied together with some clubs. The aim was to determine the effects of seven FMS (Functional Movement Screening) test over three Soccer Field Test through 74 elite young soccer players who participated in U15 Soccer League in TRNC (Turkish Republic of North Cyprus).

## Methods

The subjects who are 74 football players from 5 different football clubs have the sportsman licenses, training and formal match twice a week in TRNC Football League. The average of participants has  $14.18 \pm 0.817$  years soccer experience, and the average of license age is  $2.18 \pm 0.817$  year. Before testing we talked to all participants individually for entire technical detail of experimentation (according to our university Ethic Codes) Each participant was informed about the risks and difficulty of the test by sharing information mutually. Due to the age of participants under 18, the form which was prepared together with the TRNC Football Federation about the permission of participating, was signed by their families. Creating hygienic platform to apply 7 sections of FMS test was prepared before participants filled out the form then they started to be tested. It was about Zelenka Test, and some tests which have been suggested by FIFA Health Committee (F-MARC) like Ball Skipping Test, Ball Dribbling Test, and Appropriate Shooting Test.

## Results & Discussion

For analyses on data; in package program of IBM SPSS Statistics 22.0 Version, Pearson Correlation Analysis was used. The results of this analyses showed that there were significant correlations ( $p < 0.05$ ) between the results of FMS test and Zelenka Test, Ball Dribbling Test respectively. We found a moderate correlation between the means of FMS test values and Zelenka Test ( $p < 0.01$ ,  $r = -0.396$ ), the means of FMS test values and the Dribbling Test ( $p < 0.01$ ,  $r = -0.323$ ), Zelenka Test and the Dribbling Test ( $p < 0.01$ ,  $r = -0.464$ ), Zelenka Test and the Skipping Test ( $p < 0.01$ ,  $r = -0.330$ ) respectively.

## Conclusion

In the identification and selection periods of talented players we can use FMS Tests as well as some technical-tactic tests. Also we can fix some developmental problems in early times.

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# Quantification of the Degree of Difficulty or Ease of Goalkeepers' Shot Stopping and Assessment Methods Used

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## Introduction

Until now, the save percentage has mainly been considered as an indicator for evaluating a goalkeeper's ability to defend. However, this measurement does not consider the degree of difficulty of the shots taken, thereby limiting its usefulness. Regarding baseball, Lindsey (1963) conducted a data analysis of games; from 24 scenarios combining the number of times on base and the outs, Lindsey (1963) demonstrated the scoring probability distribution till the end of the innings and calculated the value of scoring expectations. Through this scoring expectations value, a quantitative weighting of the 24 scenarios can be performed. This makes it possible to quantitatively evaluate how much the batter's batting has contributed to the scores. In a manner similar to Lindsey's (1963) analysis with regard to baseball, this study identifies the key factors influencing a soccer goalkeeper's ability to stop a shot and develops a regression equation that can predict the probability of failing to make a save. Based on this research, a method of quantifying the probability of stopping a shot was developed and evaluated.

## Methods

The sample comprised data from 551 shots in games played during the 2010 FIFA World Cup in South Africa. The data were statistically analyzed using logistic regression analysis; the main indicators influencing the results of shots were extracted, and a regression equation to predict the probability of failing to stop a shot was constructed. This regression equation was then used to evaluate the performance of 37 goalkeepers who played in the World Cup.

## Results & Discussion

The primary factors influencing the results of shot stops were as follows:

x1:time required for the shot to reach the goalkeeper, in seconds

x2:shot by defensive forward (yes = 1, no = 0)

x3:shot by lateral and rear defensive (yes = 1, no = 0)

x4:body part taking the shot (head = 1, foot = 0)

x5:type of shot (grounder = 1, other = 0)

x6:type of shot (chip kick = 1, other = 0)

x7:next to shot course (far = 1, near = 0)

x8:shot height (medium = 1, other = 0)

x9:shot height (high = 1, other = 0)

x10:change in direction of shot due to the ball striking another player (yes = 1, no = 0)

x11:shot position and angle, in degrees

x12:shot distance, in meters

Using the above-mentioned factors, the following regression equation was formulated to predict the probability of failure:

$$P1 = 1 / (1 + \exp(-(-2.245 - 5.204x1 - 1.215x2 - 0.570x3 + 0.885x4 + 0.551x5 + 4.072x6 + 1.333x7 + 0.711x8 + 0.968x9 + 2.839$$

## Conclusion

By combining the odds ratios for each of the major factors and creating a regression equation to predict the difficulty of making a save, the result of a shot could be predicted with a high level of accuracy (84.8%). Evaluating the 37 World Cup goalkeepers with this weighted method indicated that the ranking of 34 people differed from the save percentage used conventionally. The best goalkeeper at the 2010 World Cup reduced the anticipated number of missed shots from 3.58 to 0.28, and the lowest-performing goalkeeper increased the anticipated number of missed shots from 0.25 to 4.02.

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# A new approach to arousal-performance relationship in the IZOF model: the role of big five personality traits and emotional intelligence

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## Introduction

Initially used to study optimal levels of precompetition anxiety of elite athletes the Individual Zone of Optimal Functioning (IZOF) model was later extended to assess positive (pleasant) and negative (unpleasant) emotions that help or harm performance (Robazza et al; 2006). The IZOF model also argued that the emotional experience that leads to good or bad performance for each athlete is different (Hanin; 1999). This study examined the effects of personality traits and emotional intelligence to the arousal-performance relationship in IZOF model.

## Methods

The research includes 20 professional football player participants ( $26.55 \pm 4.71$  yrs) from Goztepe Sport Club. In the first phase, in order to measure their emotional intelligence and personality traits, Schutte Emotional Intelligence Scale and Five Factor Personality Inventory have applied. In the experimental study phase, the effect of the emotional arousal level triggered with the photos from various categories that are selected from the International Affective Picture System (IAPS) to the speed and accuracy of solving color-word interference task have analyzed. For this reason, SuperLab 4.0 program and Stroop color-word test have used. Participants have been exposed to four groups of visual arousals which are selected from IAPS and it is tested if the triggered arousal level has related to speed and accuracy of solving color-word interference problem.

## Results & Discussion

Correlation analyses indicated that agreeableness personality trait has significant negative relationship with reaction times in pleasant high arousal ( $r = -.60$ ,  $P = .01$ ) and pleasant low arousal ( $r = -.47$ ,  $P = .38$ ) states. Correlation analyses also showed that utilization of emotions, which is a sub dimension of emotional intelligence, has significant negative relationship with the reaction times in all emotional states ( $r = -.55$ ,  $P = .01$ ;  $r = -.51$ ,  $P = .02$ ;  $r = -.56$ ,  $P = .01$ ;  $r = -.45$ ,  $P = .04$ ).

## Conclusion

Results of the present study demonstrated that players who have high emotional intelligence scores felt emotional stimuli faster and reacted more quickly in all arousal states. Our results also showed that players with dominance of agreeableness personality trait had faster reaction times in pleasant arousal states. Results indicated that personality traits may have an effect on arousal-performance relationship.

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# The influence of kinesiology tape during soccer-specific performance implications for ankle sprain prevention

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## Introduction

The epidemiology and aetiology of ankle injuries in soccer have been well considered, with fatigue and postural stability identified as injury risk factors. Athletic taping is a common intervention strategy; however, research demonstrates traditional taping loses its effectiveness on performance measures after 15 minutes of soccer-specific exercise (Forbes et al., 2013), raising issues regarding its efficacy. Kinesiology Tape (KT<sup>TM</sup>) purports enhanced mechanical properties when compared to traditional white tapes. However, the mechanical benefits of KT<sup>TM</sup> are still not fully understood (Yoshida et al., 2011; Halseth et al., 2004), with limited research existing regarding the efficacy of KT<sup>TM</sup> in reference to soccer-specific fatigue

## Methods

Twelve injury free male semi-professional soccer players (age  $24.1 \pm 1.2$  yrs.) performed the Soccer Aerobic Field Test (SAFT90) using no tape (CONT) and KT<sup>TM</sup> (KT) conditions in a counterbalanced order. Overall (OSI), antero-posterior (AP) and medio-lateral (ML) stability indices were measured every 15 minutes for a single legged dynamic balance task. Uni-axial PlayerLoad (PL) and heart rate were measured continuously during the SAFT90 using GPS-mounted accelerometry and heart rate monitors respectively.

## Results & Discussion

KT<sup>TM</sup> improved measures of postural stability for OSI (CONT =  $1.63 \pm 0.52$ , KT<sup>TM</sup> =  $1.23 \pm 0.35$  au;  $P = 0.02$ ), AP (CONT =  $1.28 \pm 0.35$  au; KT<sup>TM</sup> =  $0.97 \pm 0.14$  au;  $P = 0.01$ ), and ML (CONT =  $0.93 \pm 0.35$  au; KT<sup>TM</sup> =  $0.69 \pm 0.14$  au;  $P = 0.04$ ) indices, whilst no significant differences in HR data were recorded between the two conditions. KT<sup>TM</sup> significantly reduced PL in all three planes of movement PLAP, (CONT =  $53.19 \pm 6.31$  au; KT<sup>TM</sup> =  $48.15 \pm 6.11$  au;  $P = 0.03$ ), PLML (CONT =  $45.67 \pm 3.94$  au; KT<sup>TM</sup> =  $43.74 \pm 3.53$  au;  $P \leq 0.01$ ) and PLV (CONT =  $99.90 \pm 4.36$  au; KT<sup>TM</sup> =  $97.16 \pm 4.64$  au;  $P = 0.04$ ). Furthermore, although no significant trial\*time interactions were identified, KT<sup>TM</sup> maintained the same magnitude of improvement for both postural stability and PL measures throughout the soccer-specific exercise.

## Conclusion

In a healthy trained soccer population KT<sup>TM</sup> significantly improved measures of postural stability. Furthermore, KT<sup>TM</sup> application significantly reduced and maintained lower tri-axial accelerometer PL measures during soccer exercise. These results suggest that application of KT<sup>TM</sup> to the ankle may be advocated in an attempt to reduce the risk of a primary ankle injury being sustained, without negatively affecting soccer specific performance.

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# Challenges perceived by male and female coaches in elite women's soccer

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## Introduction

Jowett and Cockerill (2002) argued that the coach-athlete relationship is a crucial factor in athlete development. The coach has been identified as a key in elite performance settings and critical for high achievement (Horn, 2002). Coaching any elite athlete is challenging and complex, but little research has investigated the key, possibly gender-specific challenges perceived by coaches when coaching elite females. The purpose was to examine challenges perceived by male and female coaches when working with elite female soccer teams.

## Methods

Ten soccer coaches (6 male, age 35-63) participated in semi-structured interviews to explore challenges they had experienced when coaching in female soccer. Nine were coaches of elite Norwegian league teams and three had experience as the national team coach. Interviews took place in-person, were audio recorded, transcribed verbatim and subjected to thematic content analysis.

## Results & Discussion

Both groups identified 'Soccer competence' (5/10) e.g., "*They do not see enough football ..., they lack knowledge to discuss or reflect on the subject*"; the 'Semi-professional life' (6/10) e.g., "*It is often the practical things, they go to work, school, or taking care of family*"; and 'Low self-esteem & confidence' (4/10) e.g., "*It seems there is a lower level of self-esteem and confidence in females*" as challenges. Males identified missing the 'Dressing room culture' (6/6) e.g., "*I cannot go into the locker room as much as do with guys, so I can't feel or judge the dressing room culture*", and demand for greater levels of 'Attention and feedback' (4/6) e.g., "*They want feedback, they want confirmation that they are being seen, more conversation, perhaps a more supportive relationship*". Females identified the possible negative impact of 'Team selection' (3/4) e.g., "*always the team selection -always. No matter what I do, there will always be some players that are unhappy because they do not play*".

## Conclusion

Several of the challenges relate directly to the coach-athlete relationship. Both groups identified a lack of emersion in the sport, resulting in perceived lower levels of competence; the impact of non-professional status on engagement, and lower self-esteem and confidence compared to males. Male coaches felt distant from the team dynamics in the dressing room, possibly reducing their ability to influence team culture, and felt they had to provide greater levels of feedback and support. Females were more concerned with the negative impact their non-selection of a player may have.

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# Age-related team tactical differences in full-sized matches

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## Introduction

Research showed that physical performance of young soccer players are lower than that of older soccer players in full-sized matches (Goto et al, 2015; Buchheit et al., 2010). Besides, older soccer players show different team tactical behaviour in small-sided games (Folgado et al., 2014; Olthof et al., 2015). However, age-related differences in tactical performance in full-sized matches have not been investigated so far. Therefore, the aim of this study is to investigate team tactical behaviour of age groups in 11 vs. 11.

## Methods

One hundred and one players were assigned to four age categories (under-13, under-15, under-17 and under-19) and each age category played three 11 vs. 11 friendly games of 10 minutes in training sessions. Positional data were collected with the LPM-system. Tactical performance measures, such as the inter-team distance, surface area, length and width, were calculated for each age group. Differences between age groups were investigated using ANOVA and post-hoc analysis with Bonferroni correction.

## Results & Discussion

All tactical performance measures showed significant differences between age groups. Post hoc analyses revealed that under-17 and under-19 showed significantly larger inter-team distances than under-13 and under-15 ( $6.23 \pm 0.48$  and  $5.99 \pm 0.66$  vs.  $3.74 \pm 0.33$  and  $3.94 \pm 0.55$  m,  $p < .01$ ). This means that the distance between teams increased with older age. In addition, surface areas were larger for under-17 and under-19 than for under-13 and under-15 ( $1023.78 \pm 93.27$  and  $979.46 \pm 83.99$  vs.  $832.02 \pm 55.10$  and  $801.86 \pm 60.44$  m<sup>2</sup>,  $p < 0.5$ ). Significantly larger width was found for under-17 and under-19 than under-15 ( $42.86 \pm 2.46$  and  $41.88 \pm 2.44$  vs.  $34.94 \pm 2.29$  m,  $p < .05$ ). This indicates that older teams adopted a larger dispersion on the pitch.

## Conclusion

With an increase in age, inter-team distance, surface area and width of the teams increased. This is in line with previous research where tactical differences were found between age groups in small-sided games (Folgado et al., 2014; Olthof et al., 2015). Older age categories play the full-sized match with different tactical behaviour than younger soccer players. Increased physical performance in older age categories likely underlies these team tactical differences.

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# Locomotor activity, enjoyment and perceived exertion from 7v7 football for patients with Parkinson's disease

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## Introduction

The level of daily physical activity decrease with disease severity in patients with Parkinson's disease. Furthermore, inactivity is associated with greater disabilities in daily life and secondary complications. Participation in recreational football, organized as small-sided games, on a regularly basis show benefits in the health profile and physical capacity in untrained adult men, and improves both cardiovascular and metabolic fitness.

The purpose of this study is to describe locomotor activities, enjoyment and perceived exertion during football training for men with Parkinson's disease.

## Methods

14 men from a football team for patients with Parkinson's disease carried out a 1-h training session, during which heart rate (HR), accelerations, effort and distances (total, high intensity and sprints) was measured with ZXY radio wave based technology. The participants were  $63 \pm 6$  years old (mean  $\pm$  SD), weighed  $86 \pm 13$  kg, had a fat percentage of  $17 \pm 9$  %, a muscle mass of  $37 \pm 4$  kg and had been diagnosed with Parkinson's disease for  $9 \pm 6$  years. They were all in stage 2-3 of the disease. The participants warmed up for 22 min with selected FIFA 11+ drills, after which they played 7v7 football on a 40x40 m artificial turf football pitch with 1.5x3 m goals. After each activity perceived exertion for lower limbs and total body individually was rated on a visual analogue scale (0-10). After the whole session the participants filled out a PACES questionnaire to rate enjoyment of the session. Height was measured using a Tanita Leicester Transportable altimeter (Tanita, Amsterdam, the Netherlands). Body composition were measured using an InBody 230 multifrequency body composition analyser (Biospace, California, USA)

## Results & Discussion

During 29 min of football (7v7) the participants covered a total distance of  $1932 \pm 420$  m (mean  $\pm$  SD), of which  $193 \pm 139$  m was high intensity running. Total effort was  $1916 \pm 579$  AU. In the subsequently visual analogue scale the participants rated a perceived exertion for the lower limbs to  $5.8 \pm 2.8$  and for total body to  $6.1 \pm 2.7$ . The total Paces score was  $4.5 \pm 2.8$ .

## Conclusion

It is feasible to conduct football training for patients with Parkinson's disease. The participants enjoyed the training and perceived exertion was medium, meaning that football has great potential as a health enhancing activity for patients with Parkinson's disease.

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# Talent identification in Norway – The relative age effect in selected youth soccer players

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## Introduction

Selection of talents is a key mechanism in most sports contexts, based on the idea that the best athletes must have the opportunity to nurse and develop their potential (Sæther, 2017). In international youth soccer competitions the selection is constructed around chronological age (Williams, 2010). A fundamental challenge in identifying talent is reflected in what is called the 'relative age effect', i.e., children born early in the year are over-represented relative to playtime and selection to talent team and national youth teams (Helsen, et al., 2005; Williams, 2010). The aim of the present study was to investigate differences in birth distribution among players at regional and national level.

## Methods

A total of 624 soccer players born 2001 (n=298) and 2002 (n=326) participated in the study. All players had been selected to their regional team prior to the data collection. All players completed a questionnaire during a regional practice session during autumn 2015. Of the regional players participating in this study, 81 players were selected for representation at national level during spring 2016.

## Results & Discussion

For the regional players, the results revealed an over-representation of players born early in the selection year, with 41% of the players born in first quarter of the year (Q1), 27 % born in Q2, 21 % born in Q3 and 11% born in Q4. For the players selected for national representation, the results revealed an even stronger over-representation of players born early, as 44% were born in Q1, 32% in Q2, 17% in Q3 and 6% in Q4. However, a chi square test revealed no statistical differences in birth quartile between the two groups (p=.3). The results revealed an over-representation of players born in the first quarter of the selection year. However, the results revealed no statistical difference in birth distribution between players at regional and national level.

## Conclusion

The results of this study indicate that there is a tendency to an inclusion of players born early in the selection year.

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# Comparison between cards applied to home and visitor teams in two Brazilian competitions

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## Introduction

Refereeing involves quickly accurate decisions that could become arbitrament a stressful position in a soccer game. Referees also suffer pressure for other factors like crowd (Nevil et al. 2016). Moreover, home advantage is established phenomena in sports and probably crowd could influence referees decision (Unkelbach et al. 2010). In this sense, the objective of this study was analyze the number of cards applied to home and the visitor teams in the two main brazilian competitions.

## Methods

The yellow and red cards applied to home and the visitor teams of Three hundred eighty games of the first division of brazilian championship and one hundred sixty two games of the and Brazilian Cup were analyzed by the games summaries. The normality of dates were analyzed by Shapiro Wilk test e to compare cards applied between home and visitor teams were applied a Mann-Whitney. The significance adopted was  $p < 0,05$ .

## Results & discussion

The mean yellow cards applied to visitor teams were higher ( $p=0.001$ ) than home teams ( $2.46 \pm 1.46$  and  $2.07 \pm 1.34$ , respectively) on first division Brazilian Championship. Moreover, the mean red cards applied to visitor teams were higher ( $p = 0.002$ ) than home team ( $0.15 \pm 0.4$  and  $0.07 \pm 0.25$ , respectively) on first division Brazilian Championship. The mean yellow cards applied on Brazilian Cup were higher ( $p=0.001$ ) in visitor than home teams ( $2.72 \pm 1.64$  and  $2.11 \pm 1.24$ , respectively). However, the mean red cards did not differ ( $P=0.154$ ) between home and visitor teams on Brazilian cup ( $0.12 \pm 0.37$  and  $0.19 \pm 0.45$ , respectively).

## Conclusion

Our results demonstrate that visitor teams received more yellow cards on First Division Brazilian Championship and Brazilian Cup than home team. Moreover, visitor teams received more red cards than home teams on First Division Brazilian Championship. However, on Brazilian cup the number of reds card applied did not differ.

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# Analysis of biochemical changes after overload and taper training in soccer

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## Introduction

During the preseason period, a large volume of high-intensity training and insufficient recovery may lead into short-term performance reduction (Coutts et al., 2007). Taper training is a reduction strategy in the training loads of athletes in the final days of preseason period with the aim of optimizing performance (Mujika et al., 2004). It is important to investigate the biochemical parameters in order to explain the causes of the changes in performance. However, there are few studies examining the effect of taper training on biochemical changes in soccer. Therefore, the aim of this study is to examine changes in biochemical parameters that occur after overload and taper trainings during the preseason period in soccer.

## Methods

Fifteen male amateur soccer players completed 2 weeks of general preparation, 6 weeks of overload training with limited recovery periods and 1 week of taper training. An anaerobic threshold test was performed before overload training weeks in order to determine the individualized exercise intensity. During overload and taper training weeks, small-sided games were used as a method to train at the anaerobic threshold intensity. While maintaining the intensity, frequency and volume of the training sessions were decreased with the exponential fast decay taper method during the taper training week. Serum total testosterone (TT), serum cortisol (C), serum creatine kinase (CK), hemoglobin (Hb) and hematocrit (Hct) measures were taken 4 times; prior to general preparation and the fifth week of the overload period, and at the end of the overload period and the 7 days taper. To determine the differences, the data was analyzed using an analysis of variance (ANOVA) for repeated measures.

## Results & Discussion

Significant decreases in CK activity and C concentration and significant increases in Hct, Hb and TT levels were detected after taper training when compared with overload period ( $p < .05$ ). Significant decreases in Hct, Hb and TT levels and significant increases in CK activity were observed after overload period when compared with pre-training ( $p < .05$ ) whereas no significant changes were noted in C concentration ( $p > .05$ ).

## Conclusion

The biochemical data which shows increases in anabolism and decreases in muscle damage can be explained as a result of the 1 week of the exponential fast decay taper.

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# Analysis of pass tendency in soccer game based on tracking data

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## Introduction

Recently, tracking systems based on computer vision techniques have been used for the tactical analysis and the assessment of the ability of soccer players and teams. Many researches using tracking data concern running performance. However, the analysis of pass related to tracking data has not been studied. The purpose of present study was to analyze pass information based on tracking data.

## Methods

This study was carried out with seventeen J-League (Division 1) games in 2015 season. We used positioning and pass tendency during the game. Positioning information of the players were assessed using a semi-automatic tracking system by using particle filter (Iseyama et al., 2015). On the other hand, pass tendency was analyzed visually from the game video. Pass speed were categorized into 5 categories (0-26km/h., 26-34km/h., 34-42km/h., 42-50km/h., > 50km/h.) and visualized. The pass information was recorded by time line the information when visually checked from the video, the team, and the players.

## Results & Discussion

Analysis results showed that number of pass, pass position and pass distance were remarkably different from each team. Even in the same team, pass tendency was quite difference between the first half and second halves because the number of pass and pass position changed. Pass speed and pass distance depend on pass direction. However, average and standard deviation of pass speed were no significant difference from team to team. Therefore, that pass tendency was mainly determined five factors: number of pass, pass distance, pass speed, pass direction and pass position.

## Conclusion

The present study revealed five main determinative factors in pass tendency. Therefore, it can be expected tactical analysis based on the pass analysis using proposed five factors.

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# Protein Supplementation Facilitates Recovery Between Football Matches Performed 3 days Apart

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Football match activity is associated with the onset of muscle damage and an acute inflammatory response that result in a performance decline for 1-3 days (1, 2). Multiple matches performed within a small-time frame result in reduced field performance during the second match compared to the first one (3). Protein has been shown to stimulate protein synthesis and facilitate recovery from intense exercise. This investigation examined the effects of protein supplementation on performance recovery in response to two matches performed 3 days apart. Therefore, 20 football players received either protein (PRO, 80% casein/20% whey) or PLA (PLA) during recovery following both matches (6 days) according to a cross-over, double-blind, repeated measures design. Players participated in regular in-season training after each match. Field activity was monitored using GPS devices during matches and practices. Heart rate was recorded throughout matches and practices. Blood was collected and performance [isokinetic strength, 20-m speed, repeated sprint ability (RSA)] and muscle soreness were measured 2 hours post-match, daily for two days after the first match, 2 hours after the second match and daily for 3 days after the second match. Muscle biopsies were collected at baseline and one day after each match. In PLA, all indices of performance declined after the both matches with the 2nd match inducing a greater decline. High intensity running, sprinting and acceleration/deceleration distance decreased during the 2nd match. PRO attenuated the decline in RSA and speed and the rise of inflammatory markers (creatine kinase activity, leukocytes, CRP) following both matches. Furthermore, PRO attenuated the decline of high-intensity activities in the 2nd match. Anabolic signaling (phosphorylation of proteins in the AKT/mTOR pathway) was upregulated by PRO following both matches. These results suggest that protein supplementation may facilitate recovery kinetics and accelerate inflammation in response to two matches performed 3 days apart.

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# Re warm-up prior to football matches: is it beneficial for physical performance?

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## Introduction

Warm-up (WU) routines are widely explored and commonly accepted for optimizing performance and preventing injury. However, official international pre-match protocols may require players to passively rest for approximately 15 minutes in the time-course between WU and the beginning of the match. Therefore, the aim of this study was to assess the contribution of different re warm-up (re-WU) strategies on the physical performance of football players.

## Methods

Twenty-two Portuguese elite under-19 football players participated in the study conducted during the competitive season. 4 protocols (WU + re-WU) were tested in 4 consecutive days. The protocols differed only in the re-WU strategy applied after the standardized WU: without re-WU (CON), eccentric re-WU (ECC), plyometric re-WU (PLY) and repeated changes of direction re-WU (RCOD). Vertical jump (counter movement, CMJ; and abalakov, AJ) and Sprint capacity (10-m and 20-m) were tested immediately after WU and 12 minutes after WU. The re-WU strategies were performed 6 minutes after WU. Magnitude-based inferences and precision of estimation were employed in data analysis.

## Results & Discussion

Both CMJ and AJ performances presented a likely/very likely improvement after PLY intervention ( $\sim 3.8\%$  in CMJ and  $\sim 4.8\%$  in AJ) when compared to CON. PLY also showed a moderate very likely beneficial effect in 10-m (Cohen d;  $\pm 90\%CL$ ,  $-0.7$ ;  $\pm 0.3$ ) and a moderate most likely beneficial effect in 20-m (ES= $-0.9$ ;  $\pm 0.3$ ) performances. The RCOD presented a likely/possible beneficial effect to CMJ and AJ, and a moderate likely/most likely beneficial effect to 10-m and 20-m sprint performances. Different practical implications may be taken from the ECC since there was a  $-5.1 \pm 5.6\%$  decrease in CMJ height from post-WU to re-WU which suggests a possible harmful effect when compared to CON.

## Discussion

The absence of re-WU activities in the time-course between the WU and the beginning of the match may be detrimental to players' physical performance. However, the inclusion of re-WU exercises prior to match is a very delicate issue, since the manipulation of volume, intensity and recovery may positively or negatively affect the subsequent performance (Robbins, 2005). In fact, our research shows that eccentric exercise prior a football match may be harmful for physical performance. However, plyometric and repeated changes of direction exercises seem to be efficient active strategies to attenuate losses in vertical jump and sprint capacity after WU.

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# Neuromuscular and physiological responses during a soccer-simulation protocol on different game surfaces

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## Introduction

Newest artificial turf (AT) systems of 3rd generation are designed to provide similar functionality to that of natural grass fields (NG) when playing soccer. In fact, previous studies have reported similar sprint performance, recovery time and injury levels in both surfaces (Hughes et al., 2013; Meyers, 2016).

Although the soccer-simulation protocol (SSP) has already been used to test the influence of playing surface in player's responses, no one has assessed the internal load through the % of maximum Heart Rate (HR max) of players; using only values as beats per minute (Hughes et al., 2013; Stone et al., 2014). Thus, this research intends to assess the influence of the game surface on physiological patterns and their effect on the neuromuscular responses through a SSP.

## Methods

Sixteen players ( $22.17 \pm 3.43$  years old;  $177.12 \pm 5.24$  cm;  $73.42 \pm 4.87$  kg) completed the first three bouts of a SSP on both AT and NG. Mechanical properties of both surfaces were recorded through an advanced artificial athlete (Deltec Metaal, Duiven, Holland). Tensiomyography analysis (TMG-100 System electrostimulator, TMG-BMC d.o.o., Ljubljana, Slovenia) of the rectus femoris (RF) and biceps femoris (BF) were carried out in basal and right after the SSP; recording the following variables: maximal muscular displacement (Dm); contraction time (Tc); sustain time (Ts); delay time (Td) and half-relaxation time (Tr).

Physiological responses (HR Peak and HR mean) were tested as % of HR max through a HR monitor (Polar Team System, Kempele, Finland). Tests were carried out in same condition and time, and players rested 72 h. Results were analysed through a two-way ANOVA test (surface x bout for physiological responses and surface x moment for tensiomyography variables).

## Results & Discussion

No significant differences among either surfaces or bouts were found for heart rate (HR) peak and HR mean ( $p < 0.05$ ); which is in line with previous studies (Hughes et al., 2013). Tensiomyography variables did not present significant differences between surfaces either, concurring with Stone et al. (2014) who did not find differences in creatine kinase and the perception of muscle soreness between surfaces.

## Conclusion

The findings of this research show similar physiological and neuromuscular responses on both surfaces. Therefore, it is expected that playing soccer on AT causes the same neuromuscular adaptations and acute fatigue as on NG.

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# An analysis of offensive play in the vital area in soccer

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## Introduction

As 70–80% of all goals in soccer are scored from within the penalty area, it is considered essential for teams to find ways to penetrate the penalty area before shooting (Yiannakos et al., 2006; Njororai, 2013). In other words, for creating scoring chances, players are required to receive the ball between the opponent's defenders and midfielders (Hughes, 1990; Rees et al., 1997). This location is referred to as the vital area (Shoji, 2014; JFA, 2015), and its importance has been pointed out in many strategy manuals. However, quantitative analyses or research focusing on offensive play in the vital area has not been reported. Therefore, this study aims to obtain useful data about the vital area in soccer by identifying differences in offensive plays between top-level and lower-level in J. League division 1 teams.

## Methods

A descriptive game performance analysis was conducted, targeting 32 matches during the 2016 season involving top four teams and bottom four teams in the league. The focus of data collection was on passes that invaded or originated in the vital area. Eleven items were measured, including the identity and location on the field of players who passed the ball into the vital area, those who received a pass within the vital area, and those who received a pass coming from the vital area. In the statistical analysis, a chi-square test and simultaneous multi-population analysis were conducted.

## Results & Discussion

As a result of simultaneous multi-population analysis, the top-level teams exhibited that the number of defenders in front of ball holder affected direct play (plays that move the ball in the direction of the goal) ( $\beta = -.30$ ,  $p < .01$ ), and direct play affected pass-receiving situation ( $\beta = .31$ ,  $p < .01$ ). As a result of a chi-square test, differences between the top-level teams and lower-level teams were the occurrence rates of direct play, pass-receiving area and situations. Compared with the lower-level teams, the top-level teams had more direct plays, which suggested better pass-receiving situations.

## Conclusion

One of the main differences in offensive play in the vital area was the greater frequency of direct play by the top-level teams. Furthermore, compared with the lower-level teams, the top-level teams had more direct plays in the vital area when there were few defenders in front of ball holder, leading to better pass-receiving area and situations.

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# Comparing the running performance between soccer matches of Japanese aged Over 60, 70 and 75

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## Introduction

Japan Football Association holds conventions for various ages in order to increase opportunities that senior people play soccer. Previous studies on senior soccer have reported the Japanese player's running performance for prevention of injuries (Ishizaki et al., 2014). Generally, it is well known that physical ability depends on player's age. The present study analyzed Japanese senior's running performance to examine the differences among of match categories.

## Methods

Two matches for each category (over 60 years: O60, over 70 years: O70, and over 75 years: O75) were measured. Subjects played 20-min half soccer match on an official-sized pitch. The running performance was assessed by the tracking systems based on computer vision techniques (Iseyama et al., 2016). The locomotion categories were as follows; standing (0-2km/h), walking (2-7 km/h), low-speed running (LSR, 9-13 km/h), moderate-speed running (MSR, 13-16 km/h), high-speed running (HSR, 16-22 km/h), and sprinting (> 22 km/h) (Randers et al., 2010). In the present study, the running performance was evaluated as the summation of ten field players in the same team, because many players did not play in full time.

## Results & Discussion

The total distance covered per team was significantly different among categories (O60; 43754 ± 2961 m, O70; 35619 ± 2089 m, O75; 32042 ± 1240 m,  $p < 0.001$ ). The match of younger category was significantly lower the percentage of distance covered at standing and walking to total distance ( $p < 0.001$ ). Moreover, the match of younger category was significantly higher the percentage of MSR, HSR and sprinting ( $p < 0.001$ ). Furthermore, the distance covered for each speed category was evaluated for players aged 70 over (age; 71.0 ± 1.2 years, n=4) who played in O60 match. Compared with the player in O70 match, their percentage of walking was significantly lower ( $p < 0.05$ ) and percentage of HSR and sprinting was significantly higher ( $p < 0.01$ ).

## Conclusion

Comparing the soccer match in Japanese players aged O60, O70 and O75, it was found that total distance covered became longer as the match category is younger. As the category is younger, the percentage of walking became lower and the percentage of high intensity running became higher. Moreover, it was observed that senior players who play in younger category match showed higher running speed than they play in suitable category.

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# Match activities and positional characteristics of Canadian female university soccer players

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## Introduction

High-intensity running and sprinting ability are critical factors in determining physical capacity, physical match performance and competition level in female soccer players (Mohr et al., 2008). Match analysis techniques, including Global Positioning Systems and HR recordings, have demonstrated that physical demands vary with positional roles among elite female soccer players (Vescovi, 2014). Therefore, analyses of physiological characteristics during match-play are critical for improving match performance in high-level female soccer players. This study examined physical demands and locomotor activities of Canadian female university soccer players over the season of competitive match play in accordance with their playing position.

## Methods

89 Canadian female university outfield soccer players ( $19.4 \pm 1.0$  yrs) were monitored during 20 competitive matches using combined 10-Hz Global Positioning Systems and Heart Rate (HR) recordings (Polar Team Pro System, Polar Electro Oy, Finland). Positional comparisons of locomotor activities were made for complete matches, each half and 15-minute periods enabling statistical analyses of differences between 15-minute periods or between matches by ANOVA and ANCOVA, respectively.

## Results & Discussion

Average total distance covered in a match was 9333m (range: 7577-11979) with high-intensity running (HIR) accounting for 497m (119-1130) while average HR intensities of  $170 \text{ b} \cdot \text{min}^{-1}$  (149-192) corresponded to 88% (80-93) HRmax. Central midfielders (CM) covered greater distances ( $10535 \pm 199 \text{ m}$  vs  $8566 \pm 153 \text{ m}$ ) and had higher work-rates ( $112 \pm 2 \text{ m/min}$  vs  $91 \pm 2 \text{ m/min}$ ) than central defenders (CD). Forwards performed significantly greater HIR ( $p < 0.0001$ ) and sprinting distances ( $p < 0.0001$ ) than both groups of defenders and CM; and had higher number of sprints ( $38 \pm 3$ ) compared to CD ( $19 \pm 2$ ). However, external midfielders performed longer sprint distances ( $12 \pm 1 \text{ m}$ ) when compared to CM ( $9 \pm 1 \text{ m}$ ). Overall, there was a propensity for decreased distances within most velocity bands, work-rate and number of sprints, towards the final 15-minute period of the match, indicating fatigue development.

## Conclusion

Our findings suggest that physical demands and locomotor characteristics of Canadian female university soccer players vary with positional roles and are comparable to elite-standard female soccer players. These data provide insight for coaches and sport scientists in planning more effective training protocols by considering positional effect characteristics. Further examination of the relationship between training programme and match performance in Canadian female university soccer players is warranted.

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# Effects of functional ankle instability on collegiate female football players' performances

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## Introduction

Football is played worldwide by more than 265 million players, of whom 26 million are female players (FIFA Big count 2006). The popularity of female football players in Japan has been rising since the winning of FIFA World Cup championship in 2011. 17–20% of all injuries are sprains in soccer players (Fong et al., 2007). Ankle sprains cause functional instability in a large proportion of cases. However, no studies have examined a link between functional ankle instability and physical performances. The purpose of this study was to investigate the relationship between functional ankle instability and collegiate female football players' performance.

## Methods

16 collegiate female football players (mean age=19.7±1.4 years, mean height=159.8±7.6cm, mean weight=56.7±6.1kg) participated in this study. The players were classified into either the functional instability group (5 players) or the control group (11 players) based on the Karlsson score. (Karlsson et al., 1991) All subjects underwent performance tests (Yo-Yo Intermittent Recovery test Level 1, 20m and 40m Sprint, Bounding test, Shuttle run(10m×5), Figure of 8 hop test and Side hopping).

## Results & Discussion

A significant relationship was found among the functional ankle instability index, Figure of 8 hop test ( $\leq 0.05$ ). No relationship was revealed between the functional ankle instability index and other performance tests.

## Conclusion

The results suggest that the anterior direction motion is more likely to be influenced by the functional ankle instability than other direction motion. Therefore, regain of normal anterior direction motion is considered to be one of the criteria of recovery process in female soccer players with functional ankle instability.

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# Offensive Effectiveness in Spanish La Liga, Italian Serie A, German Bundesliga, English Premier League and Champions League

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## Introduction

In the last 20 years, attacking tactical dynamics have evolved considerably in teams playing UEFA European and FIFA World Championships from 1982 to 2010 (Barreira, 2013). To provide a more contemporary and generalised insight, this study aimed to examine the effect of playing tactics and situational variables on the effectiveness of offensive sequences in major European competitions.

## Methods

A sample of 1694 offensive sequences from the Spanish La Liga, Italian Serie A, German Bundesliga, English Premier League and Champions League were analysed using chi-square and logistic regression analyses. Data were recorded using a specific notational system developed and validated by Sarmento et al. (2010). This combined pitch zones and key offensive activities which were subcategorized into: (1) type of attack; (2) start of the offensive process (OP); (3) end of the offensive process; (4) spatial area of the field; (5) interactional context in the center of the game.

## Results & Discussion

The results revealed that chance of an offensive sequence ending successfully in La Liga, Serie A and the Premier League was 2.22 (95% IC: 1.67 to 2.97;  $P < 0.001$ ), 2.51 (95% IC: 1.69 to 3.73;  $P < 0.001$ ) and 3.01 (95% IC: 2.08 to 4.35;  $P < 0.001$ ) times higher compared with an offensive sequence performed in the Champions League. Counterattacks (OR=1.44; 95% IC: 1.13 to 1.83;  $P < 0.01$ ) and fast attacks (OR=1.43; 95% IC: 1.11 to 1.85;  $P < 0.01$ ) increased the probability of success of an offensive sequence by 40% when compared with the positional attack. Offensive sequences that started in the pre-offensive or offensive zones were more successful than those started in the defensive zones. An increase of 1 second in the offensive sequence duration and an extra pass resulted in a decrease of 2% (OR=0.98; 95% IC: 0.98 to 0.99;  $P < 0.001$ ) and 7% (OR=0.93; 95% IC: 0.91 to 0.96;  $P < 0.001$ ), respectively in the probability of its success.

## Conclusion

The data demonstrate some relevant findings about the performance indicators related to the success of offensive sequences. This data could provide valuable information for coaches to design specific training situations that can improve the effectiveness of the offensive process.

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# The influence of minutes played in soccer match on YYIRT2 performance

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## Introduction

The football match represents, for players, a physiological and cognitive load (Stolen et al., 2005), due to the continuous high intensity intermittent efforts (McMillan et al., 2005). Mohr et al. (2013) showed that Yo-Yo intermittent recovery test level (YYIRT2) performance was 16% higher in players that play regularity matches during season than players that play poor matches. Nevertheless, no information was presented about a possible different training for this two groups of players. The aim of this study was to analyse the effect of minutes played on YYIRT2 maintaining for all players the same volume and kind of training.

## Methods

Fourteen elite U-21 soccer players (age:  $18.6 \pm 1.4$  yrs, weight:  $74.2 \pm 7.1$  kg, height:  $1.81 \pm 0.1$  m; BMI:  $22.7 \text{ kg} \cdot \text{m}^{-2}$ ) were recruited in this study. Subjects performed YYIRT2 in two different moments of the first part of the season (August-January). All players knew this test and they have been performed it during the previous season. The first assessment was performed during the preparatory period, after 5 weeks of training (PRE). The second one during competitive period, to 4 months from the first test (POST). All players have performed the same number and kind of training through the two evaluation moments. A number of 12 matches and 64 training were performed. Only players that took part in 95% of training were included in this study. Data were expressed as mean  $\pm$  SD. Differences between PRE and POST were determined using a paired t-test. Relationship between YYIRT2 delta POST-PRE (DELTA) and minutes played was evaluated using Pearson's product moment test.

## Results & Discussion

Total distance covered in YYIRT2 was 14% significantly higher in POST vs PRE ( $1217 \pm 161$  m vs  $1348 \pm 91$  m). Furthermore, no significant correlation was observed between minutes played in matches and DELTA.

## Conclusion

Our data showed significant increase in performance of YYIRT2 during the first part of the season in accordance with data reported by Mohr et al. (2013). Nevertheless, no relationship between minutes played in matches and improvement in YYIRT2 was observed when maintaining the same volume and kind of training. These results seems to underlined the importance of training on a YYIRT2 performance, but no information was reported about the characteristics of training.

# Modeling of relationships between physical and technical activities and match outcome in elite German soccer players

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## Introduction

The main objective of professional association football is to achieve the best match outcome (Liu et al., 2016). Increasing the effectiveness of a team's play is associated with efficient cooperation among players in executing their physical and technical activities (Cavaco et al., 2014). The aim of the study was to examine physical and technical activities of soccer players in different pitch positions, which significantly affect the match outcome.

## Methods

Match performance data were collected from 350 soccer players competing in the German Bundesliga during the 2014/2015 domestic season. A total of 4,393 individual match observations were undertaken on outfield players. The analysis was carried out using the Impire AG motion analysis system recording all movements of players in all 306 matches. The following physical activities were chosen for logistic regression analysis: distance covered [km]; distance [km] covered below the anaerobic threshold; distance [km] covered at different intensity ranges; the number of performed sprints; mean running speed [km/h] and peak running speed [km/h]. The tactical activities under study included the number of ball touches, number of passes, and number of won one-on-one plays.

## Results & Discussion

The mean running speed in the second half of the match was a statistically significant variable for forwards, wide midfielders, and central midfielders. The odds ratio revealed that an increase in the mean running speed in the second half for 0.1 km/h improves the odds of winning the match for 27% (forwards), 15% (wide midfielders), and 10% central midfielders. Furthermore, for wide midfielders, a statistically significant variable was the distance covered at > 24 km/h, whose increase for 0.1 km improved the odds of winning the game for 32%. The estimated model included only the number of passes as the increase of this parameter by wide midfielders improved the odds of winning the match by 3%.

## Conclusion

The soccer training of forwards, wide midfielders, central midfielders and full-backs must involve the development of speed skills and aerobic capacity. The match outcome is also significantly determined by the players' greater peak and mean running speed in the second half of the match, and by covering longer distances at the speed above 24 km/h. The study of elite German soccer players indicates that match outcome is more determined by players' physical activities than technical activities.

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# A comparison of speed and high intensity running ability between Canadian and Uruguayan professional academy soccer players

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## Introduction

Linear running speed and high intensity running ability are two important physical performance characteristics of elite youth soccer players. Gissis et al. (2006) stated that elite youth soccer players can be distinguished from sub-elite players based on both strength and speed characteristics. Differences in training methodologies exist between Canadian and Uruguayan youth soccer, and they can manifest themselves in the development of different physical abilities in elite youth academy players. A greater emphasis on developing or selecting for specific physical abilities in youth soccer may be evident from examining fitness assessment data. To date, there has been no research examining the differences in physical performance characteristics, with regards to linear running speed and high intensity running ability, between elite Canadian and Uruguayan youth soccer players.

## Methods

U14, U15, U16, and U19 boys' teams of two youth academies from professional clubs – one from Toronto, Canada (n=77), and the other from Montevideo, Uruguay (n=72), participated in this study. Measurements of linear running speed (10, 20, and 35-metre distances) as well as the Yo-Yo Intermittent Recovery Tests (YYIRT), were compared between the Canadian and Uruguayan academy teams. The U14-U15 teams completed the YYIRT Level 1, while the U19 teams completed the YYIRT Level 2. Mean sprint times, and scores on the YYIRT, were compared and analysed.

## Results & Discussion

Canadian players had significantly lower times ( $p < 0.001$ ) in the 10, 20, and 35 metre sprint tests across all age categories. In comparing the teams' YYIRT scores, U15 Canadian players had significantly higher scores ( $p < 0.001$ ) in the YYIRT Level 1, and U19 Canadian players had significantly higher scores ( $p < 0.001$ ) in the YYIRT Level 2, however, there were no significant differences found in the U14 category in the YYIRT Level 1.

## Conclusion

Canadian players were significantly faster than their Uruguayan counterparts and had higher anaerobic fitness, as evidenced by the higher YYIRT Level 2 score in the U19 category. However, Canadian and Uruguayan U14 teams had similar aerobic fitness, as evidenced by their similar YYIRT Level 1 scores. It may be possible that the different training methodologies in Canadian youth soccer have led to greater development of anaerobic fitness in Canadian players, and also that a selection bias exists in Canadian youth soccer, towards youth players with better speed and anaerobic fitness. Further research comparing the differences in physical abilities between Canadian and Uruguayan elite youth soccer players may be warranted.

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# Measuring the players' intermediation in passing sequences: network analysis by using the uPATO software

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## Introduction

Network analysis has been used to test the centrality levels of players during passing sequences<sup>1,2</sup>. Intermediation measures that have been used in different scientific contexts can be relevant to understand the relevance of each player during passing sequences and the capacity to represent a dynamic node in the graph. Therefore, the aim of this study is to analyze the intermediation properties of elite soccer players during UEFA Champions League 2015/2016. Analysis of variance of closeness (CC) and betweenness (BC) centralities and proximity prestige (PP) between playing positions will be tested.

## Methods

The passing sequences made in 92 matches from UEFA Champions League 2015/2016 were analyzed in this study. Nine of the best 16-teams in the edition were observed during all the matches. Players were codified by playing positions in accordance with previous studies<sup>1</sup>: i) goalkeeper (GK); ii) external defenders (ED); iii) central defenders (CD); iv) midfielders (MF); v) external midfielders (EMF); and vi) forwards (FW). The ultimate Performance Analysis Tool (*uPATO*) was used to test the network measures<sup>3</sup>. Intermediation measures of closeness centrality (CC), betweenness centrality (BC) and proximity prestige (PP) were calculated for each player per match. One-way ANOVA followed by Tukey post-hoc test and effect size of eta squared (ES) for a  $p < 0.05$  were used to analyze the variance of centrality measures between playing positions.

## Results & Discussion

One-way ANOVA revealed differences between playing positions in CC ( $p=0.00$ ;  $ES=0.240$ ), BC ( $p=0.00$ ;  $ES=0.14$ ) and PP ( $p=0.00$ ;  $ES=0.03$ ). Highest values of CC ( $0.89 \pm 0.09$ ;  $ES=0.17$ ) and BC ( $2.77 \pm 1.93$ ,  $ES=0.06$ ) were found in MF. FW had the highest value of PP ( $0.41 \pm 0.09$ ,  $ES=0.10$ ). Smallest value of CC ( $0.75 \pm 0.10$ ,  $ES=0.04$ ) was found in FW. GK had the smallest value of BC ( $0.67 \pm 0.74$ ,  $ES=0.01$ ). The smallest value of PP ( $0.35 \pm 0.10$ ,  $ES=0.03$ ) was found in MF.

## Conclusion

Obtained results show that MF has higher CC and BC scores, thus may reach more teammates in less passes than those with lower centrality scores and can be commonly assumed to have a higher probability to exert control in passing sequences. On the other hand, FW has the highest

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scores of PP, thus suggesting his importance in the final of passing sequences.

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# The technical effects of manipulating the playing area during small-sided games in female youth football players

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## Introduction

Small-sided games (SSGs) are widely used within football training sessions and are often considered effective for concurrently enhancing the physical, technical and tactical qualities of players. Research to date has focused mostly on physical responses and adaptations to SSGs in male players, during which player number and pitch dimensions have been manipulated to optimise player's physical adaptations. In contrast, there has been limited consideration of the technical outputs of players during SSGs varying in player number and pitch dimension, especially involving youth players for which technical development is crucial. The aim of this study, therefore, was to quantify the technical outputs of young female youth football players during SSGs and to determine the effects of manipulating player number and pitch dimensions on technical responses during SSGs.

## Methods

Thirteen female football players (mean  $\pm$  SD: age  $16.2 \pm 1.2$  years, body mass  $59.3 \pm 6.6$  kg, height  $166.2 \pm 6.5$  cm) participated and played SSGs which varied in player number (3v3 and 4v4) and pitch length: width ratios (1:1 and 1:1.3). Each SSG was played for 4 $\times$ 4 minutes interspersed with 2 minutes of recovery. Technical outputs including involvements.min-1, effectiveness and variation of technical actions were determined using video analysis.

## Results & Discussion

Players had an average of 1.2-1.5 involvements.min-1 (between-player CV, 38-43%) which was unaltered by player number ( $P=0.59$ ) or length: width ratio ( $P=0.25$ ). The effectiveness of the players' individual possessions was rated as being only 'slightly effective' and did not differ according to variation in pitch-dimension ( $P=0.49$ ) or player number ( $P=0.16$ ).

## Conclusion

In conclusion, the technical performance of young female football players was unaffected by changes in length: width ratio and player number during 3v3 and 4v4 SSGs. The relatively low involvements and effectiveness of actions suggests that technical performance needs to be monitored closely during SSGs in developing young female players.

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# Effectiveness of speed endurance versus plyometric training on speed, power, and high intensity running ability in elite Canadian youth female soccer players

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## Introduction

Speed endurance training and plyometric training are two commonly used methods of developing fitness in soccer, and both have been shown to elicit improvements in multiple areas of fitness in soccer players (Iaia *et al.*, 2015; Wang & Zhang, 2016). The use of a high speed / high incline running treadmill may be advantageous versus over-ground running, due to the fact that certain variables, including running speed and percent incline, can be more closely controlled with incline treadmill running. To date, there has been little research comparing the effectiveness of speed endurance training, using incline treadmill running, with plyometric training on markers of physical fitness in soccer players. The aim of this study was to measure improvements in speed, power, and high intensity running ability by comparing speed endurance (SET) training done using an incline treadmill training protocol, versus plyometric training (PT).

## Methods

21 elite youth U15 (age:  $14.5 \pm 0.3$ ) female soccer players were randomly assigned to either SET, PT, or control (CTL) groups. SET and PT groups performed a 6-week, 2 sessions/week protocol. The SET protocol involved completing 9x30s sprint at 60% maximal running speed, with 90s recovery performed on an incline running treadmill. The PT protocol included 10x12s plyometric exercise with 20s recovery, performed on a plyometric platform. Tests of speed (time over 10-, 20- and 35-metres), power (counter movement jump – CMJ) and high intensity running ability (Yo-Yo Intermittent Recovery Test, Level 1 – YYIRTL1) were performed pre- and post-training.

## Results & Discussion

A mixed-design repeated measures analysis of variance (ANOVA) was performed (within-subject factor: time, between-subject factor: training groups) to analyze the data. There were significant ( $p < 0.05$ ) improvements in high intensity running ability (YYIRTL1; mean distance covered of  $826.7 \pm 283.6$  metres pre- versus  $1140.0 \pm 310.6$  metres post-training intervention) in the SET group.

## Conclusion

Our results indicate that speed endurance training using a high speed / high incline running treadmill may be effective at improving high intensity running ability in soccer players, whereas a plyometric training program may be effective at improving running speed in soccer players. Further research, examining the effectiveness of a combined speed endurance and plyometric training program, on speed, power and high intensity running ability, may be warranted.

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# Effect of small sided games on agility performance

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## Introduction

Agility is one of the factors that effects performance in soccer game. There are two types of agility; closed and open skills. During the soccer matches open or reactive agility skills are observed (Holmberg 2009). While the physical dimension of the agility is generally observed during the soccer trainings and agility tests, the cognitive dimension is not. Small-sided games (SSGs) are known to be an effective tool on the improvement of various skills including agility. 4v1 and 6v2 SSGs are chosen for the reason of the belief that these games would specifically improve agility. While the defenders (1 or 2) in 4v1 and 6v2 SSGs try to win the ball by intercepting, pressuring or tackling, they perform various reactive agility skills. The aim of this study was to investigate the effects of 4v1 and 6v2 SSGs and closed agility trainings on reactive agility performance.

## Methods

The participants were 45 soccer players of U17-19 teams of a professional soccer team ( $18,8\pm0,77$ years,  $69,8\pm6,7$ kg,  $173,5\pm4$ cm). Players were divided into 3: control group (CG), closed skill agility training group (CSATG) and reactive agility training group (RATG) which implemented the 4v1-6v2 SSGs. In addition to the regular trainings, the groups had agility trainings 2 days a week for 8 weeks. For the CSATG, 6 closed skill agility drills (8sec x 2 rep per drill) and for the RATG, SSGs were implemented. The SSGs were 4v1 and 6v2 in 5x5 and 7x7m fields (15 sec per defender(s) x 2), respectively. Farrow's (2005) the Reactive Agility Test was adopted to soccer (RAT) and used to assess the effects of closed skill agility and reactive agility training. Four different agility parameters were measured (movement, sprint, total agility and decision time). The normality of distribution for the values were examined by Kolmogorov-Smirnov test. The values of the normal distribution were tested by the paired samples t-tests and those which are not by the Wilcoxon test.

## Results & Discussion

In the CG, no improvement was observed in all parameters of RAT. Both RATG and CSATG showed improvements in all parameters of RAT. The improvement in the decision time by RATG was more evident when compared CSATG.

## Conclusion

According to the results, while designing agility drills for soccer, 4v1 and 6v2 SSGs can substitute for closed skill agility drills. 4v1 and 6v2 SSGs as agility training methods are not only the physically performance enhancing but also are more effective in cognitive development.

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Holmberg PM. (2009) Agility Training for experienced athletes:a dynamical systems. Strength and Conditioning Journal, 31: 73-78.

# Sport science needs and barriers: a survey among Dutch professional soccer coaches

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## Introduction

Sport science can contribute to the body of knowledge that influences practice and performance (Bishop 2008). Despite the possible contribution of research, the transfer of knowledge from sport science to soccer coaches needs further improvement. The present study's purpose is therefore to gain insight in current sport science needs and perceived barriers among professional soccer coaches.

## Methods

The digital survey was constructed through elaborate inspection of available coach literature (e.g., Stoszowski & Collins 2016) and in close collaboration with two coaches. The survey consisted of 20 questions and was sent to a database of professional soccer coaches. Answering options were: check boxes, open fields, and 5 point Likert scales. The first part of the survey contained questions about personal characteristics including age, experience as a player and coach, and academic level. The second part prioritized the coaches knowledge and interest in different topics as well as their attitude towards sport science and perceived barriers.

## Results & Discussion

In total, 75 soccer coaches (mean  $\pm$  SD age: 50.0 $\pm$ 10.05 years) filled in the survey. On average, coaches had 24.3 $\pm$ 7.0 years of experience as a player and 25.5 $\pm$ 13.7 years of experience as a coach, and three of them had an University degree. The coaches perceived their technical and tactical knowledge as good. Knowledge on physical skills was slightly lower and knowledge on mental skills was perceived as the lowest, but still fair. Sport specific knowledge for scientists was perceived as (very) important. Top five of domains that the coaches wanted to know more about to better perform in their occupation was 1. Mental skills, 2. Physical skills, 3. Group dynamics, 4. Monitoring load and capacity, 5. Talent development. The top 5 perceived barriers for using sport science in daily soccer practice was 1. Conservatism in clubs, 2. Money, 3. Lack of specific soccer knowledge of scientists, 4. Applicability of sports science in practice, 5. Lack of time. Personal contact with sport scientists was most preferred to gain knowledge in sport science. Since the survey was sent to a database, selection bias cannot be ruled out.

## Conclusion

The results suggest that there is an interest in applying sport scientific knowledge into soccer practice. The topics coaches want to know more about and the perceived barriers could improve integrating sport science and practice in work environments.

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# Anabolic Hormonal Responses to Acute Resistance Exercise after Branched-Chain Amino Acids Supplementation

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## Introduction

The purpose of this study was to investigate the effects of branched- chain amino acids (BCAA) supplementation on acute hormonal responses to a single bout of resistance exercise.

## Material and Methods

In a double-blind with control design, 20 males (age:  $21.5 \pm 1.7$  years; height:  $177.3 \pm 1.1$  cm; weight:  $77.2 \pm 2.2$  kg) consumed 200 mg.kg<sup>-1</sup> BW of either BCAA or placebo 30 minutes prior to exercise. Each subjects completed 3 sets of 8-10 repetitions at their 8-10 repetition maximum to volitional fatigue. The exercise session consisted of the high pull, leg curl, standing overhead press, leg extension, lat pull-down, leg press, and bench press. Blood samples of each subject were collected 30 min before exercise, immediately post-exercise, 60, 120 min and 24 h after exercise.

## Results & Discussion

Testosterone, insulin were significantly elevated at immediately post-exercise, 60, 120 min in two groups. Concentrations of insulin and testosterone were different significant between supplementation and placebo group ( $p < 0.05$ ) after resistance exercise. se might augment the anabolic-hormonal response.

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# Power, agility, and speed in NCAA collegiate women soccer athletes

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## Introduction

The sport of soccer requires multiple changes of direction (COD) during match play. The 505 COD speed test, which includes acceleration, deceleration, and a 1800 turn, has been used to assess COD ability in men's team sports (Lockie et al., 2014). However, there are limited data on the 505 COD test and other performance measures in collegiate women's soccer. The purpose was to investigate the relationship of the 505 COD to tests of speed, agility, and power in women's soccer.

## Methods

Collegiate women, soccer field-players ( $n=57$ ,  $19.9\pm1.3$  yrs,  $165.1\pm6.2$  cm,  $63.7\pm7.3$  kg) participated. After a dynamic warm-up, tests of vertical jump height (VJ), 10-m sprint (10-m), 505 COD speed test (505), and modified T-test (mod T) were administered. Repeated trials were permitted with the best trial selected for analyses. VJ peak power (PAPw) was calculated by the Sayers equation:  $PAPw = (60.7 \times VJ \text{ height [cm]}) + (45.3 \cdot \text{body mass [kg]}) - 2055$  (Sayers et al., 1991). Power-to-body mass ratio (P:BM) was calculated via:  $P:BM = PAPw \cdot BM^{-1}$ . Data were grouped by above (AM:  $n=30$ ) and below the mean (BM:  $n=27$ ) power producers. One-way ANOVA was used to determine if significant ( $p < 0.05$ ) differences existed between groups for all tests. Pearson's correlation coefficients were used to measure the association between measures in the AM and BM groups.

## Results & Discussion

The AM group had significantly better VJ ( $49.5\pm5.6$  vs.  $39.8\pm4.8$  cm), PAPw ( $3922.8\pm293.5$  vs.  $3147.5\pm241.5$  W), P:BM ( $60.4\pm6.6$  vs.  $51.5\pm5.8$  W·kg<sup>-1</sup>), 10-m ( $1.84\pm0.17$  vs.  $1.97\pm0.14$  s), and 505 ( $2.39\pm0.11$  vs.  $2.54\pm0.13$  s) values than the BM group. Age, height, body mass and mod T did not differ between groups. Significant correlations were observed in both AM and BM groups for VJ and 505 (AM:  $r = -0.567$ ; BM:  $r = -0.644$ ) as well as 505 and P:BM ratio (AM:  $r = -0.590$ ; BM:  $r = -0.585$ ).

## Conclusion

Running speed is influenced by the amount of force applied to the ground (Weyand et al., 1999); therefore, the relationship of COD speed to measures of lower body muscular power is of interest. Previous research with male team sport athletes has demonstrated a relationship between jump and agility performance tests (Lockie et al., 2014). Our results indicate the importance of lower body power to COD in women's soccer. Therefore, it is recommended that coaches implement programs designed to improve lower body strength and power when training their athletes.



# A Pedagogical project for football coaching education

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## Introduction

In Portugal, research has shown that coaches give more importance to guided sources, while emphasizing experiential sources through work with expert coaches (Mesquita, Isidro, & Rosado, 2010). Despite the relevance of these findings, studies addressing critical evaluation of learning models and programs are lacking (Erikson et al., 2008). Therefore, we aimed to present and discuss: 1) a model for coaching education that proposes a set of interactive learning experiences, based on real coaching practice that would emerge from the conceptualizations of students' previous ideas of their "ideal game model" and guided by expert coaches; 2) method and results of a study of student's perceptions of the program efficacy.

## Methods

Thirty-five (n=35) male students (Mage:  $25 \pm 1$  years) participated in this program. All participants had experience as football practitioners and short-term experience as football coaches. To evaluate the effectiveness of the model for coaching training, a questionnaire with 5 dimensions distributed in 10 questions was developed and applied to all the students that participated in the program. Results pointed out to the necessity of a qualitative approach follow up. Twelve students were randomly selected to participate in a focus group interview.

## Results & Discussion

The first step inquiry results revealed an increase in student's perception of confidence to work as coaches after the program comparing with previous programs ( $p < 0.05$  for all the variables). Second step inquiry (focus group) revealed the use of new concepts and new significance in student's thinking. Student's perceptions revealed a close approach to a transformative learning environment (Mezirow, 2000; Mesquita et al., 2016). A coach professional conscientiousness framework was evident in those students narrative.

## Conclusion

Results pointed out to a significant effect of the program revealing that the proposal model and intervention could be a valid method to be used in football coaching education.

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# A Comparison of Weekly Training Load and Match Performance in Selected Physical Variables in Elite Soccer Players

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## Introduction

Previous studies show divergence between training and match sprinting profiles in football (Djaoui, 2016). However, other important physical parameters need to be analysed across matches and training sessions to control the specificity of training. The aim of this study is to compare physical demands of a microcycle to match performance of elite players.

## Methods

5 players ( $25.2 \pm 4.0$  years) from different playing positions in a Norwegian elite football club were tracked in 5 consecutive in season training sessions (microcycle) and in official home matches. Physical parameters were captured by radio-based ZXY Sport Tracking and included: high intensity runs (HIR), HIR total distance (HIRdist), sprints distance (Sprintdist), acceleration counts (Acccounts), Acc distance (Accdist), deceleration counts (Deccounts) and Dec distance (Decdist). Data was analysed if the player completed an official match and all training sessions in the microcycle. One player from each playing position (central back – CB, full-back – FB, central midfielder – CM, wide midfielder – WM and central forward – CF) was randomly selected to be part of the study. Percentages were used to compare the sum of the training sessions and the average of the players' match performance. The value of 100% was given to the average of the players' match performance.

## Results & Discussion

Players performed more HIR 1-30 meters in training sessions than in match (122%, 139%, 119%, 159%, 113%, for CB, FB, CM, WM and CF). There was an inverse pattern when comparing HIR 31 - > 55 meters (0%, 43%, 21%, 9%, 75%, for CB, FB, CM, WM and CF). All players covered less HIRdist in trainings than in match (59%, 83%, 53%, 54%, 83%, for CB, FB, CM, WM and CF). CB (99%), FB (94%), CM (29%) and WM (59%) performed less sprints 1-30 meters in training than in match, while CF (150%) performed more. All players performed less sprints 31 - > 50 meters in training than in match (0% for all positions). 4 covered less Sprintdist in training than in match (52%, 57%, 26%, 37%, for CB, FB, CM and WM), while CF (149%) covered more. All players performed a higher number of Acccounts and covered more Accdist in trainings than in match (Accdist, range: 125-206%; Acccounts, range: 146-248%; Decdist, range: 113-179%; Deccounts, range: 133-211%).

## Conclusion

Preliminary results indicate that practitioners must carefully consider proximity size and physical work pattern in microcycles to better resemble match performance.

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# Assessing the impact of upper padding thickness on kicking accuracy and ball velocity.

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## Introduction

Sporting goods companies need to frequently introduce innovations to distinguish themselves in an increasingly competitive, continually changing, global football footwear market. Today, it is common practice to market football boots with an emphasis on enhancing a single key performance characteristic (e.g. kicking power). Yet little research has been published on how design parameters impact a player's kicking ability. This study aimed to analyse the impact of boot upper thickness on accuracy and ball velocity for kicking and on perceived ball velocity.

## Methods

Nine skilled football players ( $22.8 \pm 2.1$  years,  $1.77 \pm 0.03$  m,  $71.1 \pm 4.5$  kg) participated in a single test-retest validated test session. Tests were performed on an outdoor 3G artificial pitch (LigaTurf RS+ CoolPlus 260, Polytan, Burgheim, Germany). Two UK size 8 Umbro football boot prototype models were compared in a randomised order: no upper padding and 8 mm Memory foam.

The session comprised 10 accuracy-focused kicks in each boot followed by 10 maximum ball velocity focused kicks in each boot. Two participants were tested in each session, which allowed players to rest after every 10th successful kick to prevent fatigue. A single football (22 cm diameter, 0.43 kg, pressure = 0.9 bar) was placed with the valve facing player and a guiding arrow pointing to the centre of target. TrackMan Football prototype (TrackMan Golf, Vedbaek, Denmark) was used to measure ball velocity. Accuracy was assessed using two GoPro HERO4 Black cameras (GoPro Inc., San Mateo, CA) (240 Hz, 1280x720). One camera assessed the ball passing the goal line and one assessed the ball offset from target when passing the goal line. Cameras were synchronised using a synchronisation light box. Subjective perception of ball velocity for velocity focused kicks was assessed using a 7-point Likert scale (extremely fast to extremely slow).

## Results & Discussion

There was no significant between boot difference for ball velocity, perceived ball velocity, radial offset, perceived offset and horizontal offset achieved for both accuracy and velocity kicks. Vertical offset proved to be significantly higher for the 8 mm boot in both the accuracy (0.13 m, 0.48 m;  $p < 0.05$ ) and velocity (0.25 m, 0.41 m;  $p < 0.05$ ) focused kicks. Finally, there was a weak and a negative relationship between players' perceived ball velocity and their actual performance.

## Conclusion

Upper padding of 8 mm Memory foal had no effect on ball velocity, but did decrease accuracy in the vertical direction with the ball placed higher over the target. Players were also unable to perceive the speed of their kicks in both boots.

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# The psychological skills inventory for footballers: validation evidence in a sample of professional athletes

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Since long time ago, a number of researchers in sport psychology have begun to explore categories of psychological skills relevant to performance in competitive settings (e.g., Mahoney, Gabriel & Perkins, 1987; Smith, Schutz, Smoll & Ptacek, 1995). Debates continue with regard to the nature and assessment of such skills, and studies of measuring instruments specific to each sport have become evident over the last decade (e.g., Dosil, 2006). The present study describes the development of a new multidimensional scale that measures five dimensions of psychological skills with high factorial validity. The Psychological Skills Inventory for Footballers (PSIF-20) is a refined 20-item version of a 24-item PSIF which was preliminarily developed in a previous study (Dosil & Martins, 2010).

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# Ball (not) in play: the distortive effect of net playing time on the decline of match running performance in professional football

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## Introduction

The aim of the present study was to test the hypothesis that an increase in game interruptions has an amplifying effect on the decrease in match running performance. To facilitate this, we pursued a three-step approach: (1) we tested the hypothesis that a verifiable increase of game interruptions occurs over the course of a match; (2) we calculated match running performances in pre-defined 5-min intervals throughout matches, paying special attention to the development of fatigue and (3) we compared the magnitude of the observed declines in match running performance with regard to both the effective and total playing times.

## Methods

We analysed 1134 individual German Bundesliga performances using a multi-camera tracking system. Parameters analysed included the distances travelled within various speed ranges, the number of accelerations and sprints and metabolic power. Performance data were divided into eighteen 5-min periods covering the course of the match. Student's t-tests and ANOVA with Tukey's post hoc tests were used to identify temporal changes.

## Results & Discussion

We confirmed a significant decline in effective playing time ( $p < 0.01$ ) over the course of a match, from 69% of the total playing time in the first 5 min to 56% in the last 5 min. With regard to the absolute playing time, performance parameters decreased by 25% on average (mean  $\eta^2 = 0.29$ ); considering only the effective playing time, they decreased on average by only 13% (mean  $\eta^2 = 0.12$ ). These results suggest that about 48% of the decline in performance is caused merely by an increase of game interruptions.

## Conclusion

In conclusion, this study demonstrated for the first time that the decrease in players' physical performance during a football match is strongly affected by the increase in game interruptions as the game progresses. Thus, this study illustrates that evaluation of fatigue in professional football should take account of the actual playing time. These results could shed light on the frequently discussed topic of fatigue development in professional football.

# Quantifying decision making in professional soccer players during match-play

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## Introduction

Expert soccer players are superior at selecting and executing decisions when compared to lesser-skilled players (Williams & Ford, 2013). However, there is a lack of research quantifying the decision making load of soccer players during match play. The aim of this study was to examine the frequency and type of decision making in terms of actions executed by professional soccer players during soccer matches.

## Methods

Professional soccer players ( $n = 15$ ) representing three successful teams in the 2012-2013 English Premier League (EPL) participated. Player positions were centre backs ( $n=3$ ), full backs ( $n=3$ ), wide midfielders ( $n=3$ ), centre midfielders ( $n=3$ ) and strikers ( $n=3$ ). Wide-angled video footage of the full pitch during three home matches per player was recorded and analysed. The frequency of every decision executed as an action during the 90 min matches was analysed as a function of phase of play, half and positional role. ANOVA and t-tests were used to analyse the frequency or rate per minute (RPM) of actions executed.

## Results & Discussion

Soccer players executed  $2,103 \pm 149$  actions per match, averaging  $21.8 \pm 1.5$  actions per minute. They had  $60 \pm 20$  ball possessions per match, of which 75% were successfully executed. More actions were executed when in possession of the ball (89.9 actions per min,  $s = 21.8$ ) and fewer actions were executed when the ball was out of play (11.1 actions per min,  $s = 2$ ) compared to other phases of play. More actions were executed in the first half (22.3 actions per minute  $\pm 1.7$ ) compared to the second half (21.1 actions per minute  $\pm 1.9$ ). Positional role did not affect the frequencies of actions executed and ball possessions. However, the number of ball touches was greater for wide-midfielders (158 touches,  $s = 49$ ) when compared to centre-backs (88 touches,  $s = 36$ ), with no differences in ball touches between all other playing positions.

## Conclusion

Players in the EPL executed over two thousand decisions as actions across a match, demonstrating the key role of decision making during expert soccer match-play performance (Williams & Ford, 2013). Phase of play and half affected the frequency of actions executed, with more actions executed when in possession of the ball and in the first half, supporting research examining the physiological demands of match play (e.g., Bloomfield et al., 2007). Findings show that the training and preparation of players should incorporate decision making activities that specifically replicate match play to enable them to perform successfully in future.

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# The influence of maturation on the strength characteristics of elite youth female soccer players

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## Introduction

The increase in professionalism of female soccer has resulted in a growth in the number of soccer academies for youth female players in England, whereby athletes regularly undertake strength and conditioning training and fitness testing throughout the season. One desirable attribute to develop is muscular strength, given the association with athletic performance and injury resilience (Meylan et al., 2014). Athletes within soccer academies are categorised as under-10 year olds (U10) to U16, during these ages' athletes are experiencing growth and maturity at varying rates, which can confound physical data interpretation. Practitioners are required to interpret data obtained from players to inform programme prescription, however, currently no normative data for female youth soccer players exists. The purpose of this study was to provide normative strength data and evaluate the influence of maturation on strength in this population.

## Methods

Following institutional ethics approval, 157 female players (U16 = 46, U14 = 43, U12 = 38, U10 = 30) were recruited from 3 elite soccer academies. To determine the influence of maturation, participants were classified into 3 pre-defined groups based on their peak height velocity (PHV); Pre-PHV (offset < -1 years), Circa-PHV ( $\pm 1$  years) or Post-PHV (offset > +1 years). Strength was assessed using an isometric mid-thigh pull (IMTP) on a portable force plate (1000Hz). Following a warm up, participants performed 2 maximal attempts with highest peak force (PF) reported. Linear mixed modeling was used to determine the difference between maturation groups. The probability of differences beyond the smallest practical difference were determined using magnitude-based inferences.

## Results & Discussion

Pre-PHV PF was *most likely* lower than circa-PHV ( $856 \pm 135$  vs.  $1249 \pm 205$ N) and *very likely* lower than post-PHV ( $1476 \pm 211$ N). Pre-PHV relative PF (r-PF) was *likely* greater than circa-PHV ( $27.87 \pm 3.40$  vs.  $26.84 \pm 3.24$  N.kg<sup>-1</sup>), and *unclear* compared to post-PHV ( $26.44 \pm 2.53$  N.kg<sup>-1</sup>). Similarly, for pre-PHV impulse at 100ms was *likely* greater than circa PHV ( $15.04 \pm 8.08$  vs.  $13.88 \pm 6.88$  Ns) and *unclear* compared to post-PHV ( $17.44 \pm 9.02$  Ns). When impulse was made relative to body mass (r-impulse) pre-PHV was *most likely* and *possibly* greater than circa-PHV ( $0.49 \pm 0.27$  vs.  $0.30 \pm 0.15$  Ns/kg) and post-PHV ( $0.32 \pm 0.17$  Ns/kg). In contrast, impulse at 300ms was *possibly* and *likely* lower pre-PHV, compared to circa-PHV ( $104.38 \pm 40.64$  vs.  $124.97 \pm 39.45$  Ns) and post-PHV ( $169.90 \pm 44.57$  Ns). Relative impulse at 300ms was *most likely* and *possible* greater pre-PHV than circa-PHV ( $3.38 \pm 1.17$  vs.  $2.68 \pm 0.79$  Ns/kg) and post-PHV ( $3.07 \pm 0.91$  Ns/kg). Findings suggest maturation impacts upon absolute PF of youth female soccer players but has less effect on r-PF and impulse.

## Conclusion

If absolute measures of IMTP performance are evaluated, practitioners should account for maturation status when evaluating strength qualities. Practitioners should be aware that relative strength qualities do not appear to increase with maturation. These data provide normative strength data for elite youth female soccer players, which can be used to monitor player development.

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# Some characteristics in the off-season and pre-season schedules of J-League clubs

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## Introduction

It is interesting to know how each club strategically adopts different training plans and schedules for off-season and pre-season, where various elements such as exercise load, frequency, schedule of official games, training camp should be counted in drafting the whole training plan. This study focuses on how the Japanese professional football clubs (J-League clubs) make up their off-season and pre-season schedules and intends consequently to show some characteristics found there.

## Methods

This study has collected necessary data from the official websites of J1 (Top category) clubs and J2 (Second category) clubs. Obtained data were totally from 27 clubs (J1/11 and J2/16) for 2016 season, and further 40 clubs (J1/18 and J2/22) for 2017 season. Survey items were (A) the length of time between the end of one official game and the start of the next official game, (B) the length of off-season period, (C) the length of pre-season period, (D) the length of training camp and (E) the number of training days. Collected data were processed separately for J1 and J2 and student t-test was used to examine the differences in each data with SPSS 19.0. Significant difference was set at  $P < 0.05$ .

## Results & Discussion

The mean and the standard deviation of it for each survey items are as follows ( those for J1 and J2 are shown separately in parenthesis ) ; (A)  $89.1 \pm 16.8$  ( $82.8 \pm 22.9$  and  $94.0 \pm 6.9$ ), (B)  $37.7 \pm 10.9$  ( $32.5 \pm 12.4$  and  $41.8 \pm 7.6$ ), (C)  $42.4 \pm 4.2$  ( $40.5 \pm 5.1$  and  $44.0 \pm 2.4$ ), (D)  $18.0 \pm 8.9$  ( $21.4 \pm 7.8$  and  $15.5 \pm 8.8$ ), (E)  $48.2 \pm 5.0$  ( $47.1 \pm 6.5$  and  $48.9 \pm 3.7$ ). The statistical significant differences were seen in (A),(B),(C),(D).

## Conclusion

Generally the J-League season finishes in the middle of November. After that some J1 clubs have more games until early January for the Emperor's Cup tournament and some J1 clubs start Asia Champions League games from the end of February. Therefore the averages of (A),(B),(C) of J1 clubs become significantly short compared with those of J2, and consequently J1 clubs have larger standard deviations. In average, J-league clubs have 42 days of pre-season. About (D) item, it can be thought that financial factors might influence the differences seen in J1 and J2 training camp period. About (E) item, it shows that the clubs in two categories have more or less same outlook on the exercise strength and frequency of the training. This study has made clear some characteristics in the off-season and pre-season schedule of J-League clubs. In order to offer more effective training plans for professional football clubs, further survey on the annual schedule should be required from different viewpoints as well as the comparison with the clubs of other countries.

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# Implementation of immediate active recovery, at 12 and 24 hours post-training in young soccer players

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## Introduction

Competitive sport involves more strenuous physical exercises, execution of movements with a higher level of complexity, which combine intrinsic and extrinsic factors by means of the goal-oriented approach and methods directed towards the rendering process.

In the case of soccer, this is a sport that involves many physical demands that include sprints, changes in speed and direction, jumps, shocks, and technical actions such as dribbling, passing or firing the ball. These activities lead to the generation of dehydration, glycogen depletion, accumulation of metabolites, muscle damage and mental fatigue, which are framed in a state called fatigue (Nedelec et al., 2012). Fatigue is defined as the transient reduction in the generation of muscular strength and therefore a transient decrease in the control of motor abilities, negatively affecting sports performance and in turn would add up as a factor that increases the risk of injury Sport (Finsterer et al., 2012; Neto et al. 2014; Coineicao et al., 2014).

It is important to know adequate post effort recovery strategies that favor the supercompensation process that aims to facilitate the return of the baseline athlete. This contributes to the athlete achieving adequate, equal or better neuromuscular responses compared to pre-exercise states (Finsterer et al., 2012; Brophy-Williams et al., 2011).

To date, numerous methods have been proposed as nutritional and hydration, sleep, passive recovery using means such as cryotherapy (cold water immersion), compression suits, massage, electrical stimulation, and active recovery methods (aerobic exercise Of low intensity and stretching) (Ghasemi et al., 2013).

Active recovery is one of the strategies implemented in sports for the return to pre-exercise physiological states, however there are some adverse hypotheses regarding the negative effects, such as the possibility of increasing muscle glycogen degradation and Thus delaying the synthesis thereof. For them, it is necessary to investigate the effects generated by their application at different moments after the effort (Nedelec et al., 2012).

The scientific literature regarding the processes of post-effort recovery compare the use of different strategies or recovery methods, but do not mention the use of the same strategy performed at different times after the implementation of the effort. This is very important because it is not known if there are differences in the recovery of the athlete if an active recovery strategy is implemented post effort, at different times (immediately, 12 and 24 hours).

## Methods

A non-probabilistic sampling was performed for convenience. This study included 27 subjects belonging to the sub 20 category of the Real Santander Sports Corporation (age  $18.5 \pm 1.05$ , height  $1.76 \pm 0.6$ , weight  $69.4 \pm 5.55$ , percentage of fat  $15.3 \pm 3.24$  and percentage of muscle mass  $43.4 \pm 1.9$ ).

## Type of study

Randomized controlled trial with assignment to three groups:

Group 1: active recovery performed immediately upon exertion, Group 2: active recovery performed at 12 hours post-effort and Group 3: active recovery performed at 24 hours post-effort.

## General objective

To determine the effects of post-exertion active recovery in three different moments: immediate, at 12 and 24 hours, on biochemical markers, velocity and explosive force, in youth soccer players.

### **Intervention**

The implementation of the active recovery strategy (low intensity aerobic exercise and static stretching) was performed in 3 different moments (immediately after, 12 and 24 hours after exercise). This strategy of recovery was taken from the study by Rey and Col, however the intensity of aerobic exercise was modified and the overall time of stretching was increased (Rey et al., 2012).

#### **The active recovery strategy is divided into:**

12 minutes of low-intensity aerobic exercise (30% of heart rate training) and 12 minutes of static self-stretching, involving 3 30-second repetitions of bilateral hamstring, quadriceps, gastrocnemius and adductor muscles.

### **Study design**

Participants were randomized to intervention groups by means of concealment: sealed envelopes, which were deposited in a bag and a research assistant addressed each participant to take one of these.

#### **Initial assessment, explanation of formats and orientations**

- The exam was conducted by the sports doctor to determine if the athlete was fit for the study.
- Subsequently a physical warm-up of 15 minutes in total (5 minutes of joint mobilization, 5 minutes of dynamic stretching and 5 minutes of jogging at moderate intensity with changes of direction, jumps and short sprints).
- The explosive force test (CMJ) was continued using the Optogait tool. The speed test was then performed (Sprint Test 20 meters).
- The cycling anaerobic power test (5 minutes test) was then carried out to measure MHR.

#### **Execution of the study**

- Athletes were asked to perform a blood sample for CPK analysis (performed at 6:50 am).
- The implementation of the fatigue protocol (SAFT 90) was continued. The type of movement activity and intensity was controlled by the physical trainer of Club Deportivo Real Santander. There were no contact actions such as kicking or hitting. At the end they were given hydration and nutrition.

#### **Subsequently, the following activities were carried out:**

- Second CPK evaluation: this sample was taken 1 hour after the fatigue protocol was performed.
- The recovery protocol was performed on the group belonging to the active recovery intervention performed immediately upon the effort.
- The group belonging to the active recovery implemented at 12 hours after the effort to implement the protocol was mentioned.
- The group belonging to the active recovery implemented 24 hours after the effort to implement the protocol was cited.
- Blood sampling was performed (48 hours after the first blood sample taken (44 after the second blood sample taken)).
- Final test of explosive strength and speed (CMJ, SPRINT TEST 20 M)

### **Results**

In the analysis of baseline data regarding age, height, weight, percentage of fat, percentage of muscle mass, speed (sprint), jump (CMJ) and CK, no statistically significant difference was found between each One of the groups ( $p < 0.05$ ), indicating the homogeneity of each one of them.

The results with respect to the evaluation of the differences within the groups in relation to the pre and post test of speed (Sprint 20 meters) and explosive force (CMJ), showed that there are statistically significant differences ( $p < 0.05$ ). This result indicates that the active recovery protocol improves the speed and response times of the explosive force measured by the CMJ.

The evaluation of the differences between each group with respect to the pre and post test of speed (Sprint 20 meters) and explosive force (CMJ), performed by means of one-way ANOVA, did not show statistically significant results ( $p < 0.05$ ). We found results for sprint between groups ( $p = 0.121$ ) and for CMJ between groups ( $p = 0.198$ ).

This result shows that although the 3 groups improved in post effort recovery in physical capacities, there is no group that shows a better recovery when compared to each other.

As for the CPK variable, the result measured in the 27 subjects was reported by means of the median and interquartile ranges of this variable because the behavior of these data were not normal (CPK pre (249.2 [198.3-400.1]), Post 1 (350.2 [260.7-519.1]) and post 2 (252.7 [177.9-457.9])).

No statistically significant differences were found for the evaluation within the groups ( $P < 0.05$ ). In the evaluation of pretest, posttest 1 (1 hour post effort) and posttest 2 (44 hours post effort) between the groups were found statistically significant differences ( $p < 0.05$ ) between pretest and posttest 1, which was performed by means Of the T-student test. It was found that CPK increased significantly 1 hour after the fatigue test (SAFT 90) test, confirming that the fatigue test genus muscle disruption. With respect to pretest and posttest 2, no statistically significant differences ( $p < 0.05$ ) were found for group 1 and 2, indicating that CPK returned to the baseline, which shows that active recovery contributes to muscle recovery post effort. However, for group 3, a statistically significant difference ( $p = 0.028$ ) was found, indicating that in this group CPK decreased much more with respect to the first measurement or baseline (pre (249.3), post 1 (329.8) and Post 2 (205.1)). This indicates that this group had a better recovery of CPK levels from the baseline. In the analysis between groups performed using the Kruskal-wallis test, no statistically significant differences were found ( $p = 0.795$ ), which indicates that the 3 groups generate similar effects on the return of CPK to pre-fatigue states.

## Discussion

The implementation of this method of recovery in 3 different moments achieved to improve the sports performance evaluated by means of the physical capacities (speed and explosive force), as well as to achieve improvements in the clearance of CPK activity. This can be associated with the capacity of this type of methods in decreasing muscle tension, increased blood flow that favors the removal of metabolites and other substances present in both the muscle and the blood, such as the hydrogenations that generate Muscle acidosis, as well as biomarkers of fatigue such as creatine kinase. Increased blood flow leads to increased oxygen and nutrient supply to fatigued tissues, facilitating replenishment of energy stores such as glycogen and tissue repair. The scientific evidence shows results obtained in different studies that support and others that differ from what was observed in our study.

Andersson et al, in their study, performed the monitoring of neuromuscular and biomechanical parameters after 2 consecutive games in female soccer players. They found an increase in CK concentrations immediately, at 21 and 45 hours after play compared to the baseline. They also observed that the CK returned to baseline values 69 hours after play. They also found significant decreases in the speed and jump (CMJ) tests, as well as the peaks in flexion and knee extension torques. They conclude that they did not find differences between the recovery patterns on the neuromuscular and biomechanical parameters (Andersson et al., 2008). These results differ from those found in our studies, because we observed improvements in physical abilities and biochemical markers within 48 hours after generating the fatigue protocol, and subjecting athletes to active recovery after exertion.

Ispirilidiset and col, evaluated the markers of physical demand during the soccer game in 24 players. They were monitored in physical and biomechanical tests 6 days after the game. The concentration of CK increased gradually, peaking between 48 and 72 hours after play. In the same way, they found a relationship between the markers of muscle microtrauma such as CK with pain, reduction of jump and speed, indicating that demands during a soccer game need long periods of recovery (Ispirilidiset et al., 2008).

The results show that during the postpartum recovery period there was a substantial increase in CK, in the same way generating deficiencies in the parameters of neuromuscular performance. In this study jump height (CMJ) shows decline at 24 hours and some recovery at 48 hours, however this is still low compared to the baseline. In our study we reported results contrary to what De Hoyo et al found, because both jump (CMJ) and velocity (Sprint 20 meters) showed an improvement in the 3 post-effort intervention groups.

Barbosa et al, conducted an investigation with 17 professional soccer players. The aim of this study was to evaluate the kinetics of serum CK. The CK was taken before starting a soccer game and in 4 moments after the soccer game (post 1 (12-20 hours), post 2 (36-48 hours), post 3 (60-65 hours) and post 4 (90-110 hours)). Finding that CK was high at all times compared to the baseline. (35) This study shows a behavior of the enzyme CK towards an increase in its activity in blood up to 65 hours post-exercise, influenced in turn by continuous training. In comparison to our study, we observed different results in the behavior of this one, because we found that through active recovery the clearance of this biomarker was promoted at 48 hours after the effort.

Gill et al. Found that subsequent to high-intensity eccentric exercises, an increase in CK activity was generated. Finding decreased muscle function and physical performance during exercise. Therefore, I observed a significant correlation between the low performance assessed by the torque of maximal voluntary muscle contraction with the increase of CK levels (Gill et al., 2006).

Therefore we can determine that CK is not only a fatigue biomarker that indicates the level of muscle damage, but the presence of this is related to deficits in physical performance, and therefore it is important to generate rapid clearance Activity, in addition to the need to promote muscle repair after exertion, reducing the rate of muscle rupture CK serum levels.

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# Should there be a concern over purposeful heading in soccer with those who have had previous concussions?

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## Introduction

Soccer is unique in that participants can use their head to strategically move the ball to pass, clear or shoot. Concern over repetitive head impacts in American football players have led some to examine whether those same types of impacts are deleterious to soccer players who use purposeful heading while participating. Because the risk of concussion is high in both men's and women's soccer, there is a subset of participants who have histories associated with concussions, yet still play the game.<sup>1</sup> This cohort of soccer players present unique opportunities to examine both the short and long-term effects of purposeful heading on a variety of symptom and neurocognitive measure. Therefore, the purpose of our study was to determine if differences in concussion symptoms and static balance scores exist pre and post heading in a group of female collegiate soccer players.

## Methods

We employed a control group, pre-posttest design. All testing took place on an indoor, climate-controlled turf field. A total of 73 female collegiate soccer athletes (age =  $19.0 \pm 1.0$  yr.; mass =  $60.5 \pm 5.4$  kg; height =  $165.1 \pm 6.6$  cm) participated. Based on their concussion history subjects were assigned to either the control/simulated heading [CONT1] (20), control/heading [CONT2] (13), 1-2 previous concussion/heading [EXP1] (19), and 3 or more concussion/heading [EXP2] (9) groups. All subjects were healthy and free from concussion at the time of the study. Concussion symptom scores, derived from the ImPACT neuropsychological test battery, along with Balance Error Scoring System (BESS) measures were taken pre and post an acute bout of soccer heading. The purposeful heading drill consisted of 15 total headers separated by 1 minute in between. The balls were launched from a JUGS (JUGS Sports, Tualatin, OR, USA) soccer machine at a speed of 12.07 m/s. Subjects stood waiting for the ball at a distance between 22.8-36.6 meters from the machine. Day 1 testing consisted of either rotational (ROT) or linear (LIN) heading to a target, while on Day 2 of the testing (separated by 1 week) subjects performed the opposite type of heading. Immediately upon completing the heading drill, subjects returned to the lab and completed the concussion symptom checklist as well as perform the static BESS trials. Concussion symptoms and BESS scores pre and post ROT and LIN heading were examined using a direct-entry multiple regression analysis.

## Results & Discussion

Concussion symptom scores at baseline LIN averaged  $2.1 \pm 2.0$  CONT1,  $2.8 \pm 3.7$  CONT2,  $4.9 \pm 5.0$  EXP1, and  $5.8 \pm 5.8$  EXP2, while post-LIN the scores averaged  $1.9 \pm 1.9$  CONT1,  $4.3 \pm 5.3$  CONT2,  $7.2 \pm 6.5$  EXP1, and  $9.2 \pm 6.2$  EXP2. Concussion symptom scores at baseline ROT averaged  $1.8 \pm 2.6$  CONT1,  $3.8 \pm 3.7$  CONT2,  $3.0 \pm 3.6$  EXP1, and  $4.4 \pm 5.5$  EXP2, while post-ROT the scores averaged  $2.2 \pm 2.8$  CONT1,  $4.2 \pm 3.6$  CONT2,  $4.4 \pm 4.1$  EXP1, and  $6.3 \pm 7.2$  EXP2. Subsequently the baseline BESS scores averaged  $18.7 \pm 8.3$  CONT1,  $18.7 \pm 9.4$  CONT2,  $18.9 \pm 8.1$  EXP1, and  $15.9 \pm 5.5$  EXP2, while the post-LIN scores were  $17.2 \pm 8.0$  CONT1,  $18.0 \pm 8.1$  CONT2,  $20.9 \pm 7.8$  EXP1, and  $16.9 \pm 5.8$  EXP2; and the post-ROT scores were  $16.2 \pm 8.3$  CONT1,  $19.4 \pm 8.4$  CONT2,  $19.7 \pm 8.7$  EXP1, and  $13.9 \pm 7.4$  EXP2. The regression analysis indicated that concussion

symptom scores in both the EXP1 and EXP2 groups were significantly higher post-LIN heading than with either CONT groups. However these same changes were not significant post-ROT heading. With regard to BESS scores the EXP1 group demonstrated worse scores post-LIN heading than any of the other groups. Interestingly, CONT2 scored worse post-ROT with regard to BESS scores. Concussion-related symptoms are elevated in subjects having 1 or more concussions both at baseline and following an acute bout of purposeful heading in our cohort of female collegiate soccer players. Additionally, it appears that those with concussion histories exhibit deficits in balance measures immediately following the purposeful heading drill. Coaches and clinicians should be made aware of those individuals with previous concussion histories so that protective steps may be initiated to limit their exposure to purposeful heading drills in practice and to minimize those same exposures during matches.

### **Conclusion**

Female soccer players with histories of concussions demonstrate more symptoms and have worse balance following episodes of purposeful soccer heading than their counterparts without histories of concussion. This cohort of soccer players may be those most vulnerable to long-term effects of repetitive head impacts that have been previously reported in sports such as American football and boxing. Studies examining this cohort of players over the long term are warranted.

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# A pilot study to examine the physiological demands of non-elite soccer refereeing at step 7 of the English soccer pyramid.

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## Introduction

In England, football is divided into seven steps, making it possible for a club with the financial backing, commitment and winning record to progress from park football (step 7) to the top professional division (step 1). Referees are promoted through these leagues before becoming professional referees operating at the top division or international levels. Referees performing in the top professional leagues around the world have been studied quite extensively in recent years and training programmes devised to assist them develop their fitness and in particular speed training to be able to operate at these levels. However, these training programmes are filtered down to referees at lower levels, despite there being no evidence or studies in this cohort to establish if the physical demands of refereeing are the same.

## Methods

Five games were monitored involving five different referees ( $41.4 \pm 11.59$  yrs) who operated at step 7 of the English pyramid system volunteered to take part in the study, having received ethical clearance from the University of East London. The referees were fitted with a GPS S4 system (Catapult, Australia) and heart rate belt (Polar, Finland) which were worn from forty minutes before the game started until the completion of the game, during which time it continuously recorded. In line with previous research (Krustrup *et al.*, 2009) devices were set up to record time spent moving at different speeds and distances covered.

## Results & Discussion

Referees covered  $9,701.60 \pm 369.77$  m over the course of the game with the biggest contribution coming from jogging ( $3,495.20 \pm 526.01$  metres) and moderate running ( $3,426.20 \pm 390.52$  m). However, sprint and high speed running distance were  $474.60 \pm 211.00$  m and  $22.40 \pm 36.05$  m respectively. There was no significant difference between the distances travelled in the first half compared to the second half. The overall distance covered by these referees is similar to that reported at a more elite level ( $9,110 - 11,622$  m) (Cerqueira, *et al.*, 2011). However, the biggest difference found was in the amount of high speed ( $474.60 \pm 211.01$  m) and sprinting ( $22.40 \pm 36.06$  m) covered by the referees, where referees in this study.

## Conclusion

Referees seem to require similar endurance fitness levels to elite referees, but based on this initial information, referees do not seem to need similar levels of high intensity or speed training as currently delivered to elite referees. However, more research is needed on different leagues of the same level.

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# Comparative analysis of instructional behaviour of Spanish and English U12s football coaches

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## Introduction

Coaching instructional behaviours need to be adapted to individual differences to provide the players with an appropriately diverse range of learning approaches (Nelson, et al., 2014). Empowering learners is crucial for making them take their own decisions on the field of play (Light, et al., 2014). To accomplish this goal the teacher/coach has to shift the role from directing and controlling learning to facilitating and guiding it (Light, 2013). The purpose of the present study was to compare the coach instructional behaviour referred to the presentation of technical and tactical concepts of in England and Spain to investigate the predominance of the type of the instructional approach used (*instruction vs. questioning*) and to explore the potential differences that may emerge between them due to their different cultural and academic backgrounds.

## Methods

To conduct the study 10 coaches of u12 football teams were selected; 5 from Spain and 5 from England. The inclusion criteria of the participants were: coach from u12 teams, aged between 28-33 years, UEFA training licence and 5-10 years of youth coaching experience. The instrument used to collect coaching behaviour data was the Coach Analysis Intervention System (CAIS), (Cushion et al., 2012). We analysed two primary behaviours mainly linked to the instructional approach utilised to present technical-tactical concepts: *instruction* and *questioning*. The coaching behaviour was analysed during the main part of the training sessions. T-tests were performed to compare the coaching behaviour of coaches from both countries. All the analyses were conducted using *SPSS v.22* and the significance level was set at  $p < .05$ .

## Results & Discussion

In the training sessions *Instruction (I)* was utilised more than *questioning (Q)*, ( $I: 20.7$  vs  $Q: 2.8$ ,  $t(18) = 3.97$ ,  $p < .001$ ). From the total instructional messages (235), the 88.1% corresponded to instructions, while only 11.9% were questions. No differences were found between Spanish (SC) and English coaches (EC) from both countries in any of the different instructional categories: *instruction* (SC: 15.6 vs EC: 25.1,  $t(8) = 1.18$ ,  $p = .27$ ) and *questioning* (SC: 2.2 vs EC: 3.4,  $t(8) = 0.63$ ,  $p = .54$ ).

## Discussion & Conclusions

Our results are in line with previous studies reporting reduced questioning in training session of children (Partington et al., 2014). An excess of instructional directive management is contrasted to the desire of facilitate the self-autonomy and enhance decision-making behaviours in young athletes (Partington et al., 2013). Despite of the potential cultural and academic differences between Spanish and English coaches, no significant differences were found in the instructional management behaviours analysed. Future approaches to compare study coaching behaviours from different countries should be based in how to enhance behaviours in coaches to promote

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learning proactivity.

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# Processing speed in youth football players

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## Introduction:

Processing speed is the response efficiency in stimulus processing tasks (Lezak, 2004). Optimal levels of this capacity are required to perform efficiently in different sport settings. Indeed, expert athletes have shown superior processing speed capacities in wide range of general cognitive tasks (Voss et al., 2010, for a review).

## Methods

Two studies have been conducted with different groups of children (n=60) and adolescents (n=75) differentiated in terms of their regular sport expertise (athletes, football players and non-athletic controls). In one session, participants completed an adapted version of the Psychomotor Vigilance Task (PVT). In a different session, participants performed the Leger Multi-stage fitness test to estimate their aerobic fitness level. In the second study a manipulation of the velocity demands of the PVT was performed to evaluate the athletes' processing speed capacities under temporal pressure.

## Results & Discussion

Both children and adolescent football players showed better cardiovascular fitness than non-athletic controls in the Léger test (alls  $ps < .001$ ). In the first study, adolescent football players exhibited faster responses in the PVT than non-athletic controls, ( $p < .001$ ). In the second study, only differences between football players and controls were found in the normal condition of the PVT ( $p < .015$ ) in favour of the football players group. However, in speed condition, football players outperformed both track and field athletes ( $p = .011$ ) and non-athletic controls ( $p < .001$ ).

## Conclusion

The major novel finding of our research points to a positive relationship between football expertise and processing speed during childhood and adolescence. Future research should explore the role of processing speed in specific football decision making situations to determine his implications for talent identification.

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# Match play and sleeping behaviour in elite soccer players throughout a season

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## Introduction

Recently published data suggests that night matches seem to interfere with sleeping patterns in elite soccer players (Fullagar et al., 2016). This gives rise to some concern, considering that sleep loss may compromise recovery over the course of an entire season. However, longitudinal data is still lacking. Thus, the purpose of the present study was to objectively monitor sleeping patterns of elite soccer players after day (DM) and night matches (NM) throughout an entire season.

## Methods

Sleeping patterns of 20 elite Portuguese players were monitored via wristband actigraphy after NM and DM matches and compared to at least 3 training days (TD). A total of 95 training and 210 match nights (DM:  $n = 95$ , NM:  $n = 115$ ) were available for analysis. Objective sleep measures included total sleep duration (TSD), sleep onset latency (SOL), sleep efficiency (SE) and wake episode duration (WED). A t-test for dependent samples was performed to examine differences in sleep indices between TD as well as between DM vs. NM. Mixed effects models were used to analyse variability within and between players (fixed effect: type of match, random effect: subject ID and match-by-subject ID interaction).

## Results & Discussion

TSD after NM ( $5:34 \pm 0:46$  min) was significantly less than on TD ( $6:36 \pm 0:45$ ; -65 min,  $P = 0.002$ ) and after DM ( $6:38 \pm 1:36$ ; -65 min,  $P < 0.001$ ), whereas no significant difference was observed between DM and TD ( $P = 0.71$ ). No significant difference was evident for any other sleep variable ( $P > 0.05$ ). Variability attributable to subject ID ranged between 1.2% (SOL) to 32.9% (WED), whereas match-by-subject ID interaction accounted for 1.2% (WED) to 8.9% (SE) of total variability.

## Conclusion

The primary finding of this study was the significant reduction in TSD following night matches compared to both training days and day matches. Thus, there might be particular nuances about a night match, which cause an impairment of sleep independent of a player's normal sleeping behaviour or reasons arising from the match itself. The current results further support the increasing evidence that elite athlete's total sleep duration is shorter than the presumed normal healthy range (7-10 h). More research is required to assess if disruptions of sleeping patterns could influence recovery across various scenarios and over longer sampling periods.

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# Technical performance of elite youth soccer players during match play

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## Introduction

Time motion analysis has been widely conducted in both adult and youth elite soccer players and also published is some technical performance data on elite professional soccer players (Buchheit et al., 2010; Goto et al., 2015; Sarmiento et al., 2014). However, technical performance of elite youth soccer players during match play is relatively unknown. An availability of technical performance data in elite youth soccer players may support coaches and sports scientist to develop players and identify talent. Therefore, the aim of the present study was to describe the technical performance of under-13 (U13), U14, U15, U17 and U18 Japanese soccer academy players.

## Methods

Fifty seven participants (11 or 12 participants from each squad) from the same academy of a Japanese professional soccer club took part in the study and they were video-recorded during official league matches. A total of 118 complete match samples were obtained for analysis. The mean ( $\pm$  SD) number of observations for each participant was  $2.1 \pm 1.3$  and technical performance was analysed using Prozone match insight (Prozone Sports Ltd, Leeds, the UK). All matches were 11-a-side and pitch dimension was 105 x 68 m. Match durations were 60 min for U13 squad, 70 min for U14 squad, 80 min for U15 squad and 90 min for U17 and U18 squads. Results are presented as mean  $\pm$  SD and differences between the squads were examined using a one-way analysis of variance with Tuckey's post hoc test. The study was approved by a University Ethical Committee.

## Results & Discussion

The number of passes (U13:  $20.0 \pm 6.4$  passes, U18:  $37.7 \pm 16.5$  passes,  $P < 0.01$ ), the number of successful passes (U13:  $14.2 \pm 5.5$  passes, U18:  $31.0 \pm 14.1$  passes,  $P < 0.01$ ) and the number of ball involvement (U13:  $46.9 \pm 11.7$  times, U18:  $87.8 \pm 32.9$  times,  $P < 0.01$ ) during a match increased with age from U13 to U18 squad. Moreover, percentage of successful passes increased with age from U13 ( $67.8 \pm 15.3$  %) to U18 squad ( $82.1 \pm 5.1$  %) ( $P < 0.01$ ). The number of tackles performed during a match increased with age from U13 to U18 squad in both absolute (per match) (U13:  $0.9 \pm 0.9$  tackles, U18:  $3.4 \pm 2.2$  tackles,  $P < 0.01$ ) and relative (per hour) (U13:  $0.9 \pm 0.9$  tackles, U18:  $2.3 \pm 1.5$  tackles,  $P < 0.05$ ) terms.

## Conclusion

The results demonstrated that frequency of passes, successful passes and ball involvement per match, ratio of successful passes and frequency of tackles in relative term improve with age for 12 to 18 year old elite youth soccer players. Therefore, analysis of technical performance may make a valuable contribution to player development and talent identification.

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# Testing the workload variance between playing positions in professional soccer players

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## Introduction

Few studies have been differentiating external load (EL) profile between playing positions<sup>1</sup>. Therefore, the purpose of this study was to compare the EL of 7 weeks between playing positions (PP) and training sessions (TS) in two soccer teams.

## Methods

Participants were 29 professional players from two professional teams of a Portuguese (PT) and Dutch (DT) Second Leagues (n=14, 19.211.05 yrs; and n=15, 25.143.90 yrs, respectively). PP were classified in defenders (DF) (n=10), midfielders (MF) (n=9) and forwards (FW) (n=10). The players' EL was monitored by means of portable GPS devices (10 Hz, JOHAN Sports, Noordwijk, The Netherlands). The accelerometer was used to calculate Playerload<sup>TM</sup> (PL) (g/min). Total distance (TD) (m/min) and number of sprints (NS) above 20 km/h (n/min) were also quantified. TSs were codified as: +1d and +2d (days after match) and < -5d, -5d, -4d, -3d, -2d and -1 days before match.

## Results & Discussion

The one-way ANOVA split by PT and DT tested the variance of EL. No significant differences between PP ( $p > 0.05$ ) were found in TD (DF: 78.6622.53 and 74.2212.60; MF: 81.3923.81 and 74.6910.71; and FW: 86.2172.17), PL (DF: 3.571.23 and 4.270.67; MF: 3.631.20 and 4.160.75; and FW: 4.141.07 and 3.850.65) and NS (DF: 0.040.06 and 0.060.07; MF: 0.040.06 and 0.020.04; FW: 0.070.08 and 0.040.06).

Significant differences between days of the training were found in TD ( $p=0.001$ , ES=0.557; and  $p=0.001$ , ES=0.278), PL ( $p=0.001$ , ES=0.511;  $p=0.001$ , ES=0.207) and NS ( $p=0.001$ , ES=0.052; and  $p=0.269$ , ES=0.052). The greatest values of TD were found in -5d (110.895.52 and 96.734.93) and the smallest in -1d for PT (58.032.41) and +2d for DT (53.875.69). The greatest values of PL were found in < -5d in PT (5.200.19) and in -5d in DT (5.230.32) and the smallest values in -1d in PT (2.660.13) and +2d in DT (2.870.37). The greatest values of NS were found in -5d (0.130.10 and 0.100.14, respectively) and the smallest in -1d in PT (0.020.04) and +2d in DT (0.00.0).

## Conclusion

No significant differences were found in EL between PPs in both teams. The greatest amount of relative TD, PL and NS was performed in fifth day before the match. Interestingly, the smallest amount was found in one day before the match in PT and in the second day after the match in

DT.

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# Movement pattern comparison of soccer games by major and minor intercollegiate league players using GPS

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## Introduction

Comparison of movement pattern between higher and lower level of soccer match is important to understand movement demands for players to progress from lower to higher level. Several studies observed that players at a higher standard covered significantly more total distance covered and perform more high-intensity running than lower standard (Bangsbo et al., 1991; Mohr et al., 2003). However, these data were obtained in elite level, it is unclear whether these differences are observed in intercollegiate level. The aim of this study was to compare the movement pattern in major and minor intercollegiate games by players belonging to a same team.

## Methods

Players were monitored using 10Hz GPS (FieldWiz, ASI, Switzerland) during 4 major and minor league matches. Cumulative total of 44 players played over 90 min in a game were analyzed. Total distance covered (m), number of acceleration and deceleration  $> 3$  and  $> 4$  m·s<sup>-2</sup>, maximum and average velocity, and the distance of following categories were analyzed: waking (4-6 km·h<sup>-1</sup>), jogging (6-10 km·h<sup>-1</sup>), cruising (10-15 km·h<sup>-1</sup>), running (15-20 km·h<sup>-1</sup>), faster running (20-24 km·h<sup>-1</sup>), and sprinting ( $> 24$  km·h<sup>-1</sup>).

## Results & Discussion

The major-league players covered 13% more ( $p < 0.01$ ) distance than the minor-league players ( $11.06 \pm 1.17$  km vs  $9.73 \pm 0.63$  km). The number of acceleration  $> 3$  and  $> 4$  m·s<sup>-2</sup> for the major-league players were  $104.7 \pm 18.2$  and  $17.2 \pm 6.6$ , respectively, which were 58% and 69% more ( $p < 0.01$ ) than minor-league players ( $66.5 \pm 32.1$  and  $10.2 \pm 6.1$ ). The number of deceleration  $> 3$  and  $> 4$  m·s<sup>-2</sup> for the major-league players were  $99.9 \pm 16.7$  and  $29.2 \pm 6.4$ , respectively, which were 46% and 78% more ( $p < 0.01$ ) than minor league players ( $68.5 \pm 34.4$  and  $16.4 \pm 12.4$ ). The percentage of walking for the major-league players were smaller ( $p < 0.01$ ) than the minor-league players (22% vs 26%). There was no significant difference in the percentage of jogging and cruising. In contrast, percentage of running, faster running, and sprinting for the major-league players were larger ( $p < 0.01$ ) than minor-league players (16% vs 13%, 5.2% vs 4.0%, and 2.2% vs 1.5%, respectively). No significant difference in the maximum velocity was observed but major-league players moved 10% faster ( $p < 0.01$ ) in the average velocity than the minor-league players ( $6.98 \pm 0.75$  km·h<sup>-1</sup> vs  $6.30 \pm 0.38$  km·h<sup>-1</sup>).

## Conclusion

These findings suggest that the soccer players at the lower standard should improve their physical fitness to cover greater total distance, perform more higher intensity running and greater number of acceleration and deceleration in the higher standard in collegiate soccer.

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# Technical performances and activity patterns during 11-a-side-matches and 6-a-side small-sided games

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## Introduction

Small-sided games (SG) are commonly employed by coaches in soccer and several studies have investigated technical demands and activity patterns of different types of SG. However, there is a necessity to compare demands of 11M and SG with various area per player and such information would support coaches to select SG with an appropriate pitch size depending on the aim of training sessions (Halouani et al., 2014). Therefore, the aim of the present study was to compare technical performances and activity patterns during 11M and SG with various pitch sizes.

## Methods

Twelve outfield players (age =  $16.0 \pm 0.6$  years; height =  $171.1 \pm 6.7$  cm; body mass =  $59.1 \pm 6.5$  kg; playing experience =  $6.3 \pm 1.2$  years) (mean  $\pm$  SD) performed 11M and 6-a-side (including goalkeeper) SG with three different pitch sizes (area per player = 325 (11M and large SG (SGL)), 165 (medium SG (SGM)) and 85 (small SG (SGS)) m<sup>2</sup>). In SG, each team contained two central defenders, a defensive midfielder, an attacking midfielder and a striker, and they played their natural playing positions during SG as well as during 11M. All 11M and SG were conducted 4 times in counterbalanced order in six weeks and their duration was 35 min. Video recording and 15 Hz global positioning system (SPI HPU, GPSport, Australia) were employed to analyse technical performance and activity pattern during match play. One-way analysis of variance with Tukey's post hoc test was employed. The study was approved by a University Ethical Committee.

## Results & Discussion

Significantly less shots were attempted during 11M ( $0.8 \pm 0.8$  attempts) than SGM ( $4.2 \pm 2.5$  attempts,  $P < 0.05$ ) and SGS ( $5.2 \pm 4.0$  attempts,  $P < 0.01$ ). During 11M, significantly fewer tackles ( $3.7 \pm 1.0$  vs.  $5.5 \pm 2.2$  tackles,  $P < 0.05$ ), passes ( $19.9 \pm 6.5$  vs.  $31.7 \pm 6.8$  passes,  $P < 0.01$ ) and ball involvement ( $38.5 \pm 12.6$  vs.  $62.1 \pm 10.1$  times,  $P < 0.01$ ) were observed compared to SGS. Total distance covered was significantly longer during 11M ( $4060 \pm 335$  m) than SGM ( $3542 \pm 349$  m,  $P < 0.01$ ) and SGS ( $3059 \pm 322$  m,  $P < 0.01$ ). During 11M, a significantly greater high speed running distance ( $312 \pm 98$  vs.  $75 \pm 18$  m,  $P < 0.01$ ) was demonstrated compared to SGS.

## Conclusion

In conclusion, SG can provide a similar technical and physical stimulus to 11M as long as the area per player is similar. On the other hand, a reduction in area per player of SG in comparison with 11M results in greater technical demands and lower physical demands during SG compared to 11M. Therefore, coaches should carefully choose a pitch size of SG depending on the aim of training session.

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# The influence of player interchange on the cumulative and residual physical fatigue response to soccer-specific activity

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## Introduction

Soccer match-play comprises a limited number of substitutions and players are frequently exposed to a high frequency of games and, consequently, short recovery. This high physical demand can increase the risk of injury (Carling et al., 2015). Increased player interchanges, in other intermittent sports, have been associated with a lower physiological load (Moss et al., 2015) and reduced risk of knee flexor (KF) strain injuries (Orchard et al., 2012). In 2015, the International Football Association Board identified the potential merit of a player interchange strategy by approving the use of an unlimited "return sub" ruling at grassroots level soccer. The aim of this study was to assess the influence of a player interchanges on reducing the physical fatigue response to a soccer-specific exercise protocol ([SSEP] Page et al., 2016).

## Methods

Thirteen male soccer players (age  $23.2 \pm 4.6$  yrs) completed, in a counterbalanced order, a control trial (CONT) comprising 6 x 15 min bouts of the SSEP with a 15 min half time period, and an interchange trial (INT) comprising 4 x 15 min bouts of the SSEP, with 15 min passive recovery intervening bouts. Heart rate (HR), rating of perceived exertion (RPE), uni-axial and tri-axial PlayerLoadTM, and mean (EMGmean) and peak (EMGpeak) bicep femoris electromyography were measured during each trial. Isokinetic eccentric KF peak torque (PT) was also measured pre-, post-, and 48-hours post-trial.

## Results and Discussion

Significantly lower ( $P=0.003$ ) HR values were reported during INT ( $143 \pm 11$  b·min<sup>-1</sup>) compared to CONT ( $153 \pm 13$  b·min<sup>-1</sup>). INT ( $12 \pm 2$  a.u) RPE was significantly ( $P < 0.001$ ) lower than CONT ( $13 \pm 2$  a.u). The interchange trial also elicited significant ( $P < 0.05$ ) changes in PlayerLoadTM metrics. PT values were significantly ( $P=0.04$ ) higher during INT (180 degs·s<sup>-1</sup> =  $152.11 \pm 25.90$  Nm; 300 degs·s<sup>-1</sup> =  $154.13 \pm 21.52$  Nm) compared to CONT (180 degs·s<sup>-1</sup> =  $141.27 \pm 26.29$  Nm; 300 degs·s<sup>-1</sup> =  $144.12 \pm 21.30$  Nm). There was no difference ( $P > 0.05$ ) in the EMG data between the two trials.

## Conclusion

Player interchanges result in a reduced cumulative physiological, perceptual, and external load response to soccer-specific activity, with implications for reduced injury risk and improved performance. The post-exercise rate of recovery associated with the KF PT data was greater in the interchange trial, with implications for training periodization and injury management (Orchard et al., 2012).

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# High Injury Incidence in Australian Lower League Football

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## Introduction

Inconsistent recording methods have limited comparisons between elite and lower league football in existing injury surveillance research (McCunn et al., 2016). To allow direct comparisons, this study utilised methods consistent with the football consensus statement (Fuller et al., 2006) to conduct injury surveillance and determine injury aetiology in Australian lower league football.

## Methods

1049 football players were recruited during the 2016 season from second and third tier Australian clubs. Injury and exposure data were collected by Sports Trainers who attended every training session and match (Ekegren et al., 2015). Injury diagnosis was determined by a chartered physiotherapist via a detailed description from the Sports Trainer (Hammes et al., 2015).

## Results & Discussion

1109 time loss injuries were recorded during 55400 hours of exposure (training and matches combined), resulting in an injury incidence of 20 injuries/1000h. A specific, defined event, i.e. trauma, was the most reported injury type (71.7%) with 63% of all injuries occurring in matches. Anatomically, the most common injuries were observed at the thigh (21.2%) and ankle (17%). The hamstring (13.6%) was the highest reported muscle injury. The profile of injury severity was: mild - 33.9%; minor - 29.1%; moderate - 27.3%; and severe - 9.6%. Recurrent injuries accounted for 20.5% of all injuries.

## Conclusion

The present results demonstrate that the injury incidence and the risk of reoccurrence in Australian lower league football is more than twice that of elite football (Ekstrand et al., 2009; van Beijsterveldt et al., 2015). The higher injury incidence may be a consequence of the rigorous recording methods utilised in this study. This potentially resulted in more comprehensive injury reporting, especially of mild and minor severity injuries, compared with other lower league studies (van Beijsterveldt et al., 2015). The results of this study highlight the need for the development of injury prevention strategies and adoption of programmes to reduce injury incidence in Australian lower league football.

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# Characteristics of Decision Making Ability in Expert Soccer Players: A Focus on Brain Information Processing and Execution Function

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## Introduction

Open-skilled sports, such as soccer, require players to make instant decisions in response to changes in the situation. It has been reported that players who perform well not only have physical skills but also fast information-processing ability, which is a perceptive/cognitive skill (Ando et al., 2001; Montes-Mico et al., 2000). Although previous studies have indicated that expert players have excellent information-processing ability and executive function (Vaeyens et al., 2007; Vestberg et al., 2012), the relationship between these two skills has not yet been investigated. Therefore, the present study utilized physiological and neuropsychological indices to clarify the characteristics of intracerebral information processing in expert soccer players.

## Methods

A total of 26 university soccer players of different sporting levels (expert group: 13 subjects, sub-expert group: 13 subjects) participated in the experiment. As physiological indices, we measured event-related potential (ERP), electromyography reaction time (EMGRT), and reaction time (RT) in choice reaction tasks for actual play situations (3 vs. 1 maneuvering task, 4 vs. 2 maneuvering task). As a neuropsychological index, we used scores from the design fluency test (DFT), which is used for executive function screening.

## Results & Discussion

Results indicated no significant differences for P300 latency or amplitude for ERP in the choice reaction tasks. This demonstrated that there were no differences in the level of experience for the process to evaluate stimulation in the form of "what type of situation." EMG-RT and RT were significantly shorter in the expert group than in the sub-expert group. This suggested that a marked difference in intracerebral information processing during decision making was the ability to accurately and swiftly execute motions (output). DFT scores were significantly higher in the expert group than in the sub-expert group. Similar to previous studies, this suggested that expert players had excellent executive function creativity. The above results indicate that the characteristics of intracerebral information processing during decision making by expert soccer players are the abilities to swiftly process response and motions for executing plays and having excellent executive function. Thus, it appears that executive function affects the response and motion processing speed of expert players.

## Conclusion

This study revealed that 1) although there were no differences between expert players and sub-expert players in the speed of evaluation processing when they assessed the situation and executed plays, expert players more accurately and swiftly executed motions (output) and 2)

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expert players had higher DFT scores than sub-expert players, indicating that they had superior executive function.

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# Proficiency-related differences in perceptual-cognitive expertise, executive function, and grit of soccer players

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## Introduction

In soccer, players are required to capture the situations quickly in an environment that changes moment-to-moment, and are required to perform appropriate play according to the situations. In previous studies, it has been reported that experts are superior in perceptual-cognitive expertise and executive functions (Mann et al., 2007; Vestberg et al., 2012), but the relationship between the two has not been directly examined.

The mental toughness to engage in deliberate practice becomes important for the mastery of such skills. Regarding this point, grit is attracting attention as one of the major factors that influence success in this area. If grit is an important factor in proficiency, do experts have those psychological traits? Therefore, the purpose of this study was to examine proficiency-related differences in the perceptual-cognitive expertise, executive functions, and grit of soccer players with different degrees of skills.

## Methods

Eight high-level soccer players (HP) and eight local-level soccer players (LP) participated in the experiments. We evaluated perceptual-cognitive expertise such as decision-making and visual search strategies using football specific video simulation and an eye movement measurement technique. Executive functions were evaluated using the Design Fluency Test. Grit was evaluated using the Grit scale (Duckworth & Quinn, 2009).

## Results & Discussion

HP ( $87.0 \pm 3.2\%$ ) were better at decision making than LP ( $87.0 \pm 3.2\%$ ). In visual search strategies, HP maintained a significantly longer gaze on defensive players ( $19.0 \pm 3.8\%$  vs  $13.4 \pm 6.2\%$ ); this is considered to be a strategy for finding weak points of defense in a limited time and making the best pass selection. In addition, compared to LP ( $10.5 \pm 4.4$  pts), HP ( $18.6 \pm 4.8$  pts) were shown to be superior in creativity among executive functions. From these results, superior executive function for soccer players is considered an important factor for achieving high performance. Moreover, HP ( $4.0 \pm 0.4$  pts) had significantly higher grit scores than LP ( $3.1 \pm 0.2$  pts). Hence, it is considered that being a grittier is one of the psychological features of HP.

## Conclusion

In this research, the following three findings became clear; (1) HP with better decision-making revealed that they turn their eyes on the defenders for a longer time; (2) HP were shown to be superior in creativity among executive functions, and (3) Higher grit is considered to be one of the important psychological features of HP.

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# Positive Effects of "FIFA 11 for Health" for Europe on Cognitive Performance in Preadolescent Danish Children

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## Introduction

Many recent studies have shown positive effects of physical exercise on several cognitive domains both in elderly, adults and children. However, despite this firmly established knowledge, numerous children are still not complying with the recommended amount physical activity. School-implementable concepts of physical exercise represent an interesting way to reach out to a large number of children with different social-economic backgrounds. Nevertheless, little is currently known about how such concepts affect cognitive functions in children. Thus, the aim of this study was to investigate whether a school-implementable concept of physical exercise in form of "FIFA 11 for Health" for Europe could improve cognitive functions in preadolescent Danish school children.

## Methods

An 11-week cluster-randomized intervention study investigated the effects of a school-implementable concept of physical exercise on cognitive functions in preadolescent Danish children. Two groups were included: a control group (CG) ( $n = 76$ , age =  $11.99 \pm 0.02$ ), which received their normal daily school physical exercise (5x45 minutes per week) and a football group (FG) ( $n = 672$ , age =  $12.07 \pm 0.04$ ), which substituted 2x45 minutes per week of the daily school physical exercise with the "FIFA 11 for Health" for Europe concept. The concept combines small-sided football games drills and health education. Cognitive performance was evaluated at baseline and follow-up with a standardized, neuropsychological computer-based test battery (Cogstate Brief Battery™) addressing simple reaction time, two-choice reaction time, visual memory and working memory.

## Results & Discussion

FG significantly improved their performance in simple reaction time (from  $378 \pm 3$  to  $363 \pm 3$  ms,  $p < 0.001$ ), two-choice reaction time (from  $615 \pm 4$  to  $597 \pm 4$  ms,  $p = 0.002$ ) and working memory (from  $879 \pm 9$  to  $845 \pm 8$  ms,  $p < 0.001$ ) from baseline to follow-up testing. Furthermore, the improvements observed in FG were significantly larger than CG in simple reaction time ( $49 \pm 12$  ms,  $p < 0.001$ ), two-choice reaction time ( $42 \pm 14$  ms,  $p = 0.003$ ) and working memory ( $61 \pm 29$  ms,  $p = 0.035$ ).

## Conclusion

The study shows that the school-implementable physical exercise concept "FIFA 11 For Health" for Europe can improve cognitive performance in preadolescent Danish school children compared to a control group. Future studies should investigate the neurophysiological mechanisms underlying the observed behavioural effects to more precisely understand the effect of "FIFA 11 for Health" for Europe on cognitive functions.

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# Kinetic characteristics of kicking motion between football players with or without groin pain from motion analysis of inside-kick

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## Introduction

Although the incidence rate of groin pain among football players is said to be low, the treatment becomes challenging as it may become chronic once it develops (Lynch SA et al., 1999). It has been reported that kicking motion relates to the groin pain (Cetin C et al., 2004, H'olmich P et al., 2004). However, its mechanism is still unclear. The purpose of this study was to reveal the characteristic motion of kicking between football players with or without groin pain.

## Methods

Subjects were 17 male college football players. 8 players with the history of groin pain in the past year (Groin Pain group: GP group) and 9 players without the groin pain (No-Groin Pain group: No-GP group) were included in the study.

All the players kicked the ball three times to the target, which was 10m away, by instep kick after total of 39 body markers (based on Plug-in-gait maker set) were applied. Kicking motion was analyzed by three-dimensional motion analysis (Vicon T020×20; sampling 250 Hz) and mutually-synchronized force plate (Kistler×1; sampling 1,000 Hz) followed by analysis of the kicking leg and the stance leg using motion analyzing software Vicon Nexus 1.7. Analyzing interval was from the Maximum Hip Extension (MHE) of the kicking leg through the Foot Contact (FC) of the pivot leg to the Ball Impact (BI) of the kicking leg.

## Results & Discussion

Maximum torque from MHE of the kicking leg in the GP group (flexion  $77.40 \pm 31.2$  N/kg, adduction  $39.22 \pm 10.0$  N/kg) was significantly higher than that of the No-GP group (flexion  $62.61 \pm 14.0$  N/kg, adduction  $32.15 \pm 9.9$  N/kg). And maximum torque from BI of the kicking leg in the GP group (flexion  $246.52 \pm 150.8$  N/kg) was significantly higher than that of the No-GP group (flexion  $156.69 \pm 78.7$  N/kg). Relative rotation angle of the upper and lower trunk in the GP group ( $11.13 \pm 6.5^\circ$ ) was significantly smaller than that of the No-GP group ( $17.73 \pm 8.5^\circ$ ). Ankle dorsiflexion angle of the pivot leg was significantly smaller in the GP group (FC  $15.0 \pm 5.1^\circ$  and BI  $12.2 \pm 7.3^\circ$ ) than that of the No-GP group (FC  $20.6 \pm 4.9^\circ$  and  $18.3 \pm 7.6^\circ$ ).

## Conclusion

From these results, inside kick of the players with groin pain can be speculated that the gravity center being backward against the pivot leg and that it depends on the hip torque caused by the deteriorated trunk rotation leading to inefficient kicking leg movement. This may have a relationship with the occurrence of the groin pain.

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# The organisation of concurrent training and nutritional intake in English professional soccer clubs: A survey of the typical prescriptions during a one game match week

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## Introduction

In a bid to enhance physical performance and reduce injury risk elite soccer players often engage in concurrent-training (CT). It is likely that each training facility will encounter its own set of ‘constraints’ that limit the coaching staffs’ ability to prescribe ‘evidence based’, systematic training interventions (Enright et al. 2016). The adaptive response might be influenced by the organisation of training and nutrition (Enright et al. 2015). Little is known about how professional soccer teams currently administer concurrent training to their athletes. The purpose of this study was to survey the organisation CT and nutritional intake within professional soccer teams in England.

## Method

1st team / senior team’, ‘under-21 team / elite development squad’ and ‘under-18 team’ fitness coaches from forty-four professional clubs competing in the English ‘Premier League’ (EPL) and English ‘championship’ (EC) were asked to participate in this study (132 teams in total). The frequency of resistance-training (F), the sequence of CT (S+E, E+S, no set sequence, isolated on a different day (IODD) and the recovery time between training bouts was surveyed using online technology. The timing, location and quantity of carbohydrate and protein intake around concurrent training was also surveyed.

## Results & Discussion

The response rate was 55 (42%) (1st; n=22 [12; EPL, 10 EC], U21; n=18, U18 n=15). 1st teams participated in S+E; n=1, E+S; n=11, no set sequence; n=5, IODD; n=1. 9 1st teams completed CT with < 60min recovery. 5 teams separated CT by > 60min. U21 teams, engaged in S+E; n=1, E+S; n=8, no set sequence; n=6, IODD; n=1. 3 teams carried out CT with < 60min recovery. 12 U21 teams separated training by > 60min. U18 teams, performed S+E; n=4, E+S; n=6, no set sequence; n=5, IODD; n=0. 6 U21 teams had < 60min recovery. 7 U21 teams had > 60min recovery. All teams typically consumed a meal between training session 1 and 2 (1st teams; 61%, n=11; U21 teams 88%, n=15; U18 teams 100%, n=15) or a nutritional sport product between session (1st teams; 33%, n=6; U21 teams 12%, n=2). 67% of 1st teams (n=12) ate or consumed a sports drink (n=5, 28%)

## Conclusion

Teams typically prescribe endurance and strength training on the same-day but in different ‘exercise orders’ with varying recovery phases between training bouts and with different nutritional strategies supporting each training bout. The organisation of CT and nutrition observed in this survey might produce diverse acute and chronic physiological responses (Perez-Schindler et al., 2015). More work is required to investigate the short and long-term effects of the habitual CT practices typically used in applied environments. This may allow practitioners to organise training so to maximise the adaptive process.

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Perez-Schindler J, Hamilton DL, Moore DR, Baar K, Philp A. (2015) Nutritional strategies to support concurrent training. *Eur J Sport Sci.*;15(1):41-52.

# The effect of caffeine on anaerobic power, ldh enzyme and ca+2 ion of young soccer players' plasma

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## Introduction

There is a few studies about physiological influences of caffeine during Price protocol as a combined program with a range of work intensities from sub max to high intensity and have inconsistent results. The purpose of present study was the examiner of ingestion (6mg/kg) caffeine effect on anaerobic power, LDH enzyme and Ca+2 ion of male young soccer players' plasma during maximal and interval exercise as a combined program (Price Protocol).

## Methods

22 young soccer players were selected randomly and divided equally in experimental and control groups with play experience ( $5 \pm 1$ ) year, weight ( $62.5 \pm 7.5$ ) kilogram, height ( $171 \pm 5.3$ ) centimeter and age ( $16.8 \pm 2.3$ ) year. Data are presented as mean  $\pm$ SD. Pre-test were conducted to assess the rest variables amount.. There were not significant differences between two groups. The experimental subjects trained high intensity exercise, also Wingate test (30s) before Price program respectively. One hour before Price task, subjects ingested (6mg/kg) with 200cc of water either placebo (dextrose) or caffeine. This exercise program has been designed according to soccer playing, include moving, running and active rest and it consisted 30 minutes with 10 set  $\times$  3min repeats, and active rest periods on a mechanical bicycle. Each stage covered 90 sec pedaling with 40% HRR, 60sec in 60% HRR intensity, RPM=60 and 15sec exercise with max power output and finally 15sec light activity as rest period (40%HRR, RPM=40) respectively. The protocol performed with average of 69% HRR intensity. Once when the test terminated, post-test metabolic and physiological values was conducted rapidly.

## Results & Discussion

Absolute and relative anaerobic power values in experimental group increased markedly more than placebo group during 7, 9, 10th stages on Price task ( $p < 0.05$ ). Also, the averages of plasma ca+2 ion concentrations differenced significantly between caffeine and placebo groups. It seems that the caffeine consumptions before Price protocol (30min), increases in ca+2 ion of soccer players' plasma and it may prompts anaerobic capacity of muscles during interval and maximal exercise as a combined aerobic and anaerobic program performance.

# Vers un nouveau test d'évaluation de la vitesse maximale aérobie (VMA) des footballeurs de différent Niveau

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## Introduction

Le but de cette étude est d'élaborer un nouveau protocole du test (test de Benhammou) afin d'améliorer la fiabilité d'estimation de la vitesse maximale aérobie (VMA) de façon plus précise, plus simple et moins coûteuses, et tenter de mettre en évidence leur degré de validité. Il s'agit d'un test à protocole rectangulaire adapté en fonction des capacités des athlètes, avec des équations pour calculer la VMA et la VO2Max, et la signification physiologique sous-jacente.

## Methods

32 athlètes (18.21 +/- 2.40 ans), dont 15 débutants, 10 athlètes entraînés et 7 élites, ont réalisé trois tests sur une période d'une semaine à 72 heures d'intervalle : test de Benhammou, test de Léger-Boucher (1980) et test de Vameval (Cazorla, 1990), et pouvoir ensuite comparer les résultats obtenus par les mêmes sujets au test de Benhammou par rapport aux deux tests progressifs cités précédemment. La comparaison des tests s'appuie sur des protocoles bien définis, qu'il n'est pas question de remettre en cause (Cazorla, 1990) : la VMA, la fréquence cardiaque maximale (FC), et la lactatémie (LA).

## Results & Discussion

Aucune différence significative n'a été constatée entre les trois tests avec un fort coefficient de corrélation ( $r = 0,99$ ;  $p < 0,05$ ), en ce qui concerne le premier paramètre étudié (VMA). L'analyse des autres variables (fréquence cardiaque et lactate), ne montre aussi aucune différence significative entre les trois tests avec des coefficients de corrélations ( $r = 0,87$ ,  $r = 0,98$ ;  $p < 0,05$ ). L'étude comparative montre une adaptation de ce test à tous les niveaux, et permet d'affirmer que c'est une épreuve de terrain fiable, spécifique et facilement utilisable.

# The compatibility Neuromuscular ( the hand & eye and feet & eye ) and its Relationship to Long passes and Throw side Skills in Soccer

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## **Introduction**

The purpose of the study is to examine the relationship among the compatibility neuromuscular ( the hand & eye, feet & eye ) and its relationship to long passes and throw – side skills in soccer, which have undergone compatibility testing neuromuscular and experiential long passes and throw – side skills by the results of the tests.

## **Methods**

The subjects of the study were (60) students stage (V) college of Physical Education and Sports science – Tikrit University . The researcher used the descriptive nature of the search for suitability using statistical methods.

## **Results & Discussion**

The researcher found that the neuromuscular test compatibility between eye and feet may be achieved in a test long passes and throw side football when compared to the results of the test.



# Effects of core stability training program on physical fitness in young male Iraqi soccer players – a randomized controlled trial

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## Introduction

Children are skeletally immature and when participating in sport, are susceptible to musculoskeletal injury through physical activity. However, to date there is limited information available that suggest the effects a core stability program have on improving core strength and endurance in children. Therefore, the purpose of this study is to determine the effectiveness of core stability training program on core strength in younger male soccer players.

## Methods

With ethical approval, twenty-six boys (mean  $\pm$ SD: age = 10.7 $\pm$ 1.5 years; BMI = 36.1 $\pm$ 4.2 kg; stature = 1.36 $\pm$ 1.3 m) from two local sports schools were divided randomly into experimental (EXP; n = 13) or control (CON; n = 13) groups. The EXP group participated in the core stability program that focused on core strength and physical fitness (3 times/week) for 12 weeks. The CON group was instructed to continue training and warm-up as usual. Pre- and Post the intervention, both EXP and CON groups performed a battery of soccer-specific physical tests (Prone hold, Horizontal 3-step jump and Running speed). Changes in performance scores within each group were compared using independent t-tests ( $p \leq 0.05$ ). Compliance to the intervention was 87%.

## Results & Discussion

Measures of core stability by prone hold test was increased significantly in EXP group compared with CON group (48.5% vs 28.2%, respectively,  $p < 0.05$ ). Measures of leg power (3 step jump) increased significantly (3.7% vs 0.8% respectively,  $p < 0.05$ ) in EXP group compared with CON group. Speed over 30 m improved by (-2.9% vs 1.5 respectively,  $p < 0.05$ ) in EXP group compared with CON group.

## Conclusion

The high player adherence to the core stability program resulted in significant improvements in functional core muscle. Most players considered that the core stability program beneficial and reported they enjoyed more than performing regular exercises.

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# Comparison of internal load, fatigue and creatine kinase levels between different weekly microcycles: study during an entire season in elite professional players

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## Introduction

Some previous investigations have revealed the weekly training load of teams (Impellizzeri et al., 2004). Nevertheless, few analyses have been performed using different monitoring, e.g., internal training load (IL); the Hooper's index (HI); creatine kinase (CK). The aim of this study was to monitor the IL, HI and CK levels of elite professional soccer players during an entire season and to analyze the variance between two types of microcycle: with one- and two-weekly matches.

## Methods

Thirty-five elite male Portuguese professional soccer players ( $25.7 \pm 5.0$  yrs,  $182.3 \pm 6.4$  cm;  $79.1 \pm 7.0$  kg) participated in this study. IL (RPE multiplied by the time of session), HI and CK levels were monitored in all microcycles. Variance of IL, HI total and CK were tested using the independent t-test followed by Cohen's d (ES: effect size). Variance between individual HI scales was tested with Mann-Whitney U followed by the  $r$  (ES).

## Results & Discussion

A significant difference was found between type of microcycle in the variables of IL ( $p=0.00$ ;  $ES=0.40$ ) and total HI ( $p=0.02$ ;  $ES=0.08$ ). IL was significantly higher in weeks with only one match ( $308.31 \pm 59.8$ ), than with two ( $245.71 \pm 54.0$ ). Total HI was significantly higher in weeks with two official matches ( $11.9 \pm 3.8$ ) than with one ( $11.6 \pm 3.4$ ). No significant differences were found between type of microcycle in CK levels ( $p=0.92$ ;  $ES=0.01$ ). The descriptive values for CK levels in weeks with one and two matches were  $251.6 \pm 203.6$  and  $250.3 \pm 150.6$ , respectively. Variance of perceptible muscle soreness (Q1), sleep quality (Q2), fatigue (Q3) and stress (Q4) ordinate scales between types of microcycles was tested. Statistical differences of Q1 ( $p=0.00$ ;  $ES=0.08$ ), Q3 ( $p=0.00$ ;  $ES=0.06$ ) and Q4 ( $p=0.00$ ;  $ES=0.05$ ) were found. No significant differences were found in Q2 ( $p=0.79$ ;  $ES=0.00$ ). Significantly higher values of Q1 and Q3 were found in weeks with two matches ( $3.3 \pm 1.3$  and  $3.2 \pm 1.4$ , respectively) than with one ( $3.1 \pm 1.1$  and  $3.0 \pm 1.2$ , respectively). Significantly higher values of Q4 were found in weeks with one match ( $2.5 \pm 1.3$ ) than with two ( $2.4 \pm 1.3$ ).

## Conclusion

Weekly microcycles with one official match were significantly more intense and promoted higher perceptible fatigue levels. No statistical variance of CK levels was found between types of microcycle. Weeks with two matches may have influence the decrease in training load.

## Acknowledgements

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