International Journal of Sports Science & Coaching

Original research article

Why we do it, how we do it, and can we do it better? Key stakeholder perceptions of physical fitness testing as part of a talent development programme in professional youth soccer

International Journal of Sports Science & Coaching
1–12

DOI: 10.1177/17479541251367297
journals.sagepub.com/home/spo
Sage

James H Dugdale[1], Kieran Duffie[1,2], Alban CS Dickson[1], Cedric English[1], and Russell JJ Martindale[1]

Abstract

Increases in the demands placed upon soccer players during training and competition have resulted in an even greater role being played by sport scientists to compliment technical coaches. However, evaluation of multidisciplinary perspectives to routine processes and provisions within soccer talent development remain somewhat unexplored. This study aimed to investigate experiences of working as a multidisciplinary team with regards to utilising fitness testing as part of the talent development process within a professional soccer academy. Focus group interviews were conducted with six coaches (technical coaches: n = 3; physical performance coaches: n = 3) working within a professional soccer academy to explore their general philosophy, aims, decision making, and opinions in relation to physical fitness testing. Qualitative data collected from focus groups were analysed using framework analysis, which facilitated a systematic approach to framework advancement. Three themes were generated from the focus groups related to: i) Intentions and rationale behind physical fitness testing provision; ii) Utility of physical fitness test results within talent development; and iii) Reflective experiences of multidisciplinary practice associated with physical fitness testing. While technical and physical performance coaches were aligned with their perspectives related to these central concepts, role- and discipline-specific context was apparent. Collectively, results from this study may help rationalise physical fitness testing as part of academy player development in soccer and identify areas for improvement and refinement within these processes. These findings can act as a foundation to encourage similar reflective and evaluative processes in comparable talent development environments.

Keywords

Association football, communication, evidence-based approach, multi-disciplinary team

Introduction

Talent development in soccer is a complex and multidimensional process.[1] Accounting for this complexity, soccer talent development systems (i.e., academies) are typically constructed of multidisciplinary teams (e.g., technical coaches and disciplinary practitioners).[2] These stakeholders must work in unison to build effective academy environments to maximise the potential of developing players who transition into the first-team or can be sold for financial gain.[3,4] Despite seminal research highlighting the importance of multidisciplinary approaches within soccer talent development,[1] exploration of stakeholder perspectives around the complex, multidisciplinary processes demanded by successful academy environments has received limited attention compared to advancements made in other disciplines.[5,6]

Multidisciplinary teams are inclined to operate best when all staff members are working towards mutually agreed, definitive, and shared goals.[7,8] Coaches typically have a positive view of the contributions from members

Reviewers: Mark McGuigan (University of the West of Scotland, UK)
Kathryn Johnston (University of Toronto, Canada)

[1]School of Applied Sciences, Edinburgh Napier University, Edinburgh, Scotland
[2]Football Science and Medicine Department, Hibernian Football Club, Edinburgh, Scotland

Corresponding author:
James H Dugdale, School of Applied Sciences, Edinburgh Napier University, Edinburgh, Scotland.
Email: j.dugdale@napier.ac.uk

of the multidisciplinary team.[9] For example, coaches report not only valuing the discipline-specific knowledge that practitioners may offer but also commend their ability to overcome complex performance problems synergistically.[10] Yet, inter-disciplinary differences in approach and priorities may exist, resulting in challenges and potential conflict between stakeholders.[9,10] This disconnect has the capability to disrupt the workings of multidisciplinary teams, such as impacting return to play following injury, diminishing the effectiveness of training, and influencing performance outcomes.[11,12] Research within academy soccer also suggests that coaches and practitioners may place different levels of importance on performance attributes (i.e., physical, psychological) potentially leading to challenges during talent development.[2] These perspectives may hinder player development due the inconsistent prioritisation of disciplinary approaches and tendencies within different coaching environments.[10] This reinforces the necessity of multidisciplinary practitioner input to avoid overlooking different aspects of development and during talent selection, particularly in multidimensional sports such as soccer.[2] Accordingly, calls for enhanced communication, collaboration, and data sharing between key stakeholders contributing to player performance and development are warranted.[10,13,14]

The utility of supplementary scientists and support staff continues to grow within soccer.[15,16] The discipline of 'sport science' is typically employed within professional soccer, encapsulating provision such as physiology, psychology, nutrition, and strength and conditioning.[16] Recent survey data supports this notion, suggesting that soccer clubs globally are implementing sport science not only within the first team, but also as a routine component of talent identification and talent development processes.[17] Increases in the demands placed upon soccer players during training and competition has also resulted in an even greater role being played by sport scientists to compliment technical coaches.[15] Therefore, effective collaboration between coaches and sport scientists, specifically, is imperative to maximise opportunities to improve performance and developmental outcomes in soccer.

Testing and monitoring practices allow for the integration of objective data to inform training and performance evaluation. In soccer, testing and monitoring is typically incorporated within session design (such as prescribing distances or intensities), periodisation (such as manipulating training volume or load), and during athlete (de)selection (such as using data to support coach rating and evaluation).[18] Technological advancements and accessibility to equipment and software within applied settings had resulted in these practices being readily used as part of the multidisciplinary offering within soccer clubs and academies.[5,10] A commonly utilised method is the use of fitness testing; whereby sport scientists and strength and conditioning coaches assess relevant physical performance characteristics using validated fitness tests, typically in a field-based environment.[19] Considering that fitness tests primarily assess isolated physical qualities, it is vital that sport scientists work in tandem with technical coaches to ensure that these data are used to inform the training and development of players, effectively.[20] However, resultant of the challenges of the multidisciplinary performance environment, there can be a tendency for individual disciplines to work in 'silos' within professional soccer, which may hinder translation and limit the effectiveness of these processes.[21]

Investigations into multidisciplinary perspectives of the talent development environment in sport are limited.[13,14] Yet, integrated, coherent, and collaborative teamwork is critical for maximising the effectiveness of practice within these environments.[22] Investigating how such teams operate, the challenges that may exist, and the priorities, requirements, and decision-making processes of different stakeholders would provide useful insight within talent development in soccer. This would enable sport scientists within a club's academy to reflect on how best to work together to maximise expertise across disciplines in the shared interest of effective player development. As such, the aim of this study is to investigate practitioner and coach experiences of working as a multidisciplinary team with regards to utilising fitness testing as part of the talent development process within a professional soccer academy.

Materials and methods

Pragmatic research design

Considering the aim of the research, pragmatism was identified as an appropriate philosophical approach to explore the perception of stakeholders working as a multidisciplinary team within a professional soccer academy.[23,24] In contrast to the objective views of positivism, which favour scientific findings that can be generalised across time and contexts, pragmatism considers scientific findings to be on a continuum between the subjective and the objective, each dependent on the context and the research question.[25,26] A pragmatic approach supports the researcher to focus on providing a practical level of truth and identify meaningful insight,[26] in this instance, identifying "*what works*" for the benefit of the soccer academy talent development environment. And, in doing so, offers the researcher the scope to be recognised as a co-constructor of knowledge.[24]

Participants

A form of purposive sampling was adopted to attain insight based on relevant experience.[27] Eight male stakeholders (also commonly referred to as 'interest holders') who

were currently working within a professional soccer club's male youth academy volunteered to participate in this study. The academy is an 'elite' level programme based upon Club Academy Scotland classification by the Scottish Football Association,[28] and is nested within a professional soccer club playing in the top tier in Scotland. The academy boasts seven age groups beginning at U11 and up to a combined U17/U18. Inclusion criteria defined eligibility in cases where a stakeholder was currently working within the club academy and had held their current position at the club for a period longer than one year. Informed consent was gained from all participants along with providing information and a detailed explanation of the study. One stakeholder left the club during the study, while another could not participate due to personal reasons. Therefore, a total of six stakeholders (mean ± SD: age 38.8 ± 11.8 years; professional experience 8.6 ± 6.8 years) were recruited.

Participant roles included head of academy (former professional soccer player, UEFA Pro License, over 20 years of coaching experience), head of performance (Ph.D in sport science, 14 years of sport science experience), two academy physical performance coaches (both educated to Masters level, over 5 years of sport science experience), and two age-group technical coaches from the academy (both former professional soccer players, UEFA A License, 5–15 years coaching experience). In an attempt to mitigate social hierarchical influence (such as between heads of department and coaches), stakeholders were collectively briefed regarding the purpose and processes of the study, advised to speak freely throughout data collection, and reminded that their participation and contribution to the study was entirely voluntary and would not impact their role at the club. Ethical approval was obtained from the local university ethics committee (ref. 2883079) prior to commencement of the study.

Procedures

Focus groups were selected to accommodate multiple voices and viewpoints throughout data collection,[29] akin to typical processes within applied sporting environments. Participants were split into two focus groups dependent on their role (technical coaches: $n = 3$; physical performance coaches: $n = 3$). This separation facilitates analysis through the validity of comparisons between sub-groups.[30] Division into two equal sub-groups was intended to allow all stakeholders to speak freely, minimising confrontation due to divergent answers within the discussion arising from other stakeholders nested in different academy performance departments. The first focus group contained the head of academy and two technical coaches, whereas the second group included the head of performance and two physical performance coaches. Such homogeneity based on a shared characteristic – in this case, role – can stimulate interactions, flow, and consensus on a given topic.[29] Focus groups were conducted within a private meeting room within the club's training ground and were recorded using Microsoft Teams with a Dictaphone being used as a back-up recording. The process was facilitated to identify themes and relevant issues pertinent to the research question and ensured fluent discussion and richness of the data.[27] Focus groups were coordinated around core questions exploring stakeholders' general philosophy (e.g., "How do you view your role in relation to player development"), aims (e.g., "What do you want to achieve with the players during their time at the academy"), decision making (e.g., "How does physical fitness testing influence programming for players"), and opinions (e.g., "How do you find communication between disciplines regarding physical fitness testing results"), in relation to the physical fitness testing processes within the academy. Adopting a semi-structured interview style, prompts and probes were used during questioning to encourage elaboration, further explore emerging perspectives, and to ensure the researcher accurately interpreted the responses from all individuals. Focus groups proceeded until participants had no further information or comments to add. Each focus group lasted between 35 and 40 min, with 74 min of interview data collected in total. Transcripts were made available on request to all stakeholders who participated in the focus groups to permit member checking and improve the validity of the results.[31] Stakeholders were invited to revise and edit text in instances where they deemed necessary. This resulted in minor grammatical amendments and clarification of perceived ambiguity within the transcripts.

Data analysis

Qualitative data collected from focus groups were analysed using framework analysis, which is appropriately aligned to pragmatism as it facilitates a systematic approach to framework advancement and allows comparison between both focus groups. Framework analysis uses a structured, matrix-based approach to identify commonalities and differences in qualitative data, seeking to draw descriptive and/or explanatory conclusions clustered around themes.[32] Framework analysis is widely used within qualitative research, particularly when analysing data from multiple disciplines, allowing codes to be generated without losing the context of individuals' views.[32] This method was also selected due to the flexibility provided to the researcher to use either deductive or inductive research questions.[32] This mixed approach was deemed important within our research as it allowed deductive analysis of the data around core questions, whilst also remaining open to new insights that may present from the stakeholders. This process involved a six-stage procedure to develop themes and concepts from the data set: (1) transcription and familiarisation of the entire data set; (2) coding; (3) developing a

working analytical framework; (4) applying the framework; (5) charting data into the framework, and (6) interpretation and mapping of the data.[27,32] Familiarisation of focus group content was accomplished by listening to the recordings and reading the transcriptions several times; due to their interplay, both stages are presented as one as part of this procedure.

An inductive methodology was used to interpret and analyse the raw interview data, to allow for open coding that would support the development of a framework.[32] Coding was performed at this stage by adding notes alongside transcriptions. Notes were then used to generate a set of codes, each with a brief description, which formed the primary analytical framework. The framework was then applied to each transcript which was systematically coded and relevant text being attached to the corresponding code. Following synthesis of the analytical framework, data was then outlined in a matrix. Themes and sub-themes were then generated after analysing the matrix and connecting codes which were grouped into structured topics. These topics were generated based on the main aims of the study and specifically generated themes and sub-themes from the data.

Even though pragmatism accepts researcher bias and prejudice,[24] the approach recognises the importance of the moral, ethical, and practical consequences associated with the research process. To moderate any potential researcher bias, reflection and analysis played a significant role within the coding and final interpretation and mapping of the data phases.[26] A critical friend with 15 years of experience in qualitative methodology was used to review the coding and framework process. Acknowledging the importance of participant voices and perceptions related to the study aims, data were reported following a qualitative description approach.[33]

Results

Three themes were generated from the interviews with technical and physical performance coaches regarding the implementation of physical fitness testing as part of the talent development provision within the soccer club academy. These themes related to: i) Intentions and rationale behind physical fitness testing provision; ii) Utility of physical fitness test results within talent development; and iii) Reflective experiences of multidisciplinary practice associated with physical fitness testing. Themes, codes, interpretive definitions, and extracts are provided in Table 1.

Theme 1: Intentions and rationale behind physical fitness testing provision

Technical and physical performance coaches recognised the broader purpose of physical fitness testing – relative to talent development – was foundational for its inclusion within academy provision. Two codes comprising 24 extracts (Technical Coaches: $n = 15$; Physical Performance Coaches: $n = 9$) were combined for this theme.

Physical development is paramount to long-term success. All participants, across both groups identified the importance of physical qualities regarding progression within youth academy soccer. Notably, advancing physical fitness throughout adolescence was highlighted as crucial to meet the increasing physical demands of the game:

> "They must be athletic… The way the modern game is now, you have to be very, very athletic to play at the level that we're looking for them to play at. And so that's where the sports science side of things becomes paramount" (Technical Coach 1).

The ongoing development of physical qualities was also raised with a recognition of "progress" between chronological age brackets: "The key with the academy players is progressing them year to year, especially the younger age groups…" (Physical Performance Coach 2). Finally, instances of youth-to-professional transition were presented, with a clear appreciation for the physical challenges presented during this phase of development: "We need to get them quick to be able to compete with the development squad or first-team players when they get the chance to go and play alongside them" (Technical Coach 3); "[physical progress] therefore, gives players a greater chance of graduating into the first team. Or at least [players who are] physically ready to graduate to the first team" (Physical Performance Coach 1).

Fitness testing can be used as a marker of 'application'. A multidimensional approach was identified from interview data, suggesting that physical fitness testing provides broader insight on player performance. Technical coaches indicated that they evaluated psychological characteristics, such as how they perceived players' effort and dedication – their 'application' – to their training and development:

> "…[We] also look at their endurance, but I see that more as the mental side of things, especially for a lot of the players, it's a guide to see who's not worked or who's lost a bit of fitness over a period of time." (Technical Coach 1).

> "It's a benchmark of application. As generally, [at the] start of the season and at the end of the season, you get to see where individual is physically, and then you can use that when they come back to see whether they are better than that or are they worse than that. For me, that's a representation how they've been living away from the game, whether they've had a good off-season or if they've

Table 1. Themes, codes, interpretive definitions, and extracts derived from focus group interviews from technical and physical performance coaches.

	Theme	Codes	Interpretive Definition	Codes	Extracts
1.	Intentions and rationale behind physical fitness testing provision	• Physical development is paramount to long-term success • Fitness testing can be used as a marker of application	The broader purpose of including physical fitness testing within talent development should be understood, agreed across all stakeholders, and related to long-term performance and development goals.	2	24
2.	Utility of physical fitness test results within talent development	• Guiding physical development using objective data • Informing on-pitch training using fitness test results • Using fitness test results for benchmarking exercises	Results and data provided by physical fitness testing should directly inform a wide range of aspects of training, and assist stakeholders with making informed loading, development, and (de) selection decisions.	3	38
3.	Reflective experiences of multidisciplinary practice associated with physical fitness testing	• The need for ongoing education and communication between coaches • Awareness of test reliability and validity • Considerations for refinement or growth of the testing battery	Coaches should strive to work collaboratively acknowledging differences in perceptions and preferences related to dissemination and integration of fitness test results. Wider considerations relative to the selection of tests/a testing battery are evident.	3	52

> enjoyed themselves too much when they come back." (Technical Coach 2).

Similarly, physical performance coaches referenced using physical fitness testing data to make judgement on how much they felt players had performed during a training period or block: "You can get a sense of how well or how poorly they have done, or however good or bad their physical profile is for each player or each squad as a whole." (Physical Performance Coach 1).

Theme 2: Utility of physical fitness test results within talent development

The second theme generated from the interviews with technical and physical performance coaches related to areas of talent development that could be informed by physical fitness testing data. Three codes comprising 38 extracts (Technical Coaches: $n = 22$; Physical Performance Coaches: $n = 16$) were combined for this theme.

Guiding physical development using objective data. Coaches were complimentary about the use of physical fitness test data to provide structure and precision during training prescription with academy players:

> "Also, using [fitness test data] to individualise training programmes for each player who may have a particular weakness in one of the physical profiling pillars such as explosive and braking strength. This would allow us to incorporate exercises which target that area of performance." (Physical Performance Coach 3).

The influence of physical fitness testing to impact talent development was also recognised: "I think the testing over the season probably has a big influence for the programming of the players and squads…" (Physical Performance Coach 2), alongside referring to test data when evaluating the effectiveness of training approaches: "Probably to gauge how well the programme is working. That they are doing the strength and conditioning programmes and whether the interventions we are doing in the gym and on the pitch are working" (Physical Performance Coach 1).

A reported benefit of the objective data derived from the physical fitness testing was to allow coaches to gain insight on the maturity status of players. Technical coaches repeatedly referenced considering these data when making judgements and decisions:

> "Yeah, I think that's why their testing results shouldn't be taken in isolation, they should be taken in conjunction with the maturation numbers. So, we know that if a player isn't fully mature, we might not get testing results out of him the same as if he was at 100% maturation." (Technical Coach 1).

> "Especially with my age group as you can see with their growth, they become a bit like Bambi on ice – they lose

> their co-ordination. So, I think we need to take this into consideration, we have started to do this, and started to manage the players' load as well, which has been beneficial." (Technical Coach 3).

The importance of monitoring maturity status was also identified by physical performance staff: "[Maturity data] would affect our on-feet conditioning with the squads as we don't want to overload a player who is going through this stage" (Physical Performance Coach 2). Physical performance coaches also recognised the value of maturity data to technical coaches: "For those circa- peak-growth we can feed this back to the coaches in our reports with a 'red flag' to make them aware of someone who is going through [peak growth] and potentially more susceptible to a growth-related injury." (Physical Performance Coach 3).

Informing on-pitch training using fitness test results. While instances of gym-based and isolated physical training were referenced during discussions, the use of physical fitness testing data to inform on-pitch training was referenced. One physical performance coach highlighted the collaborative nature between the physical performance and technical coaches in developing appropriate pitch-based training guided by physical fitness test results:

> They [coaches] are the ones that control 90% of the physical work that players do. So, it's an opportunity for them to work on the weaknesses they might see but also those identified from the profiling through the drills they do on the pitch and in that sense its quite collaborative." (Physical Performance Coach 1).

Technical coaches also highlighted the "guiding" nature of the information that they receive, suggesting that they merge objective data with their own subjective judgement: "We use [physical fitness test data] as a guide more than anything and it's a framework from which to work from." (Technical Coach 1). However, technical coaches also raised concerns around a potential disconnect between testing performance and on-pitch evaluations:

> "So, for example, a player might test very well at certain things in the gym, but he doesn't transfer that onto the pitch and that's something that we have to look at… They have to be able to take it onto the football pitch." (Technical Coach 2).

> "Because we see players on the pitch that in a game, you know, run up and down, up and down, but then don't give a great testing score… usually our eyes tell us on the pitch what a player can do and what a player can't do." (Technical Coach 1).

Using fitness test results for benchmarking exercises. All participants, across both groups, identified the benefits of 'benchmarking' using physical fitness test results, comparing data both within a team and to previous cohorts. This evaluation allowed physical performance coaches to make a more representative judgement on physical fitness test performance:

> "… we have benchmarks for each of the tests based off historic internal data, previous years of academy teams. So, we can benchmark a player on any testing day in comparison to what has come before them, and classify whether that is high, normal, or low for each test and each profile." (Physical Performance Coach 1).

> "… [previously collected data] allows us to potentially see the progression throughout the years and tells us whether a player is [physically] performing well within their age group or not." (Physical Performance Coach 3).

This exercise was also valued by coaches who reported a particular interest in establishing both position-specific normative values: "if we know what [former successful academy players] are doing from the full back position, from centre back position, from attacking midfielders' position, we can then benchmark outwith the academy scores" (Technical Coach 3), along with drawing connections between values achieved by current first-team and senior academy players: "Can we see what the first-team standard is and where the academy is, where they need to get to?" (Technical Coach 2).

Theme 3: Reflective experiences of multidisciplinary practice associated with physical fitness testing

The final theme generated from the interviews with technical and physical performance coaches identified priorities and perceptions related to the effectiveness of physical fitness testing within the academy. A total of three codes comprising 52 extracts (Technical Coaches: $n = 28$; Physical Performance Coaches: $n = 24$) were brought together for this theme.

The need for ongoing education and effective communication between coaches. Both coach groups highlighted the importance of collaborative working between disciplines to ensure a cohesive approach to talent development. Technical coaches, specifically, sought clarity on the purpose and application of the physical fitness tests being implemented: "Do we understand enough about the tests that we do, why we do those tests?" (Technical Coach 1). This was followed by coaches declaring the need to understand translation to soccer-specific performance: "I think it would be useful to have more clarification on how the tests

relate to on-pitch for us as coaches to have a better understanding of why we are doing these tests and what it means." (Technical Coach 2). This was culminated by technical coaches querying their ability to take action upon receiving fitness testing data:

> "…we get the testing results, but then what do we do if those testing results aren't as good as what we want them to be? What can we do to make that player better, and what can that player be doing on a daily basis in the gym to make him better than to improve the testing score? So really, we're just given a test result, but then not doing enough about it. I think we could do more." (Technical Coach 1).

In addition to understanding the purpose and translation of the testing battery, technical coaches raised a desire for clear, simplistic, and timely communication of physical fitness test results:

> "Making it as simple to understand as possible, so it's as easy to use as possible and with more clarity on it… I think a lot of the time, a lot of sports science data we get is too much and not clear enough with enough clarity for us just to pick up, look, see what they get and then put down" (Technical Coach 2).

This was expanded upon, identifying a need for more improved data visualisation more suitable to a lay audience: "Can we present it in a way that is going to be easy to read for somebody that isn't a sport scientist?" (Technical Coach 1); "I agree with what [Technical Coach 1] is saying about layman's terms, simplifying it." (Technical Coach 3). Finally, one technical coach stressed the need for timely communication of results: "…we don't seem to get [the data] straight away, and I don't think the sports science department know that we want that data, and we want it straight away…" (Technical Coach 1).

Comparatively, physical performance coaches claimed to recognise the importance of effective communication of physical fitness test results with technical coaches:

> "…but they also have to be able to explain it and justify it to the parents. You know, they have to talk it through to them. We have to facilitate that for them by making sure [the data] is clear, easy to read, and easy to explain." (Physical Performance Coach 1).

Challenges in translating these data were, however, raised by the physical performance staff: "…we could have longer, more in-depth one-to-one chats with coaches to talk through the reports and go through individuals within their squads, but where do you find the time?" (Physical Performance Coach 2); "…certainly at the academy level, there probably hasn't been as much face-to-face contact in terms of speaking to [technical coaches] about the testing." (Physical Performance Coach 1). This was followed up by a comment perceiving a potential barrier from technical coaches around the physical fitness test data:

> "I think one of the pitfalls though is that the coaches just want to sort of corroborate what they already think about a player. They just want to see that there is data that's convenient to what their narrative about a player is." (Physical Performance Coach 3).

This was corroborated by a second physical performance coach who raised similar concerns about the translation of the physical fitness testing results: "as [Physical Performance Coach 3] said, when it confirms their narrative… you get coaches questioning why their physical profiling isn't very good but what they are seeing about them on pitch is good." (Physical Performance Coach 2).

Awareness of test reliability and validity. Technical and physical performance coaches acknowledged the importance of fitness tests being accurate and indicative, providing meaningful data. Physical performance coaches appeared confident with the integrity of the selected testing battery: "There is legitimate scientific rationale to use these tests, so I think that is the main thing." (Physical Performance Coach 1). Similarly, reference to the utilisation of technology underpinned additional assurance on the accuracy of data retrieved from tests: "…we have an advancement of technology at the club. For example, we now have force decks, so we don't need three practitioners standing with measuring sticks for hops." (Physical Performance Coach 2). Physical performance coaches also identified a potential trade-off between comprehension and efficiency: "…we aim to be more pragmatic to allow us now to test the whole squad in 45 min and get good data." (Physical Performance Coach 1).

Technical coaches, on the other hand, raised caution related to potential learning effects perceived for some of the tests:

> "Then the next time that you do the [maximal running test], you are aware of the distances and the timings, you can take 10–15 s of it. So, I would judge the [maximal running test] maybe after two or three times of completing it." (Technical Coach 2).

Technical coaches also highlighted considerations around construct validity, relaying the necessity for test performance to translate to on-pitch observations:

> "There are factors within [the fitness testing] that may not present themselves on a Saturday… So, you use it as a guide – and I think it's a good guide – but it's not the be all and end all for me." (Technical Coach 1).

Considerations for refinement or growth of the testing battery. Lastly, coaches proposed potential ideas for improving the physical fitness testing process. Both groups presented the idea of more specific testing to better account for the varying inter-position demands of soccer: "Can we do different tests for different positions? So, more position-specific, like a centre back doing different tests to a striker or winger as there's probably different demands, physically… I think that's the next step." (Technical Coach 3). This suggestion was shared by the physical performance staff, identifying the varying demands between goalkeepers and outfield players: "…maybe look more into goalkeeper testing and profiling. I think in football, in general, from what I've seen and read there isn't an awful lot of it. [We are] certainly looking at on-pitch type assessments for goalkeepers' performance." (Physical Performance Coach 3). In addition to proposing position-specific approaches to fitness testing, physical performance coaches also offered the idea of more individualised feedback to players following testing: "I think maybe going more individualised as they move into the older age groups… for example, prescribing individualised runs based off their [maximal running test]" (Physical Performance Coach 1).

Physical performance coaches, specifically, caveated these suggestions with a degree of conservation. These coaches reiterated time-demands they currently faced: "I think with any testing protocol, the academy is no different, you've got to be pragmatic and realise what you can logistically do and what is feasible time wise." (Physical Performance Coach 1). They also reflected on previous experiences and refinement of the current testing battery to articulate their hesitation:

> "You know, if you were reviewing it or casting a critical eye over our testing protocol, you could say well you're not measuring this directly or you're not doing that. But that is a deliberate move away from that for the reasons I've mentioned earlier [pragmatism and feasibility]." (Physical Performance Coach 1).

> "Previously, we had to do the testing over two-weeks because the protocol couldn't be fit into one session, you needed two hours to complete it. It was accepted and it was fine, but it wasn't particularly popular with the coaches because it was more time away from football." (Physical Performance Coach 2).

Discussion

This study aimed to investigate technical, and physical performance coach perceptions of effective utilisation of physical fitness testing as part of a talent development process within a professional soccer academy. The analyses provided a working framework identifying three themes central to the effective utilisation of physical fitness testing processes including: (i) Intentions and rationale behind physical fitness testing provision; (ii) Utility of physical fitness test results within talent development; and (iii) Reflective experiences of multidisciplinary practice associated with physical fitness testing. While technical and physical performance coaches were aligned with their perspectives related to these central concepts, role- and discipline-specific context was apparent.

The first emergent theme 'Intentions and rationale behind physical fitness testing provision' reiterated the necessity of establishing clear reasoning for incorporating this activity within talent development environments in soccer. Technical coaches within our study stressed the importance of physicality within their academy soccer players as they aimed to progress them through chronological age groups and towards the first team. While evaluations of multidimensional characteristics in soccer consistently place other multidimensional qualities (i.e., technical and psychological) in higher regard to physical traits,[34–36] there is recognition of the high physical standard required within professional soccer.[37] Failure to appropriately prepare soccer players for the physical demands of professional soccer can result in reduced performance or injury.[11] Scientific reports also acknowledge the increasing physical demands of training and competition in soccer.[38,39] This culmination has resulted in physical development and preparation receiving consistent allocation of time and resource within soccer talent development programmes.[40] Our findings provide support for the notion that the monitoring and evaluation of physical qualities through systematic testing processes is valued within the wider objectives and intentions of a professional soccer academy.

Also aligned to this theme was the finding that coaches used physical fitness testing as a marker of application or effort of young soccer players within the academy. This provides evidence of deeper evaluation, yielding additional information and a broader insight into players during this process.[41] Historically, physical fitness testing has received scrutiny as a monodisciplinary and potentially disconnected evaluation, typically performed in isolation away from soccer performance.[20,42] Comments recorded during our focus groups, particularly from technical coaches, combat this long withstanding critique, suggesting that some tests may allow a more comprehensive assessment of players than originally considered. Finally, coaches interpreted physical fitness testing information as part of a wider, multidimensional assessment of players as part of their player "profile". This multidimensional evaluation of players is widely endorsed within talent development literature, considering the various possible successful archetypes prevalent in team sport athletes.[2,43]

The second theme 'Utility of physical fitness test results within talent development' provided evidence of the

integration of objective data derived from testing into training prescription within the soccer academy. A systematic and evidence-based approach to talent development is widely endorsed, yet not consistently executed within soccer.[20,44,45] Furthermore, a siloed approach to working within professional sport has been reported, potentially limiting the integration of sub-disciplines within broader talent development approaches.[21] Participants within our study claimed to consult physical fitness test data during the design of both on-pitch and gym-based training, and when evaluating the effectiveness of programmes and interventions. Given the inclusion of fitness testing within the typical duties of physical performance coaches, the consideration of these data is common within isolated gym- or pitch-based physical development conducted by these staff.[9] However, the observation that technical coaches also referenced these data when designing and prescribing training was positive and demonstrated a unified and multidisciplinary approach to talent development at the academy.[46]

Both coach groups referenced the consideration of growth and maturity data when planning training and conducting evaluations on academy players. The impact that growth and maturation can have on acute player performance, inter-individual development trajectories, and risk of overtraining and injury is well-established.[43,47] Therefore, it is commendable but not unsurprising that coaches refer to this data within a professional soccer academy environment. Technical coach comments suggest a detailed understanding of the growth and maturation process with specific reference to expectations and ensuring a more balanced assessment of players during this phase. This is positive, as early maturing players are typically over-represented in academy soccer and are perceived as higher-performing compared to their less-mature peers.[48,49] Physical performance coaches equally reported utilising growth and maturity data throughout the talent development process; however, used these data to inform decisions regarding prescribing and monitoring player load. This slightly disparate use of growth and maturity data aligns to the respective roles of these coaches within the wider multidisciplinary team,[10,13] and should be recognised. Nevertheless, the integration of these data derived from physical fitness testing demonstrate effective consideration of growth and maturation within the holistic talent development environment within our study.

The last code related to this theme was the prevalence of benchmarking exercises utilising physical fitness test data. An ability to compare and reference testing scores to historical data is desirable within talent development systems.[50] Coaches within our study suggested that comparative data allowed more representative evaluations of players to be made, acknowledging discrepancies between playing positions, age group norms, and successful first-team graduates, rather than being limited to data from one individual or a single testing session. By attempting to conduct a comprehensive evaluation of players, utilising objective data, coaches in our study appear to adopt a longitudinal outlook to talent development, an approach encouraged by published literature.[51,52] Coaches also reported that comparative data was used to inform performance thresholds, establishing "high, normal, or low" scores for tests. An evidence-based approach to talent development is encouraged by contemporary literature.[45] Yet, emerging reports warn against an over-reliance on data and recommend combining both objective and subjective to inform player development.[53,54] While gaining a more extensive understanding of players' performance and areas for development is good practice, the talent development pathway is a unique and inimitable process which is influenced by a multitude of internal and external factors. Coaches should be reminded of the various possible successful archetypes in soccer,[2,43,55] and apply caution when relying upon comparative data when making player judgements or decisions.

The final theme 'Reflective experiences of multidisciplinary practice associated with physical fitness testing' provided an evaluative overview of the strengths and challenges of incorporating physical fitness testing within a talent development environment in soccer. Coach responses during focus groups stressed the importance of collaboration when coordinating multidisciplinary offerings within a soccer academy.[7,8] Within this, considerations such as continued education, ongoing communication, and implementation challenges were raised. Recognising the inter-disciplinary differences evident between technical and supplementary support coaches,[9,10] consistent effort may need to be given to ensure effective working of multidisciplinary teams. Aligned to our observations, technical coaches have previously demonstrated preference for technical, tactical, and psychological attributes ahead of physiological.[56] Conversely, supplementary support staff – such as physical performance coaches – have indicated substantial perceived value in their contributions to the talent development process.[57] Our findings identified a slight disconnect between the two groups of coaches. Technical coaches reported a desire for greater simplicity and translation from the fitness testing process, whereas physical performance coaches were sceptical whether the data were simply being used to "confirm a narrative". To combat this, future research may consider exploring co-creation methods within supplementary talent development provision in soccer. This approach has been previously implemented within youth sport contexts involving multiple stakeholders and may provide an opportunity for effective collaboration when attempting to facilitate structural change following identification of misalignment of services with shared stakeholder responsibility.[58]

Ensuring that assessments are valid and reliable is fundamental to their inclusion within talent development environments.[19,59] Physical performance coaches within our study

provided a robust rationale for the fitness testing battery used within the academy, referencing a long-term, iterative, process, and utilising technology to ensure the accuracy of the data. A recent surge in the selection of available technology within performance soccer has led to a more objective approach to testing and monitoring.[15,60] Despite this, challenging the inclusion and necessity of assessments has been advocated by coaches and practitioners, suggesting that an overreliance on data and processes has emerged within professional sport environments.[15] Physical performance coaches within our study demonstrated an appreciation for this, advocating a need to operate within constrained environments and provide meaningful, objective data on select performance metrics. Technical coaches, on the other hand, addressed this line of questioning by highlighting potentially prevalent learning effects and challenging the construct validity of the physical fitness test battery. Potential confounding variables – such as learning effects – should be considered and mitigated to the best of their ability during any performance assessment.[61] This is often combatted with appropriate familiarisation, repeated employment of a testing protocol, and robust assessment methods.[61,62] Technical coaches also queried the ability of physical fitness testing to translate to on-pitch observations due to competitive match play eliciting "factors that may not present themselves" within the isolated fitness tests. Striving to accurately reflect the demands of competition should be a primary objective of a performance test.[63] However, the open and dynamic nature of soccer competition may result in challenges between construct validity and test accuracy.[20] Stakeholders should strive to work collaboratively to communicate these challenges and temper expectations of supplementary sport science support in soccer.

Finally, coaches presented the idea of ongoing refinement of the fitness testing battery used within the soccer academy. This included ideas related to making the testing battery more specific to different playing positions, but also justification for the current testing arrangements, reflecting on decisions made historically to improve the efficiency of the process. Focus group responses related to this code were somewhat conflictual, providing developmental suggestions but then critiquing their feasibility due to the aforementioned constraints. Varied inter-position demands,[64] and the distinct and individual requirements of the goalkeeper,[65,66] are widely recognised when conducting a needs analysis for soccer players. Accordingly, it is logical that these differences would be considered during physical fitness testing, as raised by coaches within our study. There was, however, acknowledgement that this would exacerbate considerations around efficiency, a recurrent theme when reflecting on positive elements of the evolution of the current testing battery.

As with any investigation, this study is not without its limitations. One limitation of the present study relates to sample size; with only six participants recruited in total (three technical coaches, three physical performance coaches). From a methodological perspective, this may limit the richness of data and skew the thematic analyses upon the perspectives of these individuals, explicitly.[27,30] However, we pose that our sample possess adequate information power to provide rich insight into the research question, despite lower participant numbers.[67] Our sample size is also aligned to comparable studies and carries applied merit, representing a typical multidisciplinary team within academy soccer when adopting a single-club approach.[3,9,12] A further limitation is the translation of our data to other talent development environments within soccer. We recruited male coaches from two stakeholder positions within a single Scottish male soccer academy. It is well established that clubs may develop their own philosophy regarding player development and the inner workings of their multidisciplinary teams, and that discrepancies exist between different contexts and within the viewpoints of different stakeholders.[57] While our findings may provide a useful framework for multidisciplinary teams working in soccer talent development, we urge coaches and practitioners to consider the intricacies and processes of their own strategies and environment when interpreting the findings from this study.

Conclusion

In summary, this study identified three themes pertinent to stakeholder perspectives of physical fitness testing provision within a professional soccer academy. These findings reiterate the necessity of establishing clear reasoning behind including this resource within the academy offering, provided evidence of the integration of objective data derived from testing into training prescription and monitoring, and identified strengths and challenges of incorporating physical fitness testing within a talent development environment in soccer. Collectively, results from this study may help rationalise physical fitness testing as part of academy player development in soccer and act as a foundation to encourage similar reflective and evaluative processes in comparable talent development environments.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

ORCID iDs

James H Dugdale https://orcid.org/0000-0001-8101-6490
Alban CS Dickson https://orcid.org/0000-0002-4425-0349

References

1. Williams AM and Reilly T. Talent identification and development in soccer. *J Sports Sci* 2000; 18: 657–667.
2. Towlson C, Cope E, Perry JL, et al. Practitioners' multidisciplinary perspectives of soccer talent according to phase of development and playing position. *Int J Sports Sci Coach* 2019; 14: 528–540.
3. McGuigan M, Dello Iacono A, McRobert A, et al. Facilitators and barriers associated with youth player transition to professional first-team football: a key stakeholder perspective. *Int J Sports Sci Coach* 2023; 19: 988–998.
4. Swainston SC, Wilson MR and Jones MI. "It's all about opportunity": from professional contract to first-team regular. *J Appl Sport Psychol* 2022; 34: 1251–1271.
5. Mills A, Butt J, Maynard I, et al. Toward an understanding of optimal development environments within elite English soccer academies. *Sport Psychologist* 2014; 28: 137–150.
6. Gesbert V, von Roten FC and Hauw D. Reviewing the role of the environment in the talent development of a professional soccer club. *PLoS One* 16. Epub ahead of print 1 February 2021. DOI: 10.1371/journal.pone.0246823
7. Pankhurst A, Collins D and Macnamara Á. Talent development: linking the stakeholders to the process. *J Sports Sci* 2013; 31: 370–380.
8. Reid C, Stewart E and Thorne G. Multidisciplinary sport science teams in elite sport: comprehensive servicing or conflict and confusion? *Sport Psychol* 2004; 18: 204–217.
9. Burns A, Collins D and Nolte L. Coaches' experiences of performance support teams. *Int J Sports Sci Coach* 2024; 19: 965–977.
10. Silva JR, Buchheit M, Hader K, et al. Building bridges instead of putting up walls: connecting the "teams" to improve soccer Players' support. *Sports Med* 2023; 53: 2309–2320.
11. Buhain ENE, Ver Papa EL, Valleser CWM, et al. Perspectives of medical staff on the quality of communication with the head coach on injury management. *Adv Health Exercise* 2022; 2: 45–51.
12. Tee J and Rongen F. 'How' a multidisciplinary team worked effectively to reduce injury in a professional sport environment. *SportRχiv* 2020: 1–28.
13. Secomb JL. Interdisciplinary sport science in individual sports – A framework for implementation. *Strength Cond J* 2023; 46: 82–89.
14. Salcinovic B, Drew M, Dijkstra P, et al. Factors influencing team performance: What can support teams in high-performance sport learn from other industries? A systematic scoping review. *Sports Med Open* 8. Epub ahead of print 1 December 2022. DOI: 10.1186/s40798-021-00406-7
15. Drust B. Applied science and soccer: a personal perspective on the past, present and future of a discipline. *Sport Performance & Science Reports* 2019; 56: 1–7.
16. Brink MS, Kuyvenhoven JP, Toering T, et al. What do football coaches want from sport science? *Kinesiology* 2018; 50: 150–154.
17. Ford PR, Bordonau JLD, Bonanno D, et al. A survey of talent identification and development processes in the youth academies of professional soccer clubs from around the world. *J Sports Sci* 2020; 38: 1269–1278.
18. Asimakidis ND, Bishop CJ, Beato M, et al. A survey into the current fitness testing practices of elite male soccer practitioners: from assessment to communicating results. *Front Physiol* 15. Epub ahead of print 2024. DOI: 10.3389/fphys.2024.1376047
19. Dugdale JH, Arthur CA, Sanders D, et al. Reliability and validity of field-based fitness tests in youth soccer players. *Eur J Sport Sci* 2019; 19: 745–756.
20. Bergkamp TLG, Niessen ASM, den Hartigh RJR, et al. Methodological issues in soccer talent identification research. *Sports Med* 2019; 49: 1317–1335.
21. Marques J and Chamari K. Performance management in elite football: a teamwork modelling approach. *Int J Sports Physiol Perform* 2023; 18: 1371–1373.
22. Martindale RJ, Collins D and Daubney J. Talent development: a guide for practice and research within sport. *Quest* 2005; 57: 353–375.
23. Cruickshank A and Collins D. Illuminating and applying "the dark Side": insights from elite team leaders. *J Appl Sport Psychol* 2015; 27: 249–267.
24. English C, Nash C and Martindale R. The effects of structural change: an investigation into the South African cricket development pathway. *Int J Sport Policy Politics* 2018; 10: 371–391.
25. Creswell JW and Creswell JD. *Research design: Qualitative, quantitative, and mixed methods approaches. Sixth Edition*. Washington DC: Sage, 2022.
26. Giacobbi PR, Poczwardowski A and Hager P. A pragmatic research philosophy for sport and exercise psychology. *Sport Psychol* 2005; 19: 18–31.
27. Patton MQ. *Qualitative research & evaluation methods*. Fourth. London, UK: Sage Publications, 2014.
28. Scottish Football Association. *Club Academy Scotland*. 2015.
29. Grønkjær M, Curtis T, De Crespigny C, et al. Analysing group interaction in focus group research: impact on content and the role of the moderator. *Qualitative Studies* 2011; 2: 16–30.
30. Krueger RA and Casey MA. *Focus groups*. Fifth. London, UK: Sage Publications, 2014.
31. Motulsky SL. Is member checking the gold standard of quality in qualitative research? *Qualitative Psychology* 2021; 8: 389–406.
32. Gale NK, Heath G, Cameron E, et al. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol* 13. Epub ahead of print 2013. DOI: 10.1186/1471-2288-13-117
33. Sandelowski M. Whatever happened to qualitative description? *Res Nurs Health* 2000; 23: 334–340.
34. Bergkamp TLG, Frencken WGP, Niessen ASM, et al. How soccer scouts identify talented players. *Eur J Sport Sci* 2021; 22: 994–1004.
35. Koopmann T, Faber I, Baker J, et al. Assessing technical skills in talented youth athletes: a systematic review. *Sports Med* 2020; 50: 1593–1611.
36. Höner O and Feichtinger P. Psychological talent predictors in early adolescence and their empirical relationship with current and future performance in soccer. *Psychol Sport Exerc* 2016; 25: 17–26.
37. Dolci F, Hart NH, Kilding AE, et al. Physical and energetic demand of soccer: a brief review. *Strength Cond J* 2020; 42: 70–77.

38. Allen T, Taberner M, Zhilkin M, et al. Running more than before? The evolution of running load demands in the English premier league. *Int J Sports Sci Coach* 2024; 19: 779–787.
39. Barnes C, Archer DT, Hogg B, et al. The evolution of physical and technical performance parameters in the English premier league. *Int J Sports Med* 2014; 35: 1095–1100.
40. Doncaster G, O'Gorman J, Partington M, et al. Negotiating periodised training programmes in youth soccer development: a social process. *J Sports Sci* 2024; 42: 434–441.
41. Pyne DB, Spencer M and Mujika I. Improving the value of fitness testing for football. *Int J Sports Physiol Perform* 2014; 9: 511–514.
42. Unnithan V, White J, Georgiou A, et al. Talent identification in youth soccer. *J Sports Sci* 2012; 30: 1719–1726.
43. Hill M, John T, McGee D, et al. Beyond the coaches eye: understanding the 'how' and 'why' of maturity selection biases in male academy soccer. *Int J Sports Sci Coach* 2023; 18: 1913–1928.
44. Till K and Baker J. Challenges and [Possible] Solutions to Optimizing Talent Identification and Development in Sport. *Front Psychol* 11. Epub ahead of print 15 April 2020. DOI: 10.3389/fpsyg.2020.00664
45. Williams AM, Ford PR and Drust B. Talent identification and development in soccer since the millennium. *J Sports Sci* 2020; 38: 1199–1210.
46. Raya-Castellano PE and Uriondo LF. A review of the multidisciplinary approach to develop elite players at professional football academies: applying science to a professional context. *Int J Perform Anal Sport* 2015; 15: 1–19.
47. Malina RM, Rogol AD, Cumming SP, et al. Biological maturation of youth athletes: assessment and implications. *Br J Sports Med* 2015; 49: 852–859.
48. Johnson A, Farooq A and Whiteley R. Skeletal maturation status is more strongly associated with academy selection than birth quarter. *Science and Medicine in Football* 2017; 1: 157–163.
49. Hill M, Scott S, Malina RM, et al. Relative age and maturation selection biases in academy football. *J Sports Sci* 2020; 38: 1359–1367.
50. Dodd KD and Newans TJ. Talent identification for soccer: physiological aspects. *J Sci Med Sport* 2018; 21: 1073–1078.
51. Dugdale JH, Sanders D, Myers T, et al. Progression from youth to professional soccer: a longitudinal study of successful and unsuccessful academy graduates. *Scand J Med Sci Sports* 2021; 31: 73–84.
52. Leyhr D, Kelava A, Raabe J, et al. Longitudinal motor performance development in early adolescence and its relationship to adult success: An 8-year prospective study of highly talented soccer players. *PLoS One* 13. Epub ahead of print 1 May 2018. DOI: 10.1371/journal.pone.0196324
53. Sieghartsleitner R, Zuber C, Zibung M, et al. Science or Coaches' eye? - both! beneficial collaboration of multidimensional measurements and coach assessments for efficient talent selection in elite youth football. *J Sports Sci Med* 2019; 18: 32–43.
54. Jokuschies N, Gut V and Conzelmann A. Systematizing coaches' 'eye for talent': player assessments based on expert coaches' subjective talent criteria in top-level youth soccer. *Int J Sports Sci Coach* 2017; 12: 565–576.
55. McGuigan M, Dello Iacono A, McRobert A, et al. Early player transition in elite youth and first team soccer: The predictive role of sprint distance and high-intensity acceleration and deceleration attributes. *Int J Sports Sci Coach*. Epub ahead of print 1 April 2024. DOI: 10.1177/17479541241303707
56. Larkin P and O'Connor D. Talent identification and recruitment in youth soccer: Recruiter's perceptions of the key attributes for player recruitment. *PLoS One* 12. Epub ahead of print 1 April 2017. DOI: 10.1371/journal.pone.0175716
57. Bartlett JD and Drust B. A framework for effective knowledge translation and performance delivery of sport scientists in professional sport. *Eur J Sport Sci* 2020; 21: 1579–1587.
58. Horne E, Lower-Hoppe L and Green BC. Co-creation in youth sport development: examining (mis)alignment between coaches and parents. *Sport Manag Rev* 2023; 26: 271–292.
59. Paul DJ and Nassis GP. Physical fitness testing in youth soccer: issues and considerations regarding reliability, validity and sensitivity. *Pediatr Exerc Sci* 2015; 27: 301–313.
60. Rein R and Memmert D. Big data and tactical analysis in elite soccer: future challenges and opportunities for sports science. *Springerplus* 5. Epub ahead of print 1 December 2016. DOI: 10.1186/s40064-016-3108-2
61. Atkinson G and Nevill AM. Statistical methods for assessing measurement error (reliability) in variables relevant to sports medicine. *Sports Med* 1998; 26: 217–238.
62. McMahon JJ, Jones PA and Comfort P. *Performance assessment in strength and conditioning*. London, UK: Taylor & Francis, 2018.
63. Atkinson G. Sport performance: variable or construct? *J Sports Sci* 2002; 20: 291–292.
64. Abbott W, Brickley G and Smeeton NJ. Physical demands of playing position within English premier league academy soccer. *Journal of Human Sport and Exercise* 2018; 13: 285–295.
65. Lethole L, Kubayi A, Toriola A, et al. 'Goalkeepers are players too': key attributes coaches' look for in talented youth soccer goalkeepers. *BMC Sports Sci Med Rehabil* 16. Epub ahead of print 1 December 2024. DOI: 10.1186/s13102-024-01002-4
66. Otte F, Dittmer T and West J. Goalkeeping in modern football: current positional demands and research insights. *Int Sport Coach J* 2023; 10: 112–120.
67. Malterud K, Siersma VD and Guassora AD. Sample size in qualitative interview studies. *Qual Health Res* 2016; 26: 1753–1760.