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EDITED BY
Jermaine Jones,
Columbia University, United States

REVIEWED BY
Dinah Katindi Nyamai,
University of Nairobi, Kenya
Melissa Pearman Fenton,
Colorado State University, United States

*CORRESPONDENCE
Danilo Falzon
✉ d.c.falzon@stir.ac.uk

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Developing an outcomes framework for greenspace programmes supporting individuals experiencing problem substance use: a scoping review and analytical synthesis

Danilo Falzon[1]*, Wendy Masterton[1], Hannah Carver[1], Edward Duncan[2], Kirsty Park[3], Sandra Engstrom[4], Rebecca Lovell[5], Morgan Torrance[1], Josh Dumbrell[1], Trish Gorley[6] and Tessa Parkes[1]

[1]Salvation Army Center for Addiction Services and Research, University of Stirling, Stirling, United Kingdom, [2]Centre for Healthcare and Community Research, University of Stirling, Stirling, United Kingdom, [3]Biological and Environmental Sciences, University of Stirling, Stirling, United Kingdom, [4]Social Work, University of Stirling, Stirling, United Kingdom, [5]European Center for Environment and Human Health, University of Exeter Medical School, Knowledge Spa, Royal Cornwall Hospital, Truro, United Kingdom, [6]Centre for Rural Health Sciences, Faculty of Science, Health and the Environment, University of the Highlands and Islands, Inverness, United Kingdom

Background: Greenspace programmes are known to support health and wellbeing, yet limited research exists on their impact for individuals experiencing problem substance use. Early findings are promising, but systematic exploration of appropriate outcome measures and evaluation methods remains sparse. This paper addresses that gap by developing an outcomes framework tailored to this population.

Methods: A mixed methods approach was used. A review of 311 papers evaluating greenspace interventions identified and grouped outcome measures into heuristic categories–based on overarching evaluative focus such as mood, general health or nature connection. In parallel, 33 interviews were conducted with programme participants, staff, and professionals in policy, commissioning, and referral roles. Findings from both sources were synthesized to generate an outcomes framework relevant to greenspace programmes supporting problem substance use.

Results: Evaluation methods in the literature include self-report scales, physiological measures, qualitative approaches, and observational or experimental designs. Commonly explored outcomes include: nature's impact on mood, affect, and attention; reductions in stress, anxiety, and depression; shifts in self-concept and identity; and enhanced social connection. Interview data echoed these themes, with participants describing improved health and wellbeing through multiple pathways. The resulting outcomes framework identifies 29 outcomes across three domains: nature-based, individual, and social.

Conclusions: This paper addresses a key knowledge gap in evaluating greenspace programmes for individuals with problem substance use. The evidence-informed outcomes framework offers a valuable resource for

practitioners, researchers, and policymakers seeking to assess and enhance the impact of such interventions.

KEYWORDS

evaluation framework, greenspace programmes, health and wellbeing, nature-based interventions, outcomes, problem substance use, scoping review, treatment and support

1 Introduction

Greenspace programmes are nature-based interventions designed to enhance health and wellbeing (1). Common examples include adventure or wilderness activities, conservation work, care farming, forest bathing, and horticulture therapy (2–5). Although interventions vary widely, evidence suggests they offer wide ranging benefits for physical and mental health. Numerous studies have examined their impact on physiological indicators such as parasympathetic nervous system activity, and endocrine system and immune system function, highlighting that greenspace programmes hold promise for reducing stress, improving mood and boosting overall health (3, 6–12). Evidence also supports psychosocial benefits, including improved self-esteem, self-efficacy, social skills, and better mental health (13–16). Research further highlights the benefits of connection to nature and it's potential to restore attention and mental clarity (17–25). These outcomes have been explored across diverse populations including individuals with various mental and physical health conditions (14, 26–39).

Beyond specific interventions, a broader literature supports the health benefits of exposure to nature across a range of outcomes (40–43). The extensive research linking greenspace to biopsychosocial health is reflected in the growing number of systematic reviews and meta-analyses on this subject (2, 6, 7, 12–16, 26, 27, 36, 40, 41, 43–53). Notable gaps remain, however, particularly concerning the potential for greenspace programmes to support individuals experiencing drug and alcohol problems (1, 30, 54), termed in this paper as 'problem substance use'. While initial evaluations with this population show promise (30, 55), there has been limited exploration of appropriate outcome measures and evaluation methods.

Uncertainty around evaluation presents challenges to building a robust evidence base for greenspace programmes supporting this population. Limited knowledge of feasible and acceptable outcome measures constrains understanding of what works, potentially weakening funding applications and policy traction (1). A clearer grasp of appropriate methods could help evaluations capture holistic impacts beyond substance use-related metrics alone. For example, exploring links between mental health, social connection, and self-concept can offer a deeper understanding of impact (56). While psychometric measures provide useful data, they may not fully reflect the relational and experiential dimensions of programmes, particularly for individuals with intersecting health and social care needs (57). Some participants may view such tools as overly clinical or intrusive, particularly if associated with prior involvement with social work or criminal justice (58). Overuse of psychometric outcome measures may discourage participation in programmes, thereby reducing input and disempowering individuals. It is therefore important to build knowledge around the range of potential outcomes, and the feasibility and acceptability of evaluation methods, for those experiencing substance use challenges. Neglecting these considerations risks privileging quick, quantifiable impacts over more nuanced dynamics that could be central to programme effectiveness (56, 58).

The current paper addresses this gap, reporting findings from a programme of work aimed at developing an evidence-based outcomes framework, and testing the feasibility and acceptability of evaluation methods, for greenspace programmes supporting those experiencing problem substance use. To do so, a two-phased approach was taken. First, a literature review of outcome measures and evaluation methods used in greenspace research was undertaken, complemented by interviews with diverse stakeholders to develop an initial outcomes framework. In the second phase, further qualitative interviews were conducted to assess the feasibility and acceptability of evaluation methods, and further test and refine the outcomes framework (see Figure 1). The current paper reports on the first phase of this process; further details are provided in the Materials and Methods section. A future paper will report on the findings from phase two.

2 Materials and methods

Ethical approval for this study was granted by the University of Stirling's NHS, Invasive, or Clinical Research Panel (NICR, paper 14134) and the Ethics Subgroup of the Research Coordinating Council of The Salvation Army. This paper reports on the first phase of the evaluation guidance development process, involving a literature review and qualitative stakeholder interviews. Each component of this phase is now described in detail below.

2.1 Literature review: process and methods

The literature review presented in this paper did not follow a traditional, systematic search protocol; instead, a purposive, iterative approach was used to identify and examine relevant studies. Given the abundance of systematic reviews on greenspace interventions, and the absence of reviews focused specifically on outcome measures and evaluation, primary studies were extracted from existing reviews. This enabled engagement with a heterogeneous evidence base, offering valuable insights across diverse study types (59). A scoping review methodology, and iterative approach to searching, was undertaken as the evidence base relating to greenspace programmes for people experiencing problem substance use is heterogeneous, encompasses diverse intervention types and outcome domains, and has not previously

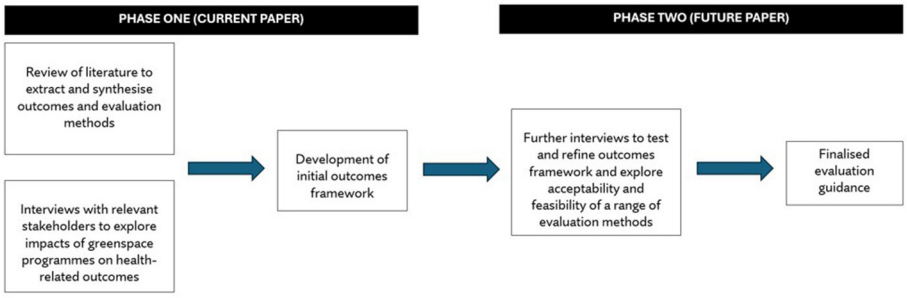


FIGURE 1
Development process for evaluation guidance across two related papers.

been comprehensively mapped. The aim was therefore to identify, characterize and synthesize the breadth of reported outcomes rather than to determine intervention effectiveness.

2.1.1 Identifying relevant studies and data extraction

The research team identified 23 existing literature reviews, primarily systematic reviews and meta-analyses (2, 6, 7, 12–16, 27, 30, 36, 44, 46–53, 56, 60, 61). Reviews were identified through a combination of searching relevant databases and Google Scholar. Papers included in the retrieved systematic reviews were then screened for relevance based on four criteria. First, papers had to evaluate the impact of a specific greenspace intervention, with "intervention" conceptualized as a structured "interference that modif[ies] a process or situation" (62). Therefore, only papers exploring an intentionally designed exposure to greenspace were considered. Second, papers focusing on children under 12 were excluded, as the framework is intended to support populations affected by substance use. Adolescents (aged over 12) were included due to the relevance of early experimentation amongst those aged 12–17, a common age for substance use initiation (63). Third, studies published before 2,000 were excluded to ensure contemporary relevance and manage review scope. Lastly, interventions centered on animal-assisted therapy in outdoor settings were excluded, as these typically place less emphasis on nature. Greenspace interventions for a range of populations, not only those experiencing problem substance use, were included for several reasons. Fewer papers focus specifically on this population, risking exclusion of relevant outcome measures from the broader evidence-base. Additionally, research suggests that outcomes observed in wider populations, such as improved health and connection to nature, also apply to individuals experiencing problem substance use (1, 56). However, for transparency, studies evaluating greenspace programmes for substance use populations were also analyzed separately, as detailed in the results section.

A systematic approach to appraising methodological quality was not adopted, given the focus on identifying the types of outcomes and evaluation methods as part of a broader framework development process. As the emphasis was not on assessing intervention effectiveness, formal quality appraisal was considered less critical (59, 64). This approach aligns with Arksey and O'Malley's (59) and Pham et al.'s (64) guidance on conducting scoping-type reviews, which emphasize breadth and conceptual mapping over formal quality assessment. Unlike systematic reviews, which often aim to assess strength of evidence, scoping reviews prioritize exploration and mapping of diverse evidence types, an approach well suited to this study's aims.

Once sources were identified for inclusion, outcomes measures from each paper were extracted. As detailed in the results section, outcomes were coded into broad heuristic categories. These, combined with insights from the qualitative interviews, informed the development of the outcomes framework.

2.2 Qualitative interviews: recruitment, coding and analysis

Thirty-three semi-structured interviews were conducted with stakeholders across Scotland, including staff on greenspace programmes; individuals with experience of problem substance use who had participated in programmes; and wider professionals in commissioning, policy, or referral roles (see Table 1 for participant demographics).

Greenspace programme and staff participants were drawn from two organizations that supported the wider research project. The first programme is a wilderness/adventure-based intervention delivered across several regions of Scotland. It involves residential stays and/or camping and typically lasts 5–10 days. The second is a conservation-focused programme based in Northern Scotland, in which individuals attend a half–day session each week for 12 weeks. After completing the initial programme, participants are invited to join monthly nature–based meet–ups organized by the service.

Participants were recruited through two routes. First, programme staff introduced the research to individuals, asked whether they were interested in taking part, and sought permission for a member of the research team to contact them. Second, a researcher attended several programme sessions to participate in activities and recruit participants directly. Further detail on recruitment procedures, participant characteristics, and informed consent is provided in a previous paper drawing on the same dataset (55).

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TABLE 1 Summary of participant demographics.

Participant group	Age	Gender	Health Board	Ethnicity
Greenspace programme participant	18–29: $n = 4$	Male $n = 9$	Grampian $n = 6$	White Scottish/British $n = 15$
$n = 15$	30–39: $n = 3$	Female $n = 6$	Lothian $n = 5$	
	40–49: $n = 3$		Greater Glasgow and Clyde (GGC) $n = 2$	
	50–59: $n = 4$			
	60–69: $n = 1$		Lanarkshire $n = 1$	
			Forth Valley $n = 1$	
Greenspace staff	30–39: $n = 1$	Male $n = 7$	Grampian $n = 2$	White Scottish/British $n = 8$
$n = 8$	40–49: $n = 3$	Female $n = 1$	Lothian $n = 2$	
	50–59: $n = 3$		GGC $n = 2$	
	60–69: $n = 1$		Lanarkshire $n = 1$	
			Forth Valley $n = 1$	
Strategic decision–makers	30–39: $n = 1$	Male $n = 4$	Lothian $n = 4$	White Scottish/British $n = 7$
$n = 8$	40–49: $n = 3$	Female $n = 4$	Tayside $n = 1$	British Pakistani $n = 1$
	50–59: $n = 3$		GGC $n = 1$	
	60–69: $n = 1$		Forth Valley $n = 1$	
			Highlands $n = 1$	
External health professionals	18–29: $n = 1$	Male $n = 1$	Lothian $n = 1$	White Scottish/British $n = 1$
$n = 2$	40:49: $n = 1$	Female $n = 1$	Tayside $n = 1$	Mixed race $n = 1$
***n* = 33**	18–29: $n = 5$	Male $n = 21$	Lothian $n = 12$	White Scottish/British $n = 31$
	30–39: $n = 5$	Female $n = 12$	Grampian $n = 8$	British Pakistani $n = 1$
	40–49: $n = 10$		GGC $n = 5$	Mixed race $n = 1$
	50–59: $n = 10$		Forth Valley $n = 3$	
	60–69: $n = 3$		Tayside $n = 2$	
			Lanarkshire $n = 2$	
			Highlands $n = 1$	

During interviews, participants were asked to describe their experiences of greenspace programmes and any perceived impacts on wellbeing and health. Coding was undertaken inductively using thematic analysis (65), with a specific focus on perceived outcomes experienced from greenspace programmes and engagement with nature. During the coding process, initial codes were refined and grouped into larger themes according to over-arching areas related to wellbeing, health and personal development. Further detail on the recruitment and analysis process and methods can be found in Supplementary File 1, which presents a full Consolidated Criteria for Reporting Qualitative Research (COREQ) Checklist.

3 Results

The results section is structured as follows. First, outcomes measures from included papers are reported by method: self-report scales; physiological measures; qualitative methods; staff/research observation; and experimental approaches. Second, studies focused on greenspace programmes for individuals experiencing problem substance use are presented separately, reflecting the core focus of this paper. Third, findings from qualitative interviews conducted by the research team are outlined. The final section synthesizes the literature review and interview data, culminating in the development of the outcomes framework.

3.1 Literature review for all included papers

A total of 634 sources was identified across 23 literature reviews, with 502 unique papers after manual deduplication (see PRISMA diagram, Figure 2). Where the same primary study appeared across multiple reviews, it was counted once and retained as a single record. Of these, 474 were successfully retrieved and screened against the inclusion and exclusion criteria outlined above. Based on screening, 290 papers were included from existing systematic reviews. An additional 21 papers were identified through citation chaining and prior knowledge, resulting in 311 total papers. Throughout the screening process, selection bias was guarded against through careful application of the inclusion and exclusion criteria. Additionally, reasons for exclusion of papers were recorded and is detailed in the PRISMA diagram (see Figure 2). Table 2 provides an overview of papers identified from each source. A full list of included studies is available in Supplementary File 2.

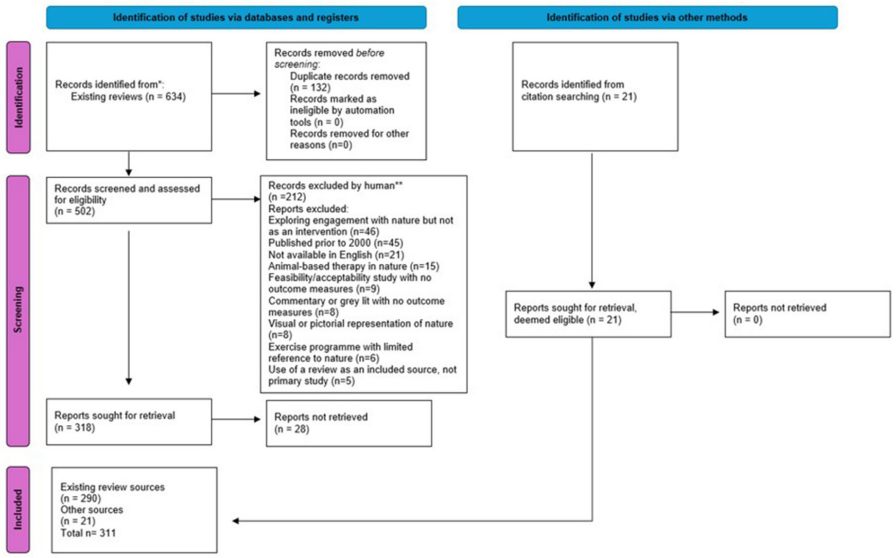


FIGURE 2
PRISMA flow diagram detailing search and inclusion process.

3.1.1 Characteristics of included studies

Of 311 included papers: 217 utilized self-report scales; 83 employed physiological measures; 75 used qualitative methods; 25 used observational assessment; 18 involved experimental tests; and 5 drew on administrative records. A total of 194 studies utilized only one methodological approach, most frequently self-report or qualitative methods. The remaining 117 papers adopted mixed methods, most commonly: physiological measures with self-report scales ($n = 59$), and self-report scales with qualitative methods ($n = 21$).

Terminology used to define the greenspace interventions varied, reflecting significant nuance in programme design (see Supplementary File 2). The most common were activities involving walking, sitting, or viewing nature ($n = 106$). Wilderness therapy and adventure-based activities were explored in 86 studies, and 47 focused on horticulture-based activities. Others included: mixed group-based activities in nature ($n = 25$); rehabilitation, wander, or healing gardens ($n = 21$); green care farms ($n = 12$); nature-based therapy ($n = 6$); green exercise programmes ($n = 4$); volunteering in nature ($n = 2$); outdoor education ($n = 1$); and park prescriptions ($n = 1$).

Participants represented a range of population groups. Ninety-eight studies involved general adult populations, where individuals with physical or mental health conditions were either excluded or this was not specified. Ninety studies focused on adults experiencing mental health and/or substance use challenges. Sixty studies involved young people, typically those experiencing mental health challenges, problem substance use, or considered at risk of negative health outcomes. Twenty-eight studies included adults with wide ranging physical health conditions. Other groups included individuals with dementia ($n = 19$); veterans ($n = 7$), typically with mental health or substance use challenges; older adults ($n = 6$); and adults with disabilities ($n = 3$).

3.1.2 Self-report/psychometric measures

Of the included studies, 217 used psychometric self–report scales. Scales from each paper were extracted and grouped into overarching categories based on shared outcome themes. Category development was iterative and involved several phases of coding. Initially, each scale was assigned a code reflecting the specific outcome(s) it was designed to measure. Coding then became progressively more analytical, as the research team organized these initial codes into broader categories according to their overarching focus (for example, mental health or general wellbeing). Categories were refined repeatedly through ongoing discussion and recoding. This process resulted in seven heuristic groupings: self-concept-based outcomes; general health, wellbeing, and quality of life; mood and current emotional wellbeing; specific mental health conditions; spirituality, mindfulness, and life meaning; connection to nature, restorativeness, and attentional functioning; and social outcomes (see Table 3). These categories are intended as heuristic tools to inform outcome framework development, rather than fixed classifications. Some scales could reasonably fit more than one category, and decisions were guided by dominant thematic focus. Due to the number of references associated with each category, a comprehensive list of studies and self-report scales grouped under each category is provided in Supplementary File 3.

3.1.3 Physiological measures

Eighty-three studies employed physiological measures. Sympathetic and parasympathetic nervous system activity was typically measured via blood pressure, heart rate/heart rate variability, or pulse rate. Immune system functioning was evaluated through markers of cytotoxic activity, while endocrine system responses were assessed through hormone levels such

TABLE 2 Included papers and source of identification*.

Sources included from Mygind et al. (52): (10, 11, 17, 18, 20, 23, 28, 35, 66–152).
Sources included from Corazon et al. (47): (11, 18, 20, 22, 87, 89, 105, 109, 145, 146, 153–177).
Sources included from Masterton et al. (61): (5, 31, 178–212).
Sources included from Wen et al. (12): (3, 8, 11, 28, 137, 153, 161, 167, 168, 177, 213–232).
Sources included from Djernis et al. (48): (21, 89, 102, 133, 141, 171, 175, 177, 185, 233–247).
Sources included from Antonelli et al. (7): (10, 24, 102, 105, 109, 110, 122, 123, 141, 144–146, 160, 162, 167, 168, 170, 177, 218, 236).
Sources included from Kotera et al. (15): (8, 9, 28, 89, 105, 113, 121, 133, 142, 168, 177, 213, 214, 225, 226, 245, 248–252).
Sources included from Annerstedt and Wahrborg (44): (19, 77, 93, 98, 143, 148, 253–265).
Sources included from Briggs et al. (13): (25, 37, 222, 223, 245, 266–278).
Sources identified from Murroni et al. (51): (33, 34, 253, 254, 279–287).
Sources identified from Murray et al. (36): (29, 187, 193, 194, 197–199, 207, 288–293).
Sources identified from Andersen et al. (6): (3, 89, 108–110, 161, 218, 224, 229, 294–296).
Sources identified from Lee et al. (16): (28, 35, 89, 105, 109, 110, 133, 137, 142, 160, 218, 297).
Sources identified from Cipriani et al. (46): (33, 34, 254, 255, 257, 269, 270, 283, 298–300).
Sources identified from Fang et al. (49): (90, 111, 114, 191, 301–308).
Sources identified from Diaz–Martinez et al. (30): (31, 309–317).
Sources identified from Fleischer et al. (60): (111, 127, 148, 183, 318–320).
Sources identified from Grassini (14): (22, 226, 243, 321–324).
Sources identified from Gorman and Cacciatore (2): (187, 194, 197–199, 290).
Sources identified from Fernee et al. (56): (181, 184, 206, 262, 325).
Sources identified from Picton et al. (53): (183, 195, 196, 326–330).
Sources identified from Beck and Wong (27): (311, 331–333).
Sources identified from Houlden et al. (50): (334–337).
Sources identified from other methods and citation chaining: (4, 212, 338–358).

*Several studies were identified across multiple reviews. For clarity, these are cited under each review in which they appeared, meaning some sources are repeated in Table 1.

TABLE 3 Grouping of self-report scales by heuristic category.

Self–concept	This category includes scales assessing psychological constructs related to how individuals perceive themselves. Scales in this category focus on internal psychological resources that contribute to a healthy sense of identity. Outcomes include self–esteem, self–concept, self–efficacy, resilience, and hope.
General health, wellbeing and quality of life	This category includes scales that assess overall mental and physical health, wellbeing, and perceived quality of life. These measures do not evaluate specific health conditions but instead capture broader health status and subjective wellbeing. Some scales included in this category assess general mental health symptomatology, provided they are not tied to a diagnostic category.
Mood and current emotional wellbeing	While overlapping somewhat with general health and wellbeing measures, this category includes scales that assess more temporally specific indicators of mood. These tools are used to evaluate the immediate affective impact of greenspace exposure, focusing on short–term changes rather than long–term assessments of health or life satisfaction.
Specific mental health conditions	This category includes scales designed to assess symptomatology related to defined mental health conditions or psychological states. Measures in this group target outcomes such as depression, anxiety, trauma, post–traumatic stress disorder (PTSD), stress, burnout, suicidality, and schizophrenia.
Spirituality, mindfulness, and life meaning	This category represents the broadest and most conceptually complex grouping. Scales were included if they assessed the self in relation to the external world and the meaning individuals attribute to these dynamics. Measures in this category capture constructs such as mindfulness, existential wellbeing, self–actualisation, spiritual wellbeing, and alienation. These scales often explore deeper psychological and philosophical dimensions of wellbeing, extending beyond functional health.
Connection to nature, restorativeness and attentional functioning	This category includes scales that assess individuals' connectedness to the natural environment. It also encompasses measures of perceived restorativeness and attentional functioning. While some of these attentional scales can be applied in broader contexts unrelated to nature, they were included here because they were used to evaluate the impact of nature exposure on psychological restoration.
Social outcomes	This category includes scales that assess interpersonal constructs such as loneliness, social skills, connectedness, and perceived quality of relationships. These measures focus on the social dimensions of wellbeing, capturing how individuals experience their social environment.
Miscellaneous	This category includes scales that could not be grouped within the categories above and were not frequent enough to warrant standalone classification. This includes a diverse range of outcomes, including capacity to work, sleep quality, physical activity, attachment, pain, recovery, substance use, health attitudes, creativity, and daily functioning.

TABLE 4 Qualitative themes and outcomes.

Key reported outcome	Description and sub–outcomes
Connection to nature	Feelings of peace; self–reflection; nature as a metaphor for adversity and recovery; nature as a strategy for wellbeing.
Improved mood and sense of wellbeing	Mental clarity; feeling present; reduced stress.
Self–concept	Self–acceptance; personal growth; self–esteem; hope and optimism.
Goal setting and motivation	Identifying desired changes; setting and pursuing goals.
Learning skills	Developing practical, social and emotional skills; applying strategies to daily life.
Routine and self–care	Increased physical activity; improved daily structure.
Social connection	Opening up to others; improved communication; feeling safe, accepted, and valued.
Potential unintended outcomes	Strained relationships; boredom; post–programme challenges; anxiety; weather.

as cortisol, adrenaline, noradrenaline, and dopamine. While measurement techniques varied, these biomarkers were utilized to explore shifts in stress regulation, emotional states and overall physiological functioning in response to nature-based exposure. Due to the diversity of measures and associated references, see Supplementary File 4 for a full list of studies utilizing each physiological measure.

3.1.4 Reported qualitative outcomes

Seventy–five studies employed qualitative methods, including interviews, focus groups, and ethnography. Due to the diversity of outcomes and number of related references, and to assist readability, a full list of references under each discussed outcome, along with example quotes, is provided in Supplementary File 5. However, Table 4 provides a summary of reported outcomes, and these are expanded on further below.

A prominent theme was participants' perceived connection to nature. Many described a sense of calm when outdoors, which supported mental refreshment, reduced stress, and enhanced emotional wellbeing. This calming effect often created space for reflection, enabling experiences of self–acceptance, personal growth, and the development of a more positive self–concept. Closely linked to this was the emergence of mindfulness and learning to be present, which participants reported helped regulate their emotions. Building on this, others adopted nature–based coping strategies, such as practicing breathing exercises outdoors to manage stress. Several studies also noted that individuals viewed nature symbolically, drawing metaphors from wildlife and landscapes to make sense of personal challenges. Alongside these psychological and emotional benefits, some studies highlighted improvements in physical health, often attributed to increased activity in greenspace, with some evidence that participants continued to lead more active lifestyles after programmes ended.

Beyond nature–related benefits, studies reported a wide range of perceived psychosocial outcomes. Many papers described improvements in confidence, self–esteem, and perceived resilience, with a sense of achievement and pride from participation often framed as a mechanism for personal development. Participants also reportedly valued learning practical skills and emotional regulation strategies, which was said to contribute to feelings of competence. Several studies noted that greenspace engagement could foster a sense of purpose and structure, thereby helping individuals establish or maintain routine. In some cases, this growing self–efficacy and motivation were linked to goal setting, with participants identifying goals and taking steps toward achieving them. For example, some reported increased opportunities to engage in education or training, alongside greater confidence to pursue these pathways. Across papers, participants also described experiencing greater hope and optimism about the future.

Social connection was commonly discussed, with opening up to others described as central to this process. Participants frequently reported reductions in loneliness and a sense of mutual support within nature-based groups, which were seen as key intervention components and linked to improved self–esteem and general wellbeing. Several studies specifically noted that the group–based context fostered better communication and conflict–resolution skills. Feeling accepted, valued, and not judged was often described as essential for enabling these social connections, and was also viewed as an important foundation for personal growth.

Only a small number of papers reported negative impacts or challenges. One study described participants experiencing boredom, isolation, and strained relationships with group facilitators. Several studies highlighted difficulties in maintaining improvements after programmes ended, with emotional flatness and a lack of follow–up support identified as key issues. Another paper noted that although self–reflection could be beneficial, it also raised emotional challenges for some individuals. Additional difficulties reported across studies included anxiety, interpersonal conflict, and adverse weather conditions.

3.1.5 Observational methods

Twenty-five studies employed observational methods. These were common where participatory methods were less feasible, such as with participants living with dementia. In other cases, observational techniques supplemented participatory methods. Observations were conducted by researchers, clinicians, or programme staff, often using behavioral rating scales or clinical assessments. Frequently reported outcome included mood (34, 253–255, 257, 258, 279–281, 283–285, 287, 299, 352); task motivation and engagement (25, 34, 254, 255, 258, 300, 356); and cognitive or daily functioning (29, 33, 258, 286, 299, 352). Additional outcomes included depression (280, 284); symptoms of schizophrenia or general psychiatric distress (4, 148, 245); quality of life (279, 280); sleep quality (299); and social interaction (356).

3.1.6 Experimental methods

Eighteen studies employed experimental tasks to assess the restorative effect of greenspace. Commonly used tests included the Digit Span Forwards/Backwards Tests (17–19, 24, 72, 130, 156); Trail Making A and B Tests (19, 21, 134); Necker Pattern Cubes (19, 129, 138, 139); Symbol Digit Modalities Test (106, 156); Operation Span Task (72); The Finding As Test (106); Memory Loaded Search Task (23); Letter Digit Substitution Task (21); and the Change Detection Task (72). These tasks evaluated working memory, processing speed, attentional control, and cognitive flexibility. Additionally, one study asked individuals to conduct tasks to assess racial and gender bias (100), while another explored memory and verbal fluency through the Wordlist Memory Task and Verbal Fluency Task respectively (223).

3.1.7 Healthcare and administrative records

A small number of studies ($n = 5$) analyzed administrative records to assess intervention impacts. One study assessed healthcare utilization and sick leave records to evaluate a greenspace stress reduction programme's impact on work capacity (235). Two studies combined healthcare records and sick leave data with self-report measures (138, 173). Two studies utilized school records, with one examining absenteeism (66) and the other educational attainment (82).

3.1.8 Other methods/measures

Several studies ($n = 11$) employed outcome measures not covered by the categories described above. These included assessment of physical activity, such as the Senior Fitness Battery (268), Stair Climb Test (91), pedometer use (151, 172, 223), and a smartphone application to track activity (24). Others captured anthropometric data including height, weight, and waist size (96–98, 148, 268, 333).

3.2 Literature review for problem substance use papers

Thirty–eight studies involved participants with experience of problem substance use. Due to the number of references associated with each outcome, for readability, Supplementary File 6 provides a detailed breakdown of these studies and full reference lists.

Programme types included wilderness or adventure–based activities, care farms, horticulture therapy, forest therapy, eco–therapy or conservation programmes, outdoor behavioral healthcare, nature–based recreation programmes, and green exercise. Seventeen studies used self–report scales only, while 10 relied solely on qualitative methods. Three studies combined self–report and qualitative approaches. Other methodological designs included observation paired with qualitative or self–report methods, self–report alongside physiological measures, and experimental methods.

3.2.1 Self-report measures

Self–report scales used in studies involving participants with experience of problem substance use captured a wide range of outcomes. Several studies assessed aspects of mental health, including stress, depression, suicidal ideation, and Post Traumatic Stress Disorder. Measures of social functioning or social connection were included in 11 papers. Other outcomes included: life outlook or perceived quality of life; substance–use and recovery–related outcomes; elements of self–concept such as self–esteem, self–efficacy, and resilience; general wellbeing; physical health; mindfulness; attachment; and work–related rehabilitation.

3.2.2 Qualitative methods

Papers using qualitative methods reported a range of outcomes, echoing themes from the wider review. These included increased: self–esteem and self–efficacy; a strengthened sense of purpose and routine; improved physical health; enhanced daily functioning; connection with nature; and social outcomes such as greater interpersonal connection. Although qualitative papers identified diverse benefits, few directly evaluated substance–use–specific outcomes, such as reductions in use. Elings and Hassink [(187) p.315], noted that participants described programmes as providing *"something useful to do"* which *"helped to distract participant thoughts from their preoccupations with drugs or alcohol"*. Other studies similarly described greenspace programmes as helping reduce cravings and maintaining recovery through daily structure (199, 206, 316). One study reported that improved physical fitness helped manage cravings (187), whilst another found that programmes increased participants' knowledge of health-protective resources (313). Seifert [(316) p.7], observed that participants viewed nature as a valuable alternative to substance-centered activities, offering *"remedial social alternatives"*. Some participants also valued nature-based approaches as a break from intensive, talk-based therapies, with greenspace programmes often framed as supporting recovery through wider psychosocial and environmental mechanisms, rather than acting as direct treatment and noted that *"by providing socialization and personal development opportunities, [programmes] mitigate, to some extent, the social and psychological causes, rather than the symptoms"* (316) (2014: p.9).

3.3 Primary data findings from qualitative interviews

This paper will now present findings from 33 qualitative interviews conducted with a range of stakeholders, as described in the Materials and Methods section above. Participants described a range of impacts from engaging with greenspace programmes, with thirteen outcomes identified and grouped into 5 over-arching categories: nature-related outcomes; individual-level outcomes; social-level outcomes; substance use-specific outcomes; and challenges and unintended outcomes (see Table 5).

TABLE 5 Coding categories and outcomes.

1. Nature–related outcomes
Connection to nature
2. Individual–level outcomes
Improved mood and mental health
Physical activity
Confidence and skill development
Belief and motivation for change
Routine and self–care
Meaning and purpose
Self–acceptance and reduced self–blame
3. Social–level outcomes
Social connection and support
Community integration and involvement
4. Substance–use specific outcomes
Reducing use or maintaining abstinence
Engagement with treatment and support
5. Challenges and unintended outcomes
Challenges post–programme

3.3.1 Nature-related outcomes

Participants described nature as a restorative and reflective space, evoking feelings of peace and connection. Nature was not only experienced physically, but it was also drawn on symbolically offering metaphors for growth and resilience. These connections often supported emotional regulation, mindfulness and personal growth.

3.3.1.1 Connection to nature

Connecting with nature was described as a central outcome, with participants highlighting a sense of wonder and peace, and reflecting on it's restorative qualities. Many recognized the benefits of nature for their health and wellbeing. Nature was described as a space that could quiet internal noise, foster gentle reflection, and support emotional openness:

> *Nature has this amazing way of bringing people inward to a kind of stilling space so they will be able to still the chaos of life generally. Where they feel more peaceful, more able to reflect.* (Greenspace staff participant 8)

Participants also spoke about nature as a symbolic terrain for navigating adversity and recognizing internal strength, drawing inspiration and parallels from processes such as plant growth and seasonal changes:

> *Exploring a forest, finding new ways to get through a certain space, just like finding new ways to deal with your problems.* (Greenspace programme participant 2)

Others described how nature could foster new perspectives through encouraging individuals to be more present and observe their surroundings:

> *Often people say "I am seeing things in a completely different way for the first time," and they go on seeing things in a very different way. I don't just see a tree now, I see that tree. I don't label it and pass on.* (Greenspace staff participant 8)

This example highlights the transferability of experiences where learning about the complexity of nature may encourage individuals to resist easy labeling and categorization and instead encourage them to observe and embrace differences.

3.3.2 Individual-level outcomes

Participants described a range of personal changes when attending nature-based programmes, including improvements in mood, emotional regulation, motivation, and confidence. Programmes were often said to support the development of practical and emotional skills, helping individuals maintain self-care practices.

3.3.2.1 Improved mood and mental health

Participants frequently described a sense of peacefulness during and after greenspace sessions, which they felt contributed to improved mood and mental clarity. Sessions were framed as enabling space for non-ruminative reflection, allowing individuals to consider their situation with greater emotional ease. These improvements were not limited to the duration of the programme and many reported that the positive effects persisted:

> *Before, my mood wasn't really the best, it was up and down, but then during the programme my mood was it it's peak, so I was feeling really good. And when I came back, I was feeling even better.* (Greenspace programme participant 11)

Staff participants echoed these observations, noting that mental health improvements were often substantial: "*It's good for their mental health as well, their mental health improves greatly.*" (Greenspace staff participant 1) Importantly, mental health was not described as a fixed or final state. Given the complex and longstanding challenges faced by participants, greenspace programmes were seen as supporting an often-non-linear journey of healing, rather than delivering a singular destination.

3.3.2.2 Physical activity

Increased outdoor activity was a recurring theme, with many participants recognizing it's benefits for wellbeing and recovery. Physical activity was often described as a personal goal, particularly for older individuals with a history of problem substance use:

> *It's a quite common goal a lot of people set, particularly the older people who have maybe got alcohol problems.* (Greenspace staff participant 2)

Participants spoke positively about physical activity across programme types, not only relating to multi-day adventure excursions, but also lower-impact activities such as planting and gardening. These were seen as particularly beneficial for individuals with limited mobility, offering accessible ways to engage with nature, while supporting physical and emotional wellbeing.

3.3.2.3 Confidence and skill development

Many participants described entering greenspace programmes with a lack of confidence and negative self-image shaped by longstanding challenges. Improved confidence was frequently identified as a key goal, linked to engaging with unfamiliar activities and situations:

> *I came back confident. I came back with a backbone which I've never had in my life.* (Greenspace programme participant 10)

Participants also spoke about developing and reconnecting with skills, both practical and emotional, as an important impact. Practical skills included setting campfires, survival skills, and exploring outdoors, with participants describing increased confidence to do so independently:

It's given me motivation and confidence to try things that I wanted to, but something had been holding me back. Like rock climbing, abseiling, the going into greenspace and just exploring. (Greenspace programme participant 9)

Beyond practical skills, participants described gaining coping strategies, which supported their wellbeing. For example, one individual reflected on learning to pause, reflect and seek support from family when faced with adversity, rather than acting impulsively:

> *If I get stressed normally, I would just go and do the wrong thing. But I've now got the confidence to phone up my parents and say, "can I come down? I need to talk". I've been a lot more open about how I'm feeling.* (Greenspace programme participant 10)

Others described employing breathing exercises learned through programmes:

> *Certain breathing exercises are good, we did some of that. So, all these things help.* (Greenspace programme participant 6)

Developing and practicing social skills was also prominent, with participants reporting learning how to better interact with others:

> *It builds up my confidence for socializing, because I don't normally mix with others or I always feel anxious even saying 'hi' to people or having a conversation.* (Greenspace programme participant 14)

A linked outcome was increased engagement with employment, education or volunteering, often attributed to improved confidence and skill acquisition. Some described how programmes could lead to new opportunities, explaining, "*that might be some training, that might be employment, it might be volunteering*" (Greenspace programme participant 5). However, staff emphasized the importance of managing expectations, noting that many individuals were still early in their recovery journey:

> *We kind of see ourselves as being a step-before-the-step for going into education and employment, because a lot of them* [participants] *are quite far removed from the labor market, or even considering education or training.* (Greenspace staff participant 4)

In this sense, it was important that participants did not feel undue pressure and that moving into education or employment was a pre-requisite for continued engagement, otherwise this could lead to drop out.

3.3.2.4 Belief and motivation for change

Participants often described programmes as fostering a renewed sense of belief in the possibility of change. This was rooted in experiences of hope, reflection, and emotional openness, particularly for those who had felt stuck or overwhelmed by longstanding challenges:

> *It's sensing something new as a possibility. Yes, I think it's hope, hope of change in something that has maybe been feeling intractable for a long time.* (Greenspace staff participant 8)

Staff participants also noted that supporting hope and motivation was a central aim of programmes: "*The key areas that we work with are dealing with challenge and change, hope, aspirations, and motivations*" (Greenspace staff participant 4). Having time and space for reflection during greenspace outings was said to facilitate this process. Being in the outdoors and reflecting on life in a supportive environment was described as aiding recognition that there was "*more to life*," therefore building motivation:

> *The location here today it takes everything away from me, otherwise I'd be sitting at home looking at four walls thinking about my next drink. While I'm here, I don't think about it at all. I am out in the big open with people that I enjoy, people I really get on with. And you don't know until you get taken to places like this, that there's so much more to life rather than sitting and getting drunk basically.* (Greenspace programme participant 7)

Goal setting was described as a key component for change, helping individuals identify attainable steps toward change:

> *They do something called action planning, you set real goals and they're attainable goals. And for me, it was simple stuff like taking better care of myself physically, like taking better care of my home and signing up to be a volunteer. If I'd have not done that, I don't think I would have had the confidence—and that's turned into meet people that inspired me to go back to college. There's this snowball effect.* (Greenspace programme participant 5)

Indeed, many participants echoed the above notion of a "*snowball effect*," where small achievable goals had iteratively led to bigger life changes overall, suggesting potential for sustained impact of programmes over a period of time.

3.3.2.5 Routine and self-care

Greenspace programmes were described as supporting improved routine and self-care, often through the beneficial impacts of nature and activity on mood, sleep and diet:

> *I still go to my bed at 10pm, and I'm up about 6/7am since I've been back. And I feel 10 times better for it.* (Greenspace programme participant 4)

For some, the regularity of sessions provided something to look forward to, which helped reinforce motivation to care for oneself and maintain a consistent routine:

> *People think, "this life is not worth living, my life's not worth it" but to look forward and say "of course it is"–Tuesday I'll go to meet the group and we are going to this place, we are going to that place. It gives you the inspiration to be strong.* (Greenspace programme participant 7)

This is notable as it suggests that programme benefits may be far reaching across different facets of a person's life, rather than only linked to the intervention setting.

3.3.2.6 Meaning and purpose

Some participants discussed greenspace programmes as offering a space to reflect on life, values, and identity, often fostering a sense of meaning and purpose. Many discussed feeling disconnected from their sense of self prior to engaging with a programme, shaped by longstanding challenges. One participant reflected on how far they had come, describing a transformation they had previously thought impossible:

> *I never had that in my mind. I didnae'* [didn't] *think I'd be where I am now. I just thought I'd be some down and out, never have my kids.* (Greenspace programme participant 8)

This shift in perspective was described by some as a process of reclaiming a sense of intrinsic worth, challenging internalized narratives of abandonment and disconnection:

> *Being abandoned, abandoning yourself because society abandons us, or our families abandon us. It's re-evaluating that and not abandoning ourselves.* (Greenspace staff participant 7)

Several participants described engaging with greenspace as part of an ongoing process of existential inquiry, allowing them to reconsider past beliefs and explore new perspectives on life and recovery:

> *In some of those more peaceful moments, I was able to question myself. It gives the ability to choose what you think is important to yourself. I see it as a moralistic or philosophical thing.* (Greenspace programme participant 12)

Nature was described as playing a central role, with it's calming effect said to help individuals move from rumination on internal constraints to a broader perspective. For example, one participant described moving from a "*closed*" internal space, to the expanse of nature, which enabled them to reflect on their life's purpose. They noted that reflecting on this outside "*helps you actually look harder… in a way that makes you look harder at yourself.*" (Greenspace programme participant 2).

3.3.2.7 Self-acceptance and reduced self-blame

A recurring theme was the development of greater self-acceptance, and reduced self-blame regarding personal circumstances. This shift typically occurred through two key mechanisms. First, as discussed, being in nature provided a calming environment, supporting less ruminative reflection. Second, participants described how recognizing shared experiences with others helped to reduce feelings of isolation and shame:

> *From personal experience there's no lonelier feeling than being an addict - you feel like no one's ever felt the way you feel, like no one's every been as bad as you. And so, knowing that you're not alone anymore is like, shit this isn't just me.* (Greenspace programme participant 5)

For some, this realization was described as a turning point, enabling them to acknowledge and accept their struggles, and seek support.

3.3.3 Social-level outcomes

Participants described the social aspects of programmes as central to their effectiveness. Connection, mutual support, and a sense of belonging were seen as important for wellbeing, with some noting that group dynamics helped foster trust and emotional openness. For some, engaging with programmes was a first step toward wider community involvement—whether through

increased confidence, discovering new interests, or feeling more able to leave the house.

3.3.3.1 Social connection and support

Participants described the social connection formed as central to their experience. Communal activities and a sense of belonging were often linked to improved wellbeing:

> *The groups have supported us, saved our lives really. I moved to* [nearby area] *seven and half years ago, and I never knew a soul, not a person. So, coming to the groups has really made a big difference to me. You just feel like you can talk about anything.* (Greenspace programme participant 3)

Mutual support and non-judgement were described as vital. Some participants valued not only receiving support, but also offering it to others, even those they initially struggled to connect with:

> *When they can go there, and they can start to develop positive relationships with someone they haven't got on with for the first couple of days, but after day six and seven, these guys are the best friends.* (Greenspace staff participant 3)

3.3.3.2 Community integration and involvement

Being involved in greenspace programmes was also described as a facilitating integration into other community spaces. Many participants entered programmes feeling isolated, with some describing struggling to leave the house. Initial engagement with programmes was discussed as a meaningful step toward reconnecting with others and the wider community:

> *Having done this, meeting people, and enjoying it, and getting stuff out of it, it makes you more likely to do other stuff in the future.* (Greenspace programme participant 6)

Some individuals described discovering new interests on programmes, which they pursued further through other community-based groups. However, the relationship between greenspace programmes and wider community involvement was not always linear. Some participants were already engaged in wider support and described greenspace as one part of a broader network.

3.3.4 Substance-use specific outcomes

Participants generally described greenspace programmes as playing a supportive role in their substance use journeys, whether helping to maintain abstinence or reduce use. For some, the structure, mood benefits, and sense of connection provided meaningful alternatives to substance use, without requiring direct disclosure or an explicit treatment-based framing. While programmes were often not explicitly focused on substance use, they were described as creating space for reflection on these issues and, in some cases, supported engagement with treatment services.

3.3.4.1 Reducing use or maintaining abstinence

Participants described nature-based activities as helping reduce cravings and improve mood, providing tools and motivation to reduce use:

> *I used to say I needed a drink. No, just come to the woods and listen to the birds for a few hours and, honestly, you just go back floating.* (Greenspace programme participant 3)

Access to a non-judgemental support network was also described as important for navigating the non-linear journey of recovery. While some participants reported reductions in use or efforts to sustain recovery, it was noted that substance use was not typically an explicit focus of programmes. Instead, these outcomes often emerged organically, with participants appreciating the emphasis on enjoyable, meaningful activity rather than disclosure or explicit therapeutic intervention.

3.3.4.2 Engagement with treatment and support

Some participants described greenspace programmes as a first step toward engaging with wider support services, including treatment and mutual aid groups. Staff were described as playing a key role in this process, working with individuals to consider whether additional support might be helpful:

> *We then have to kind of look at what other services might be out there, especially in the local area. And it might also be a service that they've engaged with before but just weren't ready at the time.* (Greenspace staff participant 2)

Greenspace programme participants echoed this, describing how programmes had highlighted other available support. However, participants also emphasized the value of not being pressured into engaging with other services, recognizing that some may prefer to continue greenspace activities without formal treatment.

3.3.5 Challenges and unintended outcomes

While participants largely focused on positive outcomes, some challenges were noted—particularly the emotional impact of returning to daily life after a programme ends. In certain cases, the absence of continued support was described as undermining progress, highlighting the need for longer-term structures to sustain change.

3.3.5.1 Challenges post-programme

Participants described feeling emotionally elevated during sessions, which could be difficult to sustain once a programme ended, especially if the support structures built throughout engagement were no longer available. This shift was sometimes associated with feelings of loss, and in some cases, was seen as disrupting progress. One staff participant offered an example

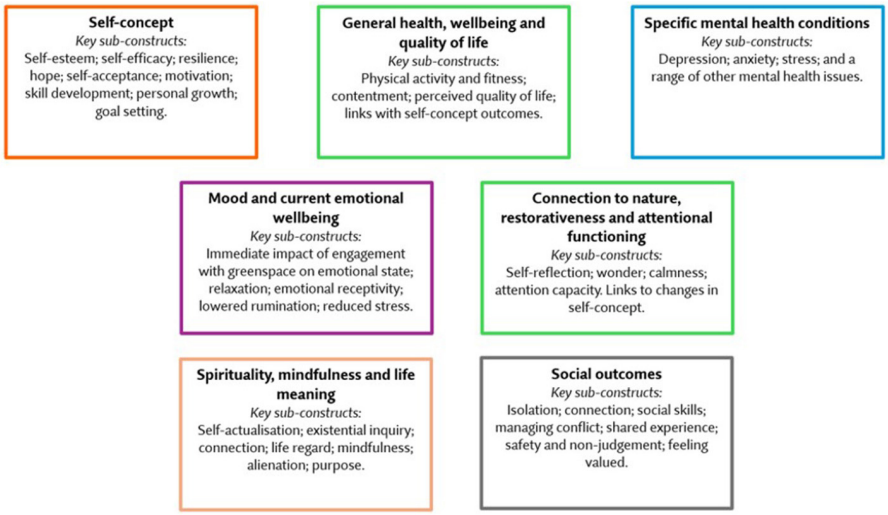


FIGURE 3
Visual representation of heuristic outcome categories and sub-constructs.

of how quickly positive change could be disrupted without ongoing support:

> *I had a someone who came back from one of our programmes who did amazing, probably one of the best kind of outcomes or changes that I've seen in somebody. Then when she came back, one of her goals was 'I'm going to go down there and make peace with* [addiction support service] *right away', and they refused her entry to the office, threw her out in the street. So, all the positive stuff was undone within half an hour.* (Greenspace staff participant 2)

This issue was primarily discussed in relation to shorter programmes, where the opportunity for sustained support was limited. In contrast, ongoing groups were seen as offering greater scope for longer-term progress, providing a more consistent presence in people's life.

3.4 Developing an outcomes framework

The following section presents a synthesis of outcomes from the literature review and primary qualitative data to develop an outcomes framework for greenspace programmes supporting individuals experiencing problem substance use. The synthesis process followed two steps. First, literature review data were grouped into heuristic overarching categories based on broad outcomes of interest. Second, these conceptual categories (and their associated sub–categories) were considered alongside themes from the primary qualitative research to produce a synthesized outcomes framework. Each step is described in detail below.

3.4.1 Synthesizing literature review data into categories

As outlined in the Methods section, outcomes extracted from the literature review were first organized using the broad heuristic categories developed during categorization of the self-report scales (see Table 3 above). These categories provided a practical means of mapping the wide range of constructs and sub–constructs assessed across heterogeneous study designs. Their purpose was descriptive: to structure diverse evidence base and support initial conceptual orientation, rather than to serve as an explicit foundation for the final outcomes framework. A full list of references and counts of papers coded under each category is provided in Supplementary File 7. Figure 3 presents a visual overview of these categories and their associated sub–themes.

These heuristic categories were often conceptually linked. For example, cortisol levels were coded under "specific mental health conditions" due to association with stress, alongside psychometric stress scales. However, cortisol could also be situated within mood or general wellbeing, particularly when assessed following short–term greenspace exposure, whereas self–report stress measures were typically used in longer–term interventions. Such overlaps highlight the complexity of categorizing outcomes in greenspace research, where constructs frequently intersect and resist neat separation. While categorization was sometimes challenging due to conceptual overlap, the use of broad heuristic categories enabled synthesis across diverse methodologies (see Supplementary File 7).

3.4.2 Synthesizing primary data and literature review data

To develop a more conceptually coherent structure for the outcomes framework, findings from the literature review were

synthesized with those from the primary qualitative research. This integrative process involved re–coding outcomes identified in either data source and grouping them into higher–order domains that more accurately reflected the mechanisms and experiences described by participants and reported in the literature. Sub–categories from each heuristic grouping (Figure 3 above) were considered alongside themes from the qualitative interviews to generate a consolidated list of outcomes.

Drawing on previous theoretical work by the research team (1, 61), these outcomes were organized into three interrelated domains: nature–related, individual–level, and social–level. These domains capture the dynamic interplay between personal processes, social context, and engagement with the natural environment, providing a more analytically meaningful structure than the heuristic categories alone (359). Unintended outcomes, discussed throughout the paper, are not included in the framework, not due to lack of relevance, but to preserve it's function as a tool for evaluating intended programme impacts. The finalized outcomes framework is presented in Table 6.

TABLE 6 Outcomes framework developed through analytical synthesis.

Domain	Sub–themes/outcomes
Nature–based outcomes	Sensory and emotional experience *Connection to nature* *Peace and serenity*
	Cognitive and attentional benefits *Attentional restoration* *Mindfulness* *Mental refreshment and invigoration*
	Reflective and symbolic engagement *Space for reflection* *Drawing on nature as a metaphor*
Individual–level outcomes	Psychological and emotional wellbeing *Reduced stress* *Self–acceptance* *Perceived resilience* *Improved confidence, self–esteem and self–efficacy* *Improved health, wellbeing and quality of life*
	Personal growth and recovery *Achievement and pride* *Motivation and goal setting* *Reduced substance use* *Building recovery capital* *Meaning, purpose and spirituality*
	Skills and behavior change *Developing practical and emotional skills* *Increased physical activity* *Engagement in employment, education, volunteering or training*
Social–level outcomes	Relational connection and support *Social connection* *Mutual support* *Opening up to others* *Learning from others* *Improved social relationships (on or outside of programme)*
	Belonging and emotional safety *Sense of belonging* *Feeling valued, safe, respected and not judged* *Reduced stigma*
	Community engagement *Reduced social isolation* *Community involvement and engagement*

4 Discussion

This paper presents results of an analytical synthesis with the aim of developing an outcomes framework for greenspace programmes supporting individuals experiencing problem substance use. Outcome measures were extracted from 311 academic papers and synthesized with primary qualitative data. Findings suggest a wide range of potential outcomes that may inform greenspace evaluations. The review highlights diverse evaluation methods, including physiological measures, self-report scales, qualitative approaches, experimental tasks, and researcher observation. Given the diversity of outcomes, using multiple methods in combination may offer the richest insight into programme impact (47). However, this should be balanced against the risk of overburdening participants. Greenspace programmes often provide a sense of escape from daily stressors for those experiencing substance use and mental health challenges (1, 31, 61), and intensive or intrusive data collection may raise ethical and practical concerns. Additionally, individuals experiencing problem substance use may have experienced stigma, discrimination, and conditionality in service delivery, as well as negative interactions with criminal justice and social work systems, particularly where substance use intersects with other marginalized identities (360). This can foster distrust, especially where evaluation is perceived as aligned with clinical or bureaucratic systems of progress monitoring that carry significant potential consequences (e.g., prison progression or child custody). This highlights the need for evaluation to be relational, collaborative, and trust-building, rather than imposed by professionals (361).

While outcomes in the developed framework are presented in distinct domains for analytical clarity, our analysis suggests many outcomes are interrelated. For example, nature-based experiences, such as mindfulness and reflection, often support individual-level changes in emotional regulation and self-concept, while increased confidence and wellbeing may have a bi-directional relationship with social connection. These connections highlight the dynamic nature of greenspace programme impacts, where change in one domain may reinforce change in another. The outcomes framework is intended to support the exploration of these connections, rather than serve as a static checklist, reflecting the interconnectedness of self, social context, and wider environment.

Finally, it is not assumed that included outcomes will occur across all programmes or participants. Intervention impact depends on interactions between social environment, programme

design and delivery, and individual circumstance (362, 363). Existing work provides a framework for understanding process-based elements of greenspace programmes and their effectiveness across varied contexts (1, 26, 54, 55, 61). The outcomes framework presented here could be used alongside this previous work, by providing a broader range of outcomes and offering measurement examples.

4.1 Strengths and limitations

This paper presents an approach to developing an outcomes framework which may be useful in other areas with emerging evidence bases. To our knowledge, this is the first paper which aims to develop an outcomes framework for greenspace programmes supporting this population. However, several limitations should be considered.

The absence of a systematic review approach in developing search terms and extracting data may be viewed as a methodological gap. However, as the aim was to scope existing outcomes and evaluation methods to support theoretical synthesis, systematic review methods may be viewed as less imperative. Furthermore, our approach aligns with guidance on conducting a scoping review (59). The use of existing systematic reviews and meta-analyses to identify sources also partially offsets this limitation.

Another limitation may be that developing heuristic outcome categories underplays theoretical and methodological nuance in the included literature. Synthesizing large volumes of data invariably entails abstraction. However, abstraction can be a valuable tool in social science when creating theoretical syntheses, supporting the identification of commonalities across diverse research areas (364). The overarching outcomes framework is intended as a starting point, bringing together relevant outcomes to guide evaluation approaches that are nuanced, grounded and context specific.

A further limitation is that the literature review only focused on extracting outcomes and outcome measures, without assessing the quality or strength of evidence associated with each construct. While some of the existing reviews from which primary studies were drawn included quality appraisal procedures, they often highlighted limitations in relation to study quality. As such, the findings should be interpreted with awareness of the variable quality of included studies. However, as discussed above, the outcomes framework does not imply that outcomes will invariably occur across all greenspace programmes or for all participants. A follow-up paper will seek to consolidate and deepen understanding of each outcome through further qualitative work.

A final limitation to consider relates to the primary qualitative work undertaken. It is important to note that the outcomes discussed may reflect broader processes of recovery, healing, and personal development which, in some cases, individuals were already undertaking prior to their engagement with programmes. Greenspace programmes may not act as a singular catalyst for improved health but rather as a supportive context through which existing internal and contextual process are expressed or reinforced. This highlights the need for caution in attributing causality and the importance of viewing interventions as embedded within wider personal trajectories and circumstance.

5 Conclusion

This study has explored how greenspace programmes supporting individuals with problem substance use could be meaningfully evaluated. By synthesizing a wide range of outcomes, the paper provides a framework that is both empirically evidenced and informed by lived experience. This approach ensures that the outcomes identified are not only methodologically grounded, but also meaningful to programme participants, practitioners, and persuasive for policymakers and funders. The breadth of outcomes identified provides insight into multiple dimensions of the recovery process, extending beyond clinical indicators to include emotional, social, and existential change. It is hoped that the findings of this paper will offer practical guidance for programme design and evaluation, particularly in contexts where evaluation occurs outside academic institutions. An intended contribution of this work is to further support the implementation of equitable, person-centered substance use strategies across diverse service contexts with a wider focus than simply substance use reduction.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical approval for this study was granted by the University of Stirling's NHS, Invasive, or Clinical Research Panel (NICR, paper 14134) and the Ethics Subgroup of the Research Coordinating Council of The Salvation Army. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

DF: Data curation, Methodology, Visualization, Investigation, Formal analysis, Writing – review & editing, Writing – original draft. WM: Methodology, Investigation, Conceptualization, Supervision, Formal analysis, Funding acquisition, Writing – review & editing, Writing – original draft, Project administration. HC: Writing – review & editing. ED: Writing – review & editing. KP: Writing – review & editing. SE: Writing – review & editing. RL: Writing – review & editing. MT: Writing – review & editing.

JD: Writing – review & editing. TG: Writing – review & editing. TP: Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that Generative AI was not used in the creation of this manuscript.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2026.1965592/full#supplementary-material

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