

Thal, Sascha, Bright, Stephen, Ntoumanis, Nikos, Myers, Bronwyn, Jones, Jocelyn and Quested, Eleanor (2025) A Co-design approach to develop a motivational intervention to promote physical activity engagement and maintenance among individuals in residential substance use disorder treatment settings. *Psychology of Sport and Exercise*, 78. p. 102829.

Downloaded from: <https://ray.yorks.ac.uk/id/eprint/15914/>

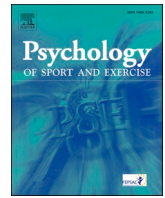
The version presented here may differ from the published version or version of record. If you intend to cite from the work you are advised to consult the publisher's version:
<https://doi.org/10.1016/j.psychsport.2025.102829>

Research at York St John (RaY) is an institutional repository. It supports the principles of open access by making the research outputs of the University available in digital form. Copyright of the items stored in RaY reside with the authors and/or other copyright owners. Users may access full text items free of charge, and may download a copy for private study or non-commercial research. For further reuse terms, see licence terms governing individual outputs. [Institutional Repositories Policy Statement](#)

RaY

Research at the University of York St John

For more information please contact RaY at
ray@yorks.ac.uk



A Co-design approach to develop a motivational intervention to promote physical activity engagement and maintenance among individuals in residential substance use disorder treatment settings

Sascha Thal^{a,b,*}, Stephen Bright^{b,c}, Nikos Ntoumanis^{d,e}, Bronwyn Myers^{a,f,g}, Jocelyn Jones^h, Eleanor Quested^{a,b}

^a Physical Activity and Well-Being Research Group, EnAble Institute, Curtin University, Perth, Australia

^b Curtin School of Population Health, Curtin University, Perth, Australia

^c School of Medical and Health Sciences, Edith Cowan University, Perth, Australia

^d Danish Centre for Motivation and Behaviour Science, University of Southern Denmark, Odense, Denmark

^e Norwegian School of Sport Sciences, Oslo, Norway

^f Mental Health, Alcohol, Substance Use and Tobacco Research Unit, South African Medical Research Council, Tygerberg, South Africa

^g Division of Addiction Psychiatry, Department of Psychiatry and Mental Health, University of Cape Town, Cape Town, South Africa

^h National Drug Research Institute, Curtin University, WA, Perth, Australia

ABSTRACT

Substance use disorders (SUDs) pose a significant public health concern. Preliminary research suggests benefits of physical activity (PA) for individuals receiving SUD treatment. However, current PA interventions have limitations, particularly regarding PA maintenance, due to motivational issues among people with SUDs. Our co-designed intervention is the first to target PA motivation for sustaining PA in individuals with SUDs. We employed the Behaviour Change Wheel (BCW) to co-design an intervention to increase PA motivation and support PA maintenance among people in residential SUD treatment. The BCW process involved semi-structured interviews with people with lived or living experience ($n = 5$) and stakeholders ($n = 5$) from Western Australian SUD treatment facilities and five advisory group meetings with members of the same population. Following the BCW process, we conducted a behavioural diagnosis, selected intervention functions and behaviour change techniques (BCTs) and determined modes of delivery for the intervention. Our behavioural diagnosis highlighted the need for tailored PA programs. Further, knowledge, accessibility, encouragement, role models, and routine or the lack thereof were identified as barriers and facilitators for PA motivation and PA maintenance. Barriers and facilitators were considered when selecting suitable BCTs and modes of delivery. This process resulted in a 12-session face-to-face intervention. The intervention is based on Motivational Interviewing principles and will be delivered in individual and group sessions. By integrating insights from interviews and advisory group discussions with evidence-based strategies, we co-designed a multi-dimensional PA intervention to address motivational barriers to PA maintenance for adults with SUDs.

Substance use disorders (SUDs) are a significant public health concern. Global estimates indicate that 2.6% of all people meet criteria for 12-month prevalence of SUD (Degenhardt et al., 2017). In Australia, 0.49% of the population received treatment for substance use in 2022–2023. Indigenous Australians aged 10 and over accounted for 18% of people receiving treatment or support (Australian Institute of Health and Welfare, 2024). The challenges of SUD treatment include high treatment attrition (Brorson et al., 2013) and repeated relapses, with estimates suggesting that between 40 and 60% of people with SUDs relapse at least once (Fleury et al., 2016) and only 35–54% achieve long-term remission (McLellan et al., 2000). Physiological and psychological comorbidities (Kingston et al., 2017; Wu & Blazer, 2014) as well as the chronic nature of SUDs (McLellan et al., 2000) further complicate

response to treatment.

Physical activity (PA) has been shown to have potential physiological benefits for individuals undergoing treatment for SUDs, including enhanced neuromotor skills, endurance, flexibility, strength, cardiovascular function, and respiratory capacity (Flemmen et al., 2014; Giesen et al., 2015; Gür & Gür, 2020; Hallgren et al., 2017; Unhjem et al., 2016; Yan-guang et al., 2021). Potential positive psychological effects in individuals with SUDs may include the reduction of distress and mental health problems (Dowla et al., 2022; Piché et al., 2023; Zheng et al., 2024), alleviation of cravings (Buchowski et al., 2011; Garza et al., 2016), the development and transfer of life skills (ter Harmse-Nieuwenhuis et al., 2022), and increased self-esteem (Furzer et al., 2021). Nonetheless, current evidence regarding the positive

* Corresponding author. Curtin University, GPO Box U1987, Perth, 6845, Australia.

E-mail address: sascha.thal@curtin.edu.au (S. Thal).

<https://doi.org/10.1016/j.psychsport.2025.102829>

Received 8 July 2024; Received in revised form 19 February 2025; Accepted 20 February 2025

Available online 21 February 2025

1469-0292/© 2025 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

effects of PA on psychological functioning and substance use among people with SUDs remains inconclusive. Reviews reporting positive results include, for instance, a systematic review and meta-analysis by Giménez-Meseguer et al. (2020) suggesting that PA may have positive effects on anxiety (SMD = 0.50, $p = 0.004$), depression (SMD = 0.63, $p < 0.001$) and stress (SMD = 1.11, $p = 0.006$) in individuals with SUDs. Similarly, a meta-analysis by Zheng et al. (2024) found reduced anxiety (SMD = -0.73, $p < 0.05$) and depression (SMD = -0.666, $p < 0.05$) alongside reduced cognitive impairments (SMD = -0.523 [-0.887, -0.159], $p < 0.05$) as a consequence of PA in individuals with SUDs. A systematic review and meta-analysis by Hallgren et al. (2017) found no significant effects of PA on reduced daily drinking (SMD = -0.886, $p = 0.24$), or Alcohol Use Disorders Identification Test scores (SMD = -0.378, $p = 0.18$). However, they reported significant reductions in depression (SMD = -0.867, $p = 0.006$) and physical fitness (i.e., VO_2 ; SMD = 0.564, $p = 0.01$). Conversely, Colledge et al. (2018) found no positive effects on abstinence, craving, quality of life, anxiety and depression in their systematic review of acute or chronic anaerobic exercise components in SUD treatment. Gür and Can Gür (2020) conducted a systematic review and meta-analysis investigating the effects of PA in alcohol use disorder treatment and found no significant alterations for levels of anxiety, depression, self-efficacy, and alcohol consumption. However, they reported significant effects on increased fitness (i.e., VO_2 ; SMD = 0.487, $p < 0.05$; HRmax: SMD = 0.717, $p < 0.05$) and improved quality of life (SMD = 0.425, $p < 0.05$).

Notably, the quality of systematic reviews on PA in the treatment of SUDs has been judged as critically low (Martinez-Calderon et al., 2023). A possible reason for these inconclusive findings is that most PA interventions do not result in sustained change in PA (Giménez-Meseguer et al., 2020; Thal et al., 2023; Thompson et al., 2020) among individuals with SUDs (Thal et al., 2023). Low motivation for PA is a well-known barrier to PA sustainment (Abrantes & Blevins, 2019; Stoutenberg et al., 2015). Individuals with SUDs often exhibit abnormal goal-directed behaviours, which may stem from substance-use related changes in reward-related brain regions and dopamine pathways that govern reward-seeking behaviours (Lauretani et al., 2024). While PA might activate the dopaminergic reward system and normalise dopaminergic signalling (Lynch et al., 2013), SUD-related disruptions to dopaminergic systems may make it particularly challenging for individuals with SUDs to summon the initial motivation to initiate and sustain PA. Effective, tailored strategies to enhance motivation for continued engagement in PA are instrumental to foster recovery and overall well-being in this population. Yet, current PA interventions for people with SUDs do not target motivation (Thal et al., 2023).

Motivational Interviewing (MI) may be an effective approach to enhancing motivation for continued engagement in PA. MI aims to elicit behaviour change by assisting individuals to explore and resolve ambivalence to behaviour change through goal-directed and client-centred counselling (Miller & Rollnick, 2023). MI has demonstrated effectiveness in increasing PA and adherence to PA interventions (Anshel & Kang, 2008; O'Halloran et al., 2014), change in substance use behaviour (Smedslund et al., 2011), and is adaptable to individual (Miller & Rollnick, 2023) as well as group settings (Wagner & Ingersoll, 2013). While MI programs from past studies provide a solid foundation for an intervention aimed at enhancing PA motivation in individuals with SUDs, research indicates that these individuals have unique motivational needs that must be addressed for the intervention to be effective. These include the need to learn how to set achievable and personalised short-term goals and to emphasise the enjoyment of PA – both of which play a role in reconditioning dopaminergic signalling – as well as creating supportive contexts that foster social support, autonomy, and PA approaches tailored to an individual's abilities, preferences, and beliefs (Horrell et al., 2020; Thal et al., 2024). An intervention grounded in MI and tailored to enhance PA motivation might effectively address current motivational challenges to PA maintenance among individuals in SUD treatment.

Given the significant public health concern of SUDs in Australia and globally, there is a clear need for effective, sustainable, and scalable interventions that address the physical and psychological effects of substance use on individuals and improve their general health. PA engagement, if sustained post-treatment, may offer indispensable benefits for individuals in SUD treatment. Stakeholder involvement and co-design are widely recommended research practices for public health studies involving patient groups (Brett et al., 2014; Gray-Burrows et al., 2018). Participatory methods, such as co-production, are increasingly recognised for their value in behaviour change intervention development (Colquhoun et al., 2017; Smith et al., 2023). Engagement of people with lived or living experience (PWLE) and stakeholders (e.g., service providers and managers from SUD treatment facilities) in the co-design of an intervention to increase motivation for PA among people in SUD treatment is crucial for identifying, navigating, and effectively addressing the motivational challenges faced by this population. Past studies have had limited consumer and stakeholder involvement and reported high dropout rates. Such involvement in co-design processes of an intervention addressing these specific motivational challenges might result in the development of a program that is more acceptable, effective, and sustainable than would be possible without these insights.

The Behaviour Change Wheel (BCW) is a practical framework that provides a systematic approach to the design of behaviour change interventions (Michie et al., 2011). The BCW is based on the idea that behaviour change is not a one-size-fits-all process, but rather a complex and dynamic process that involves multiple steps. These steps include conducting a behavioural analysis of the issue, diagnosing the necessary changes, and connecting that diagnosis to intervention functions and behaviour change techniques (BCTs) to drive behaviour change. BCTs are replicable, standalone techniques or components used in interventions to modify, redirect, or regulate behaviour (Marques et al., 2024). The BCW provides a step-by-step framework for identifying and integrating effective BCTs into the design process of behaviour change interventions, with the goal of improving their effectiveness. Systematic reviews have identified effective BCTs for PA interventions in SUD contexts (Klamert et al., 2023; Thal et al., 2023). At its core, is the COM-B model for behaviour change, which suggests that behaviour (B) is generated through an interaction between capability (C; physical capability and psychological capability), opportunity (O; physical opportunity and social opportunity), and motivation (M; reflective motivation and automatic motivation; (Michie et al., 2011, 2014). The BCW has been successfully used for the development of PA (Truelove et al., 2020; Webb et al., 2016) and substance use (Gould et al., 2017; Shoosmith et al., 2023) interventions. Further, there is substantial overlap between MI techniques and BCTs (Hardcastle et al., 2017), making the use of the BCW for co-designing an MI-based intervention – and specifically for identifying effective techniques to increase PA motivation in SUD contexts – a logical choice.

To the best of our knowledge, there are no published studies employing theory-driven co-design approaches for the development of PA interventions for people with SUDs. We aim to describe the process via which we, with PWLE and stakeholder involvement, co-designed an MI-based intervention to increase PA motivation and PA maintenance among individuals in SUD treatment.

1. Materials and methods

1.1. Ontological and epistemological positions

For the purpose of the study, we adopted a social constructivist position (Burr, 2015). Accordingly, we acknowledge that reality is socially constructed and influenced by various contexts. Therefore, the data collected through interviews and advisory group meetings are shaped by our participants' cultural, social, historical, and political contexts. Similarly, our interpretation and analysis of the data are influenced by our own cultural, social, historical, and political backgrounds. Our

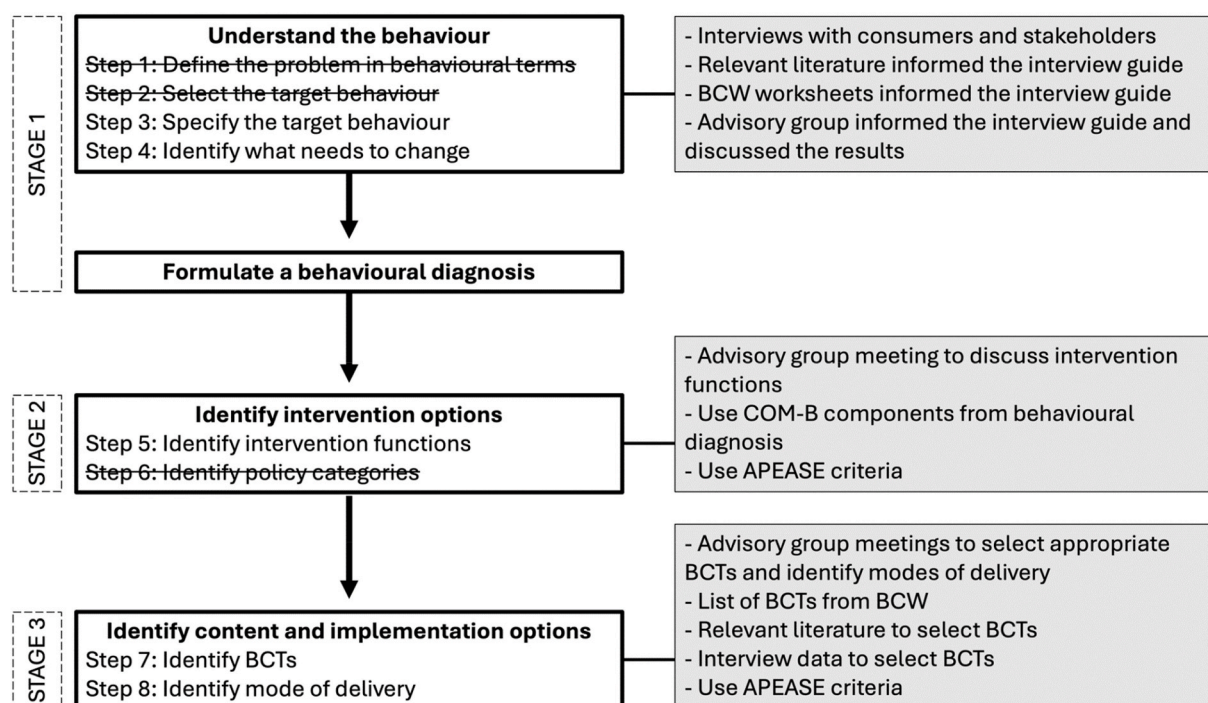


Fig. 1. Flow Diagram of the Co-design Process Using the Behaviour Change Wheel as a Framework

Note. Strikethroughs indicate that the respective BCW step has not been completed as part of the co-design process. Steps 1 and 2 were not completed as a clear understanding of the problem and the target behaviour existed from a systematic review of the literature. Step 6 was not completed, as none of the policy categories listed in the BCW model were expected to support the intervention.

Definitions. According to Michie et al. (2011, 2014). BCW: Behaviour Change Wheel; BCT: Behaviour Change Technique; COM-B: The initials stand for "capability," "opportunity," "motivation," and "behaviour," with the model recognising that behaviour is part of an interactive system involving all these components; APEASE: This is a set of guidelines used in the development, selection, and evaluation of interventions, the initials stand for "affordability," "practicability," "effectiveness and cost-effectiveness," "acceptability," "side-effects/safety," and "equity".

ontology embraces a relativist perspective. We recognise that multiple, context-dependent realities exist. We aim to understand and interpret these diverse perspectives and acknowledge that knowledge and truth are constructed through social interactions and individual experiences (Burr, 2015; Rassokha, 2022). These positions are reflected in our methodological choices. We employed semi-structured interviews and advisory group meetings with PWLE and relevant stakeholders. Our inductive approach to data analysis further aligns with our social constructivist paradigm.

1.2. Study design

The BCW guided the co-design process of our motivational intervention (Michie et al., 2011, 2014). For the co-design process, we used an Integrated Knowledge Translation approach. Integrated Knowledge Translation is defined as collaboration between knowledge users (i.e., stakeholders and PWLE) and academic researchers, with the aim of increasing the impact and utility of the research (Smith et al., 2023). This process was facilitated through semi-structured interviews with PWLE of SUD treatment and other stakeholders, regular advisory group meetings, and evidence from current literature. Fig. 1 provides an overview of the method.

1.3. Participants

Participants in the co-design study were PWLE of SUD treatment and stakeholders (managers, consultants, and clinicians) from four residential treatment facilities, one harm reduction service and one organisation representing stakeholders in the SUD treatment sector in Western Australia (Palmerston Association, Milliya Rumurra Aboriginal Corporation, Tenacious House, and Ngnowar-Aerwah Aboriginal

Table 1

Demographic information of people with lived or living experience participating in interviews.

Sample Characteristics	<i>n</i>	%	<i>M</i>	<i>SD</i>
Age			34.25	4.42
Gender				
Female	1	20		
Male	3	60		
Ethnicity				
Aboriginal	2	40		
Caucasian	2	40		
Other	1	20		
Employment				
Part-time	1	20		
Full-Time	3	60		
Relationship				
Yes	3	60		
No	1	20		
Current Substance Use				
Alcohol	2	40		
Cannabis	1	20		
Nicotine	2	40		
(Meth-)Amphetamines	1	20		
Methylenedioxymethamphetamine	1	20		
Painkillers/Opioids	1	20		
Benzodiazepines	1	20		

Note. *n* = 5. Data from one individual with lived or living experience is partially missing.

Corporation). For the ten semi-structured interviews, we recruited five PWLE of SUD treatment and five stakeholders (five male, four female, one individual did not disclose their gender; mean age = 39.8 years, SD = 11.8) from four WA residential SUD treatment facilities. About 20% of participants identified as Aboriginal and/or Torres Strait Islander

Table 2
Demographic information of stakeholders participating in interviews.

Sample Characteristics	<i>n</i>	%	<i>M</i>	<i>SD</i>
Age			44.20	14.48
Gender				
Female	3	60		
Male	2	40		
Ethnicity				
Caucasian	5	100		
Relationship				
Yes	5	100		
Employment				
Part-time	1	20		
Full-Time	4	80		
Years Employed				
≤5 years	2	40		
≤10 years	1	20		
>11 years	2	40		
Job Role				
Manager	2	40		
Exercise Physiologist	1	20		
CEO	1	20		
Counsellor	1	20		

Note. *n* = 5.

Table 3
Demographic information of advisory group members.

Sample Characteristics	<i>n</i>	%	<i>M</i>	<i>SD</i>
Age			46.86	12.10
Gender				
Female	3	37.5		
Male	4	50		
Ethnicity				
Caucasian	7	87.5		
Level of Education				
Tertiary Education	7	87.5		
Employment				
Full-Time	7	87.5		
Years Employed				
≤10 years	6	87.5		
Job Role				
Manager	3	37.5		
Exercise Physiologist	1	12.5		
CEO	2	25		
Project Officer	1	12.5		

Note. *n* = 8. Data from one participant is partially missing.

people, representing the demographic profile of people who access SUD treatment in WA. Our advisory group consisted of eight individuals (four male, three female, one who did not share their gender; mean age = 46.9 years, *SD* = 12.1) from across all abovementioned institutions. Demographic information of all participants can be found in [Tables 1–3](#).

1.4. Recruitment and consent procedure

We used purposeful sampling to recruit participants. We recruited stakeholders by sending them an email including a project outline, our contact details, and an invitation to contact us if they wanted to participate in the advisory group and/or the interviews. We recruited PWLE of SUD treatment through collaborating facilities that assisted in identifying and connecting key potential interviewees with researchers. Staff members were asked to verbally advertise the project to PWLE of SUD treatment. We ensured recruitment of a representative proportion (20%) of individual who identified as Aboriginal and/or Torres Strait Islander people. PWLE of SUD treatment and stakeholders were only contacted if they initiated contact or expressed an interest in the study, or if a staff member had initiated contact on their behalf.

Participant information statements and consent forms were distributed to and signed by all participants. Participants had the opportunity

to discuss any queries related to the research project with the researchers. Once informed consent was obtained, participants were requested to complete a survey encompassing demographic information.

1.5. Behaviour Change Wheel process for intervention development

The BCW consists of eight steps across three stages guiding the intervention design: stage 1: understand the behaviour, including steps 1–4; stage 2: identify intervention options, including steps 5–6; and stage 3: identify intervention content, including steps 7–8.

1.5.1. Steps 1–2: defining the problem and selecting the target behaviour

The first two steps of the BCW involve defining the problem (step 1) and identifying a list of possible target behaviours to be altered for the desired outcome to be achieved (step 2). We did not go through these two steps as we had a clear understanding of the problem and the target behaviour from a systematic review of the literature ([Thal et al., 2023](#)).

1.5.2. Step 3–4: Specifying the target behaviour and identifying necessary changes

We commenced with step three in which we followed [Michie et al. \(2014\)](#)'s suggestions for describing the target behaviour in terms of who needs to do what, when, where, how often and with whom. In step four, we identified what changes (if any) were needed in terms of capability, opportunity, and motivation to facilitate the desired behaviour change. This study addressed steps three and four simultaneously through semi-structured interviews with PWLE of SUD treatment and stakeholders of SUD treatment facilities in WA. A preliminary interview guide was informed by findings from a systematic review ([Thal et al., 2023](#)), the COM-B Self-Evaluation Questionnaire, and the COM-B Behaviour Diagnosis Form outlined in [Michie et al. \(2014\)](#). The interview guide was presented to the advisory group in the first meeting and finalised based on feedback from group discussions. Semi-structured interviews were then conducted and analysed after the first and prior to the second advisory group meeting. Through an analysis of the interview data, we identified and categorised recurring themes related to the COM-B components. During the second advisory group meeting, the interview findings were discussed, and the group was asked to provide feedback on how the proposed intervention could address barriers and capitalise on opportunities. The behavioural diagnosis, guided by the COM-B model, was finalised to provide an overview of the factors identified by interviewees and advisory group members as key barriers and facilitators to the planned intervention.

1.5.3. Step 5: identifying intervention functions

In step five, we used interview themes and the behavioural diagnosis during the third meeting to guide advisory group discussions on suitable intervention functions identified by [Michie et al. \(2011\)](#): education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring, modelling, and/or enablement – and their potential effectiveness for an MI-based intervention. APEASE criteria (that is, acceptability, practicality, effectiveness, affordability, side-effects, and equity) were used to evaluate the suitability of each intervention function ([Michie et al., 2014](#)). Furthermore, the group assessed whether the intervention functions addressed the barriers and facilitators identified in the behavioural diagnosis.

1.5.4. Step 6: identifying policy categories

We omitted step six, since our intervention was not expected to be aided by any policy categories listed in the BCW model.

1.5.5. Step 7: identifying behaviour change techniques

In step seven, we determined which BCTs were most suitable for the intervention functions we had identified in step five. We chose these BCTs from a list of BCTs provided by [Michie et al. \(2014\)](#) alongside the interview data and relevant literature on effective BCTs in PA

interventions in SUD populations (Thal et al., 2023), effective BCTs for long-term PA maintenance (Howlett et al., 2019), and BCTs that overlap with MI techniques (Hardcastle et al., 2017). We created a comprehensive table of potential BCTs and discussed them as a research team and then again with the advisory group (meeting four) to select the most appropriate techniques using the APEASE criteria while considering the barriers and facilitators identified earlier.

1.5.6. Step 8: identifying mode of delivery

In step eight, we decided on the intervention content and mode of delivery, including the provider(s), the setting, the recipients, the intensity, the duration, and the fidelity assessment in consultation with advisory group members. Researchers initially drafted an outline of the intervention content, which was then presented to the advisory group (meeting five). Afterwards, the outline was revised to incorporate advisory group feedback.

1.6. Data collection

Semi-structed interviews were conducted with each stakeholder and PWLE in person, via telephone, or video-call by the first author (ST) between February and March 2023. The average duration of the interviews was 32.5 min (range: 30–45 min). The interviews were audio-recorded, transcribed verbatim using AI transcription software and then checked for accuracy by ST. Subsequently, the interviews were anonymised and discussed with the advisory group in steps 3 and 4 as part of the co-design process.

Five 1-h long advisory group meetings took place between January and August 2023. The meetings were conducted via Microsoft Teams, with each advisory group meeting structured around specific aims and objectives outlined at the beginning of the session. The agendas followed the respective steps of the BCW, and the research team prepared and distributed all necessary materials to participants beforehand. ST led the sessions, with three additional researchers (JJ, SB, EQ) co-facilitating group discussions and working to maintain equal power relations and ensuring that all perspectives were heard and considered. The meetings were audio-recorded, and recordings were used for reflexive discussions amongst the researcher team and to create extensive notes to inform the co-design process of the intervention and the analyses of the outcomes related to the BCW components.

1.7. Data analysis

We conducted a conventional content analysis (Hsieh & Shannon, 2005) of the interview data. The data were coded independently by ST using the NVivo software (version 12). Preliminary codes were inductively developed through a systematic examination of the data, wherein ST identified noteworthy and informative aspects of data items in relation to barriers and facilitators to PA motivation and PA maintenance. Thereby, codes were continually revised, joined and consolidated to group them into meaningful clusters (Patton, 2014). Once we reached a succinct collection of codes that still retained sufficient detail to independently convey the commonalities among constituent data items, we developed higher-order categories based on the COM-B components (i. e., physical capability, psychological capability, physical opportunity, social opportunity, reflective motivation, and automatic motivation). Subsequently, we matched our inductively developed codes with these higher-order COM-B categories which served as a predefined framework for the behavioural diagnosis which was discussed and revised with the advisory group. The final behavioural diagnosis was used to inform subsequent BCW steps.

1.8. Research ethics approval

The study was approved by the Curtin University Human Research Ethics Committee (HRE2022-0671), and the Western Australian

Table 4
Summary of behavioural diagnosis using the COM-B model.

Source of Behaviour	Barriers and Facilitators Identified in Interviews	Barriers and Facilitators Emphasised by Advisory Group
Physical capability	• Medical & physiological conditions • Tailor exercises & programs • Structured plan	• Tailor exercises & programs • Determine and overcome physical limitations • Experience benefits • Change beliefs about exercise
Psychological capability	• Discipline • Social comparison & shame • Mental health conditions • Competing behaviours & commitments • Knowledge	• Overcoming mental obstacles • Having more mental stamina • Knowledge about benefits, how-to, nutrition
Physical opportunity	• Accessibility • Arrange PA group after treatment ends • Finances • Weather	• Accessibility
Social opportunity	• Community & culture • Return to old environment • Social support • Combine PA & talk therapy • PA instructor • Role-model	• Social support
Reflective Motivation	• (Self-)motivation • Accountability • Encouragement • Make PA mandatory • Experience benefits • Feedback about health • Goal setting • Positive future perspective • Self-monitoring device	• Reinforce conscious decision to perform PA
Automatic Motivation	• Routine • Having fun, joy, passion	• Feel that they want to do it enough • Routine

Note. According to Michie et al. (2014). Physical capability: Physical skill, strength or stamina; Psychological capability: Knowledge or psychological skills, strength or stamina to engage in the necessary mental processes; Physical opportunity: Opportunity afforded by the environment involving time, resources, locations, cues, physical ‘affordance’; Social opportunity: Opportunity afforded by interpersonal influences, social cues and cultural norms that influence the way that we think about things, e.g. the words and concepts that make up our language; Reflective motivation: Reflective processes involving plans (self-conscious intentions) and evaluations (beliefs about what is good and bad); Automatic motivation: Automatic processes involving emotional reactions, desires (wants and needs), impulses, inhibitions, drive states and reflex responses.

Aboriginal Health Ethics Committee (HREC1215).

The collection, use, and storage of all data complied with the National Aboriginal and Torres Strait Islander Health Data Principles (Australian Institute of Health and Welfare, 2006). Thereby, it was ensured that privacy was protected, and the data were handled ethically and were used meaningfully and collaboratively.

2. Results

2.1. Behavioural diagnosis

A comprehensive summary of the behavioural diagnosis based on the COM-B model can be found in Table 4.

2.2. Physical capability

In every interview, participants highlighted medical and physiological comorbidities (e.g., diabetes, obesity, or injuries) as potential obstacles to PA:

“There are definitely people that are obese [...] and there’s people that literally have knee injuries” (PWLE 2).

“I mean, weight is always an issue. And just the ability to, you know, to move fluidly or breathe correctly, because you, you carry excess weight. There’s, there’s people that carry injuries and things like that. So they’re limited with some of the types of exercises they can do, or, or, you know, some of the body areas that they can work on” (Stakeholder 1).

There was consensus on the importance of tailoring exercises and programs to accommodate specific needs arising from these comorbidities.

“I guess for the older people that had medical issues as well, it was [...] a bit hard for them. So something that helps them as well. You know, whether it be pool, water works or something” (PWLE 1)

“We do get quite a lot of people coming in who’ve got chronic illnesses, particularly diabetes, but oftentimes high blood pressure, and also muscular skeletal injuries from accidents. And so for a lot of that’s, I think, why the exercise physio was really good, because we were looking at kind of exercise programs that are tailored around their specific health needs and goals, and trying to get their physical health [...] while they’re here in a drug and alcohol free environment, trying to recover some of the physical health as well” (Stakeholder 4).

This was endorsed by the advisory group who emphasised the necessity of identifying physical limitations of participants and determining individual strategies to overcome them. This approach was deemed crucial for supporting sustained motivation for PA and PA maintenance.

2.3. Psychological capability

Participants mentioned that self-discipline or the lack thereof, social comparison and shame, mental health conditions, and the presence or absence of knowledge about the benefits of PA, how to conduct PA, and proper nutrition were facilitators (or barriers) for long-term PA motivation and maintenance.

“[...] and even in rehab, the only thing that would stop you is your own head” (PWLE 1).

“The other challenges will be around mental health, and severe mental health conditions such as schizophrenia or anxiety, depression. Which could limit an individual’s ability to participate in group activities or group fitness, or even have the motivation to participate in a daily walk” (Stakeholder 5).

Advisory group members also highlighted the importance of knowledge about the benefits of PA, how to undertake different forms of PA, and nutrition. Additionally, they drew attention to the significant contribution of psychological capability to overcome mental obstacles and the presence of mental stamina for long-term PA motivation and maintenance. Advisory group members also emphasised the importance of residents gaining first-hand experience of the benefits of PA, which may lead to a shift in their beliefs about PA.

2.4. Physical opportunity

Interviewed participants emphasised the importance of post-SUD treatment access to PA groups and other opportunities to perform PA. Access and opportunity were often described as associated with financial challenges and adverse weather conditions in WA; both identified as barriers for long-term PA motivation and maintenance.

“I mean, there’s ... just cost money as well. That’s another thing, you know, like, some of these gyms are quite expensive” (PWLE 4).

“The gym is on the other side of town, which is quite a long walk and quite hot up here” (PWLE 1).

The advisory group also emphasised the pivotal role of accessibility to facilities, equipment, and/or instructed PA sessions in long-term PA motivation and maintenance.

2.5. Social opportunity

The profound positive effects of social support and the negative effects of its absence on long-term PA motivation and maintenance was consistently mentioned across interviews. This was further reinforced in advisory group discussions. The availability of PA instructors during and after SUD treatment and their ability to function as role-models was considered essential engaging in and maintaining PA and PA motivation long-term by interviewees.

“Which is, which is what really appealed to me though. Having some discipline and especially having someone like train me like that. [...] Yeah, maybe someone like who’s in the same ... from the same background? And telling them, you know, their story and telling them health ... how physical exercise is part of their recovery and is gonna get to where they are” (PWLE 5)

Other potential barriers mentioned in interviews included challenges faced by residents upon returning to their old environment and living conditions outside of treatment facilities.

“So yeah, once you leave the rehabilitation centre, you can just go off by yourself and just lose kind of your way a little bit” (PWLE 5).

2.6. Reflective motivation

Likewise, encouragement and goal setting were identified as effective strategies for PA motivation and PA maintenance. It was further discussed that positive beliefs and conscious decisions to perform PA must be reinforced.

“setting goals I think is very important, even as small as just this week goal, or just today” (PWLE 5)

2.7. Automatic motivation

According to interviewees, establishing a routine and exploring ways to derive fun, joy, and passion from or in relation to PA were important factors in fostering long-term PA motivation and maintenance.

“But from a physiological adaptation perspective, I think that takes time, it takes consistency, as in, you know, we want to be exercising multiple times a week, for, you know, six to eight weeks to even, you know, see those changes” (Stakeholder 2).

Advisory group members echoed the importance of establishing and adhering to a routine. Further, they suggested that a genuine desire to engage in PA was important, as well.

2.8. Identification of intervention functions

Four intervention functions were excluded during advisory group discussions as they did not meet the APEASE criteria (see Table 5). Incentivisation was not considered to be practicable, affordable, or equitable for this intervention context. Coercion and restriction were not considered acceptable and equitable by either residents or clinical staff. Environmental restructuring was omitted as it was not considered practical. As a result, the following five intervention functions were selected for the co-designed intervention: Education, persuasion, training, modelling, and enablement.

Table 5
Linking behavioural diagnosis and intervention functions.

Intervention Function	Physical Capability	Psychological Capability	Physical Opportunity	Social Opportunity	Reflective Motivation	Automatic Motivation
Education	×	✓	×	×	✓	×
Persuasion	×	✓	×	×	✓	✓
Incentivisation	×	×	×	×	×	×
Coercion	×	×	×	×	×	×
Training	✓	✓	✓	×	×	✓
Restriction	×	×	×	×	×	×
Environmental Restructuring	×	×	×	×	×	×
Modelling	×	✓	×	✓	×	✓
Enablement	✓	✓	✓	✓	×	✓

Definitions. According to [Michie et al. \(2011, 2014\)](#). Education: Increasing knowledge or understanding; Persuasion: Using communication to induce positive or negative feelings or stimulate action; Incentivisation: Creating expectation of reward; Coercion: Creating an expectation of punishment or cost; training, imparting skills; Restrictions: Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours); Environmental Restructuring: Changing the physical or social context; Modelling: Providing an example for people to aspire to or imitate; Enablement: Increasing means/reducing barriers to increase capability (beyond education) or opportunity (beyond environmental restructuring).

2.9. Selection of behaviour change techniques

A total of 20 BCTs met APEASE criteria and were selected to be included in the intervention. The 20 BCTs that we selected can be found in [Appendix A](#) alongside their definitions, evidence for their efficacy, reasons for using the BCTs, and their application in the final intervention.

2.10. Mode of delivery

Face-to-face delivery at both individual and group level was selected by the advisory group as the mode of delivery. This decision was influenced by the unanimous recognition that social support is crucial to PA motivation and PA maintenance, highlighted by stakeholders, PWLE of SUD treatment, and the advisory group early in the co-design process. Eventually, this recognition prompted the consideration of a group intervention in which the importance of establishing feasible strategies to access (group) PA following the conclusion of residential SUD treatment plays a vital role.

Meanwhile, the desire for role-models and professional PA instructors, identified through the interviews, prompted considerations for a multi-professional approach. Discussions within the advisory group affirmed the significance of incorporating PWLE, as their involvement was recognised as crucial for enhancing credibility. The intervention was thus co-designed to be delivered by a health professional with training in MI, with the support of a peer worker and an exercise physiologist and/or personal trainer, as an adjunct intervention to treatment as usual in residential SUD treatment facilities.

The intervention was based on MI principles ([Miller & Rollnick, 2023](#)) and covers the five key themes of behaviour change maintenance ([Kwasnicka et al., 2016](#)). The preliminary version of the intervention content was designed by the research team based on a MI manual specifically adapted for group settings ([Wagner & Ingersoll, 2013](#)). Through discussions with the advisory group, the content was revised. The final intervention comprises three individual sessions (sessions #1, #11 and #12) and nine group sessions (session #2-#10). The first individual session is an introductory session, while the last two individual sessions are booster sessions which will be conducted after residential SUD treatment has been concluded. The advisory group highlighted the importance of incorporating booster sessions after the end of the treatment to enhance the translation of intervention strategies into real-life settings, thereby promoting long-term PA maintenance. Furthermore, advisory group members emphasised the importance of creating, reviewing, and revising individual action plans. This included considerations on enabling recipients to access physical activity groups post-treatment. The group sessions adhere to a support group format ([Wagner & Ingersoll, 2013](#)).

All sessions are designed to last approximately 60 min, include a short burst (1–2 min) of PA, and are conducted in a designated room in

the treatment facility. Sessions #1 through #10 will be conducted weekly, while the booster sessions may be scheduled at four-week intervals. To support resource conservation and flexible integration, the intervention was designed as a standalone component that can be seamlessly incorporated into various existing PA programs at treatment facilities. Ideally, each motivational session would be followed by group PA. Decisions on these aspects of the intervention have all been heavily influenced by discussions with the advisory group and their personal and professional experiences. The suggestion to include short bursts of PA was proposed by one member to demonstrate to participants how exercise can be seamlessly incorporated into everyday situations. An outline of all sessions can be found in [Appendix B](#). A research trial evaluating the intervention commenced in December 2023, and the findings from this study will be reported in a separate publication.

3. Discussion

The aim of this study was to co-design an intervention, guided by the BCW framework, to improve PA motivation and maintenance for individuals in residential SUD treatment. We developed an individual and group-based face-to-face intervention with five intervention functions (i. e., education, persuasion, training, modelling, enablement) and 20 BCTs. While the use of effective BCTs ([Thal et al., 2023](#)) and motivation for PA ([Abrantes & Blevins, 2019](#); [Stoutenberg et al., 2015](#)) are known to influence PA intervention outcomes in this population, these factors have received limited consideration in current interventions ([Thal et al., 2023](#)). Importantly, our co-designed intervention specifically targets these critical elements and, by incorporating insights from PWLE and stakeholders into co-design process, enhances acceptability and fills an important gap in the literature.

To understand the essential behavioural changes required to maintain PA in this population, we conducted a comprehensive behavioural diagnosis as part of the BCW process. [Michie et al. \(2014\)](#) recommend collecting data from a diverse range of relevant sources to attain a comprehensive, multi-perspective understanding of the target behaviour. Our behavioural diagnosis was informed by a thorough review of the literature, semi-structured interviews with PWLE of SUD treatment and stakeholders, and advisory group discussions. Interview participants and advisory group members came from a diverse range of backgrounds and treatment facilities across WA. This diversity of perspective facilitated a multidimensional understanding of potential barriers and facilitators for PA behaviour initiation and maintenance which informed all subsequent stages of the co-design process. Although we set the initial agenda for the advisory group discussions, there was ample opportunity for input from all group members. Group discussions were facilitated with flexibility, allowing for open contributions from all members without strict control while designated members ensured that power dynamics remained equitable. The importance of input from PWLE and stakeholders was consistently acknowledged, and their contributions were genuinely integrated

into the final decisions. The co-design process was instrumental in ensuring that the barriers and facilitators we identified were, not only theoretically grounded, but also practically relevant and actionable for the target population. Discussions around accessibility to PA were particularly prevalent in regional areas of WA. Similar issues have been identified in a co-design study for PA in refugees (McKeon et al., 2024). In our study, participants from these regions played a key role in acknowledging and understanding the complexity of accessibility issues and the need to address them pre-emptively. They contributed valuable insights on how to develop context-informed action plans as part of the intervention, ultimately benefiting individuals with substance use issues in metropolitan areas as well. This highlights the importance of contextual sensitivity, a key strength of our co-design process.

Interviews provided additional insights, revealing that interviewees valued the potential of incorporating interventions targeting PA motivation alongside actual PA. While research highlights the importance of integrating PA interventions directly into the therapeutic process and broader SUD treatment plans (Theodorakis et al., 2024), combining interventions targeting PA motivation and PA has not been considered or implemented in past interventions and represents a unique insight derived specifically from the PWLE and stakeholder involvement in the co-design approach. Interviewees further expressed a desire for personalised exercise strategies that promote accessibility and inclusiveness and reduce potential feelings of shame. Advisory group discussions reinforced these findings, echoing findings from a recent review by Horrel et al. (2020). Their study outlined the significance of offering choice and individually tailored support to align PA with an individual's abilities, preferences, and beliefs about its benefits as crucial to fostering PA motivation. Further person-centred care is a core component of high quality and effective SUD treatment services (Davis et al., 2020). Similarly, the critical role of social support for PA was identified in the review of the literature, the interviews, and advisory group discussions. Interview participants and advisory group members expressed the desire for peer role models and professional PA instructors. This is not surprising as social support in cohesive PA groups and regular contact with PA instructors have been shown to be superior to individual exercise for adherence to and effectiveness of PA interventions (Burke et al., 2006). Ultimately, advisory group discussions of the interview findings shaped the decision to involve peer workers who successfully managed to be and stay physically active as part of their recovery in the facilitation of the intervention. This decision represents another element of the intervention that was directly influenced by the co-design approach and the involvement of PWLE and stakeholders. While the increased use of peer workers in SUD settings has been highlighted in the literature (e.g., Chapman et al., 2018; Shalaby & Agyapong, 2020), they have not been involved in past PA interventions within SUD contexts.

Preliminary considerations derived from the behavioural diagnosis and advisory group discussions regarding the feasibility of potential intervention functions had a critical influence on the BCT selection. While we considered BCTs which had previously been identified as potentially effective for certain intervention functions (Michie et al., 2014) and/or PA interventions in SUD contexts (Thal et al., 2023), we also included BCTs associated with long-term PA increases (Howlett et al., 2019) and MI techniques (Hardcastle et al., 2017). This illustrates the strengths of our BCW approach which allowed for the effective combination and integration of insights from interviews and advisory group discussions with evidence-based strategies. The iterative and theory-driven approach to co-designing this motivational intervention resulted in an intervention that was informed by real-world perspectives on feasibility, acceptability and appropriateness while being grounded in established evidence-based techniques for enhancing motivation.

3.1. Limitations

A limitation of documenting the BCW process lies in its iterative nature. It is difficult to capture the complexity of the stepwise approach,

as outlined by Michie et al. (2014), due to its bidirectional flow. The process sometimes involved revisiting earlier stages, and these revisits and consequential adjustments are difficult to document. While the iterative nature of the BCW process can be considered a strength due to its flexibility and adaptability, it becomes challenging to describe each step in the development process.

Since stakeholders and PWLE of SUD treatment were self-selecting and motivated it is important to acknowledge that the generalisability of the findings to the broader population of people with SUDs might be limited. While we successfully recruited PWLE of SUD treatment, as well as stakeholders with varying self-reported levels of PA, it is noteworthy that some interviewed participants, for instance, reported high levels of PA, including activities such as running marathons.

Certain elements of the BCW process, particularly advisory group discussions, could have benefited from greater process depth. Studies employing experience-based co-design approaches (Matthews et al., 2022; McKeon et al., 2024) have employed methods such as trigger films, emotional and priority mapping, and action planning, which could be integrated into certain steps of the BCW framework in future research.

The SUD treatment landscape varies significantly across countries and healthcare systems, with notable differences in the quality and availability of PA programs as part of standard treatment. Therefore, the findings of this study are specific to Australia and would require further adaptations to be effectively implemented in countries with different healthcare systems. Furthermore, the motivational intervention was co-designed to be implemented in SUD treatment facilities that include an instructor-led PA program as part of their treatment program. Consequently, the intervention would require further adaptation to be delivered in SUD treatment facilities that do not currently deliver PA.

3.2. Future directions

International organizations, including the World Health Organization (World Health Organization, 2018, 2023) and the United Nations Office on Drugs and Crime (United Nations Office on Drugs and Crime, 2021), explicitly highlight the importance of preventive measures against substance use issues and the benefits of physical activity for substance use prevention. The motivational intervention developed from the co-design study aligns well with the directions advocated by these organizations and could prove helpful in fostering long-term physical activity maintenance among this population.

To advance this work, the next steps involve piloting the intervention prototype to test whether it is feasible to deliver in real world SUD treatment settings, acceptable to service users and providers, and leads to desired changes in motivation and PA. This feedback is needed to refine the intervention before further testing in a randomised trial. Fostering PA motivation and maintaining PA engagement among individuals with SUDs remains vital for increasing their quality of life and reducing health care expenditures. While further testing is needed to establish the intervention's effectiveness, the intervention outline provided in Supplement B offers treatment providers the opportunity to implement this low-cost motivational intervention into treatment plans that include instructor-led PA programs.

4. Conclusion

To the best of our knowledge, this co-designed intervention is the first to employ evidence based BCTs to target PA motivation in this population. By targeting PA motivation through tailored individual and group-based face-to-face motivational sessions, this intervention tackles well-known barriers of PA in SUD populations which previous studies failed to address. The iterative co-design process, with inputs from PWLE of SUD treatment and stakeholders ensured that the intervention was responsive to the needs, concerns, and intervention preferences of people with SUDs, likely enhancing its feasibility and acceptability. As

such this intervention has the potential to support people with SUDs to maintain physically active lifestyles during and after residential SUD treatment. Further studies are needed to establish the feasibility, acceptability, and outcomes of the intervention.

CRedit authorship contribution statement

Sascha Thal: Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Stephen Bright:** Writing – review & editing, Supervision, Project administration, Methodology. **Nikos Ntoumanis:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Bronwyn Myers:** Writing – review & editing, Supervision, Conceptualization. **Jocelyn Jones:** Writing – review & editing, Supervision, Conceptualization. **Eleanor Quested:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We acknowledge the Whadjuk Nyoongar people on whose traditional lands most of the work in relation to this study has been conducted. We acknowledge individuals within our communities who have lived or living experiences with substance use and mental health challenges, as well as those who provide care and support to them. We would like to acknowledge and extend our gratitude to the Western Australian Network of Alcohol and other Drugs Agencies, Palmerston Association, Milliya Rumurra Aboriginal Corporation, Tenacious House, Ngnowar-Aerwah Aboriginal Corporation, and Peer Based Harm Reduction WA for collaborating with us in this study. Furthermore, we would like to thank every member of the advisory group including James Clarke, Sarah Ludowici, Suzanne Blyth, Lesley Roxbee, Mark Walker, Paul Dessauer, Matt Ryan, and Wendy Shannon for their invaluable contributions, innovative ideas, and constructive feedback. Lastly, we want to extend our gratitude to everyone who participated in the interviews.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.psychsport.2025.102829>.

Data availability

The data that has been used is confidential.

References

- Abrantes, A. M., & Blevins, C. E. (2019). Exercise in the context of substance use treatment: Key issues and future directions. *Current Opinion in Psychology*, 30, 103–108. <https://doi.org/10.1016/j.copsyc.2019.04.001>
- Anshel, M. H., & Kang, M. (2008). Effectiveness of motivational interviewing on changes in fitness, blood lipids, and exercise adherence of police officers: An outcome-based action study. *Journal of Correctional Health Care*, 14(1), 48–62. <https://doi.org/10.1177/1078345807308846>
- Australian Institute of Health and Welfare. (2006). *National aboriginal and Torres Strait Islander health data principles*. Australian Institute of Health and Welfare. <https://www.aihw.gov.au/getmedia/885b2545-33c0-46c0-ad89-6db7de6f801e/nagatsih-id-data-principles.doc.aspx>
- Australian Institute of Health and Welfare. (2024). Alcohol and other drug treatment services in Australia: Early insights. <https://www.aihw.gov.au/reports/alcohol-other-drug-treatment-services/australian-institute-of-health-and-welfare/contents/ky-findings/clients>
- Brett, J., Staniszewska, S., Mockford, C., Herron-Marx, S., Hughes, J., Tysall, C., & Suleman, R. (2014). Mapping the impact of patient and public involvement on health and social care research: A systematic review. *Health Expectations*, 17(5), 637–650. <https://doi.org/10.1111/j.1369-7625.2012.00795.x>
- Brorson, H. H., Arnevik, E. A., Rand-Hendriksen, K., & Duckert, F. (2013). Drop-out from addiction treatment: A systematic review of risk factors. *Clinical Psychology Review*, 33(8), 1010–1024. <https://doi.org/10.1016/j.cpr.2013.07.007>
- Buchowski, M. S., Meade, N. N., Charboneau, E., Park, S., Dietrich, M. S., Cowan, R. L., & Martin, P. R. (2011). Aerobic exercise training reduces cannabis craving and use in non-treatment seeking cannabis-dependent adults. *PLoS One*, 6(3), Article e17465. <https://doi.org/10.1371/journal.pone.0017465>
- Burke, S. M., Carron, A. V., Eys, M. A., Ntoumanis, N., & Estabrooks, P. A. (2006). Group versus individual approach? A meta-analysis of the effectiveness of interventions to promote physical activity. *Sport & Exercise Psychology Review*, 2(1), 13–29. <https://doi.org/10.53841/bpssepr.2006.2.1.13>
- Burr, V. (2015). *Social constructionism* (3rd ed.). Routledge. <https://doi.org/10.4324/9781315715421>
- Chapman, S. A., Blash, L. K., Mayer, K., & Spetz, J. (2018). Emerging roles for peer providers in mental health and substance use disorders. *American Journal of Preventive Medicine*, 54(6, Supplement 3), S267–S274. <https://doi.org/10.1016/j.amepre.2018.02.019>
- Colledge, F., Gerber, M., Pühse, U., & Ludyga, S. (2018). Anaerobic exercise training in the therapy of substance use disorders: A systematic review. *Frontiers in Psychiatry*, 9 (December). <https://doi.org/10.3389/fpsy.2018.00644>
- Colquhoun, H. L., Squires, J. E., Kolehmainen, N., Fraser, C., & Grimshaw, J. M. (2017). Methods for designing interventions to change healthcare professionals' behaviour: A systematic review. *Implementation Science*, 12(1), 30. <https://doi.org/10.1186/s13012-017-0560-5>
- Davis, E. L., Kelly, P. J., Deane, F. P., Baker, A. L., Buckingham, M., Degan, T., & Adams, S. (2020). The relationship between patient-centered care and outcomes in specialist drug and alcohol treatment: A systematic literature review. *Substance Abuse*, 41(2), 216–231. <https://doi.org/10.1080/08897077.2019.1671940>
- Degenhardt, L., Glantz, M., Evans-Lacko, S., Sadikova, E., Sampson, N., Thornicroft, G., Aguilar-Gaxiola, S., Al-Hamzawi, A., Alonso, J., Andrade, L. H., Bruffaerts, R., Bunting, B., Bromet, E. J., Almeida, J. M. C. de, Girolamo, G. de, Florescu, S., Gureje, O., Haro, J. M., Huang, Y., ... Zaslavsky, A. M. (2017). Estimating treatment coverage for people with substance use disorders: An analysis of data from the World Mental Health Surveys. *World Psychiatry: Official Journal of the World Psychiatric Association (WPA)*, 16(3), 299–307. <https://doi.org/10.1002/WPS.20457>
- Dowla, R., Simmaz, H., Mavros, Y., Murnion, B., Cayan, E., & Rooney, K. (2022). The effectiveness of exercise as an adjunct intervention to improve quality of life and mood in substance use disorder: A systematic review. *Substance Use & Misuse*, 57(6), 911–928. <https://doi.org/10.1080/10826084.2022.2052098>
- Flemmen, G., Unhjem, R., & Wang, E. (2014). High-intensity interval training in patients with substance use disorder. *BioMed Research International*, 2014. <https://doi.org/10.1155/2014/616935>
- Fleury, M. J., Djouini, A., Huynh, C., Tremblay, J., Ferland, F., Ménard, J. M., & Belleville, G. (2016). Remission from substance use disorders: A systematic review and meta-analysis. *Drug and Alcohol Dependence*, 168, 293–306. <https://doi.org/10.1016/j.drugalcdep.2016.08.025>
- Furzer, B., Rebar, A., Dimmock, J. A., More, A., Thornton, A. L., Wright, K., Colthart, A., & Jackson, B. (2021). Exercise is medicine... when you enjoy it: Exercise enjoyment, relapse prevention efficacy, and health outcomes for youth within a drug and alcohol treatment service. *Psychology of Sport and Exercise*, 52, Article 101800. <https://doi.org/10.1016/j.psychsport.2020.101800>
- Garza, R. D. L., Yoon, J. H., Thompson-Lake, D. G. Y., Haile, C. N., Eisenhofer, J. D., Newton, T. F., & Mahoney, J. J. (2016). Treadmill exercise improves fitness and reduces craving and use of cocaine in individuals with concurrent cocaine and tobacco-use disorder. *Psychiatry Research*, 245, 133–140. <https://doi.org/10.1016/j.psychres.2016.08.003>
- Giesen, E. S., Deimel, H., & Bloch, W. (2015). Clinical exercise interventions in alcohol use disorders: A systematic review. *Journal of Substance Abuse Treatment*, 52, 1–9. <https://doi.org/10.1016/j.jsat.2014.12.001>
- Giménez-Meseguer, J., Tortosa-Martínez, J., & Cortell-Tormo, J. M. (2020a). The benefits of physical exercise on mental disorders and quality of life in substance use disorders patients. Systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, 17(10). <https://doi.org/10.3390/ijerph17103680>
- Giménez-Meseguer, J., Tortosa-Martínez, J., & Cortell-Tormo, J. M. (2020b). The benefits of physical exercise on mental disorders and quality of life in substance use disorders patients. Systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, 17(10). <https://doi.org/10.3390/ijerph17103680>
- Gould, G. S., Bar-Zeev, Y., Bovill, M., Atkins, L., Gruppeta, M., Clarke, M. J., & Bonevski, B. (2017). Designing an implementation intervention with the Behaviour Change Wheel for health provider smoking cessation care for Australian Indigenous pregnant women. *Implementation Science*, 12(1), 114. <https://doi.org/10.1186/s13012-017-0645-1>
- Gray-Burrows, K. A., Willis, T. A., Foy, R., Rathfelder, M., Bland, P., Chin, A., Hodgson, S., Ibegbuna, G., Prestwich, G., Samuel, K., Wood, L., Yaqoob, F., & McEachan, R. R. C. (2018). Role of patient and public involvement in implementation research: A consensus study. *BMJ Quality and Safety*, 27(10), 858–864. <https://doi.org/10.1136/bmjqs-2017-006954>
- Gür, F., & Can Gür, G. (2020). Is exercise a useful intervention in the treatment of alcohol use disorder? Systematic review and meta-analysis. *American Journal of Health Promotion*, 34(5), 520–537. <https://doi.org/10.1177/0890117120913169>
- Gür, F., & Gür, G. C. (2020). Is exercise a useful intervention in the treatment of alcohol use disorder? Systematic review and meta-analysis. *American Journal of Health Promotion*, 34(5), 520–537. <https://doi.org/10.1177/0890117120913169>

- Hallgren, M., Vancampfort, D., Giesen, E. S., Lundin, A., & Stubbs, B. (2017). Exercise as treatment for alcohol use disorders: Systematic review and meta-analysis. *British Journal of Sports Medicine*, 51(14), 1058–1064. <https://doi.org/10.1136/bjsports-2016-096814>
- Hardcastle, S. J., Fortier, M., Blake, N., & Hagger, M. S. (2017). Identifying content-based and relational techniques to change behaviour in motivational interviewing. *Health Psychology Review*, 11(1), 1–16. <https://doi.org/10.1080/17437199.2016.1190659>
- Horrell, J., Thompson, T. P., Taylor, A. H., Neale, J., Husk, K., Wanner, A., Creanor, S., Wei, Y., Kandiyali, R., Sinclair, J., Nasser, M., & Wallace, G. (2020). Qualitative systematic review of the acceptability, feasibility, barriers, facilitators and perceived utility of using physical activity in the reduction of and abstinence from alcohol and other drug use. *Mental Health and Physical Activity*, 19, Article 100355. <https://doi.org/10.1016/j.mhpa.2020.100355>
- Howlett, N., Trivedi, D., Troop, N. A., & Chater, A. M. (2019). Are physical activity interventions for healthy inactive adults effective in promoting behavior change and maintenance, and which behavior change techniques are effective? A systematic review and meta-analysis. *Translational Behavioral Medicine*, 9(1), 147–157. <https://doi.org/10.1093/tbm/iby010>
- Hsieh, H.-F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277–1288. <https://doi.org/10.1177/1049732305276687>
- Kingston, R. E. F., Marel, C., & Mills, K. L. (2017). A systematic review of the prevalence of comorbid mental health disorders in people presenting for substance use treatment in Australia. *Drug and Alcohol Review*, 36(4), 527–539. <https://doi.org/10.1111/dar.12448>
- Klamert, L., Craike, M., Bedi, G., Kidd, S., Pascoe, M. C., & Parker, A. G. (2023). Behaviour change techniques in physical activity-focused interventions for young people at risk of problematic substance use: A systematic review and meta-analysis. *Early Intervention in Psychiatry*, 17(12), 1139–1153. <https://doi.org/10.1111/eip.13467>
- Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehotka, F. (2016). Theoretical explanations for maintenance of behaviour change: A systematic review of behaviour theories. *Health Psychology Review*, 10(3), 277–296. <https://doi.org/10.1080/17437199.2016.1151372>
- Lauretani, F., Giallauria, F., Testa, C., Zinni, C., Lorenzi, B., Zucchini, I., Salvi, M., Napoli, R., & Maggio, M. G. (2024). Dopamine pharmacodynamics: New insights. *International Journal of Molecular Sciences*, 25(10), 5293. <https://doi.org/10.3390/ijms25105293>
- Lynch, W. J., Peterson, A. B., Sanchez, V., Abel, J., & Smith, M. A. (2013). Exercise as a novel treatment for drug addiction: A neurobiological and stage-dependent hypothesis. *Neuroscience & Biobehavioral Reviews*, 37(8), 1622–1644. <https://doi.org/10.1016/j.neubiorev.2013.06.011>
- Marques, M. M., Wright, A. J., Corker, E., Johnston, M., West, R., Hastings, J., Zhang, L., & Michie, S. (2024). The behaviour change technique ontology: Transforming the behaviour change technique taxonomy v1. *Wellcome Open Research*, 8, 308. <https://doi.org/10.12688/wellcomeopenres.19363.2>
- Martinez-Calderon, J., Villar-Alises, O., García-Muñoz, C., & Matias-Soto, J. (2023). Evidence level of physical exercise in the treatment of substance abuse/dependence: An overview of systematic reviews including 53 meta-analyses that comprised 103 distinct clinical trials. *Mental Health and Physical Activity*, 24, Article 100519. <https://doi.org/10.1016/j.mhpa.2023.100519>
- Matthews, E. W., Cowman, M., Brannigan, M., Rosenbaum, S., Sloan, D., Ward, P. B., & Denieffe, S. (2022). Implementing experience-based co-design to develop a physical activity programme in recovery-focused outpatient mental health services. *International Journal of Therapy and Rehabilitation*, 29(4), 1–16. <https://doi.org/10.12968/ijtr.2021.0101>
- McKeon, G., Curtis, J., Rostami, R., Sroba, M., Farello, A., Morell, R., Steel, Z., Harris, M., Silove, D., Parmenter, B., Matthews, E., Jamaluddin, J., & Rosenbaum, S. (2024). Co-Designing a physical activity service for refugees and asylum seekers using an experience-based Co-design framework. *Journal of Immigrant and Minority Health*, 26(4), 674–688. <https://doi.org/10.1007/s10903-024-01587-5>
- McLellan, A. T., Lewis, D. C., O'Brien, C. P., & Kleber, H. D. (2000). Drug dependence, a chronic medical illness: Implications for treatment, insurance, and outcomes evaluation. *JAMA*, 284(13), 1689–1695. <https://doi.org/10.1001/jama.284.13.1689>
- Michie, S., Atkins, L., & West, R. (2014). *The behaviour change Wheel: A guide to designing interventions*. Silverback Publishing. <https://www.behaviourchangewheel.com/>
- Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 6(1), 42. <https://doi.org/10.1186/1748-5908-6-42>
- Miller, W. R., & Rollnick, S. (2023). *Motivational Interviewing 4/e: Helping People Change and Grow* (4th ed. edition). THE GUILFORD PRESS.
- O'Halloran, P. D., Blackstock, F., Shields, N., Holland, A., Iles, R., Kingsley, M., Bernhardt, J., Lannin, N., Morris, M. E., & Taylor, N. F. (2014). Motivational interviewing to increase physical activity in people with chronic health conditions: A systematic review and meta-analysis. *Clinical Rehabilitation*, 28(12), 1159–1171. <https://doi.org/10.1177/0269215514536210>
- Patton, M. Q. (2014). *Qualitative research & evaluation methods* (4th ed.). SAGE publications, Inc <https://us.sagepub.com/en-us/nam/qualitative-research-evaluation-methods/book232962>
- Piché, F., Daneau, C., Plourde, C., Girard, S., & Romain, A. J. (2023). Characteristics and impact of physical activity interventions during substance use disorder treatment excluding tobacco: A systematic review. *PLoS One*, 18(4), Article e0283861. <https://doi.org/10.1371/journal.pone.0283861>
- Rassokha, I. M. (2022). Relativism as an ontological system. *Axiomathes*, 32(6), 1433–1449. <https://doi.org/10.1007/s10516-021-09589-w>
- Shalaby, R. A. H., & Agyapong, V. I. O. (2020). Peer support in mental health: Literature review. *JMIR Mental Health*, 7(6), Article e15572. <https://doi.org/10.2196/15572>
- Shoesmith, E., Huddleston, L., Pervin, J., Shahab, L., Coventry, P., Coleman, T., Lorencatto, F., Gilbody, S., Leahy, M., Horspool, M., Paul, C., Colley, L., Hough, S., Hough, P., & Ratschen, E. (2023). Promoting and maintaining changes in smoking behavior for patients following discharge from a smoke-free mental health inpatient stay: Development of a complex intervention using the behavior change wheel. *Nicotine & Tobacco Research*, 25(4), 729–737. <https://doi.org/10.1093/ntr/ntac242>
- Smedslund, G., Berg, R. C., Hammerstrom, K. T., Steiro, A., Leiknes, K. A., Dahl, H. M., & Karlsen, K. (2011). Motivational interviewing for substance abuse. *Campbell Systematic Reviews*, 7(1), 1–126. <https://doi.org/10.4073/csr.2011.6>
- Smith, B., Williams, O., Bone, L., & Collective, the M. S. W. C. (2023). Co-Production: A resource to guide co-producing research in the sport, exercise, and health sciences. *Qualitative Research in Sport, Exercise and Health*, 15(2), 159–187. <https://doi.org/10.1080/2159676X.2022.2052946>
- Stoutenberg, M., Warne, J., Vidot, D., Jimenez, E., & Read, J. P. (2015). Attitudes and preferences towards exercise training in individuals with alcohol use disorders in a residential treatment setting. *Journal of Substance Abuse Treatment*, 49, 43–49. <https://doi.org/10.1016/j.jsat.2014.08.008>
- ter Harmseel-Nieuwenhuis, L., Alarlan, G., van Hilvoorde, I., Koelen, M., Super, S., & Verkoijen, K. (2022). Life skills development and transfer amongst socially vulnerable adults through sports: A systematic review. *International Review of Sport and Exercise Psychology*, 0(0), 1–41. <https://doi.org/10.1080/1750984X.2022.2135125>
- Thal, S., Graham, C., Ntoumanis, N., Myers, B., Bright, S., Jones, J., & Quedsted, E. (2024). Fostering physical activity motivation at substance use disorder treatment facilities: A qualitative study grounded in self-determination theory. *Mental Health and Physical Activity*, 27, Article 100650. <https://doi.org/10.1016/j.mhpa.2024.100650>
- Thal, S. B., Maunz, L. A., Quedsted, E., Bright, S. J., Myers, B., & Ntoumanis, N. (2023). Behavior change techniques in physical activity interventions for adults with substance use disorders: A systematic review. *Psychology of Addictive Behaviors*, 37, 416–433. <https://doi.org/10.1037/adb0000842>
- Theodorakis, Y., Hassandra, M., & Panagiotounis, F. (2024). Enhancing substance use disorder recovery through integrated physical activity and behavioral interventions: A comprehensive approach to treatment and prevention. *Brain Sciences*, 14(6). <https://doi.org/10.3390/brainsci14060534>. Article 6.
- Thompson, T. P., Horrell, J., Taylor, A. H., Wanner, A., Husk, K., Wei, Y., Creanor, S., Kandiyali, R., Neale, J., Sinclair, J., Nasser, M., & Wallace, G. (2020). Physical activity and the prevention, reduction, and treatment of alcohol and other drug use across the lifespan (the phase review): A systematic review. *Mental Health and Physical Activity*, 19(February), Article 100360. <https://doi.org/10.1016/j.mhpa.2020.100360>
- Truelove, S., Vanderloo, L. M., Tucker, P., Di Sebastiano, K. M., & Faulkner, G. (2020). The use of the behaviour change wheel in the development of ParticAction's physical activity app. *Preventive Medicine Reports*, 20, Article 101224. <https://doi.org/10.1016/j.pmedr.2020.101224>
- Unhjem, R., Flemmen, G., Hoff, J., & Wang, E. (2016). Maximal strength training as physical rehabilitation for patients with substance use disorder; a randomized controlled trial. *BMC Sports Science, Medicine and Rehabilitation*, 8(1), 1–10. <https://doi.org/10.1186/s13102-016-0032-2>
- United Nations Office on Drugs and Crime. (2021). Leveraging sport for substance use prevention: Reviewing the evidence at the Commission on Narcotic Drugs. <https://www.unodc.org/dohadeclaration/en/news/2021/04/leveraging-sport-for-substance-use-prevention-reviewing-the-evidence-at-the-commission-on-narcotic-drugs.html>
- Wagner, C., & Ingersoll, K. (2013). *Motivational interviewing in groups*. Guilford Press.
- Webb, J., Foster, J., & Poulter, E. (2016). Increasing the frequency of physical activity very brief advice for cancer patients. Development of an intervention using the behaviour change wheel. *Public Health*, 133, 45–56. <https://doi.org/10.1016/j.puhe.2015.12.009>
- World Health Organization. (2018). *International standards for drug use prevention* (2nd ed.) 2018 <https://cdn.who.int/media/docs/default-source/substance-use/standards-180412.pdf>
- World Health Organization. (2023). The global health observatory. <https://www.who.int/data/gho/data/themes/topics/indicator-groups/indicator-group-details/GHO/sdg-target-3.5-substance-abuse>
- Wu, L.-T., & Blazer, D. G. (2014). Substance use disorders and psychiatric comorbidity in mid and later life: A review. *International Journal of Epidemiology*, 43(2), 304–317. <https://doi.org/10.1093/IJE/DYT173>
- Yan-guang, Y., Jing-yi, C., Xiao-Wu, P., Meng-lu, S., Su-yong, Y., Ding, X., Ke, X., Tian-yuan, W., Jia-bin, W., & Dong, Z. (2021). Comparison of physical effect between two training methods for individuals with substance use disorder. *BMC Sports Science, Medicine and Rehabilitation*, 13(1), 1–11. <https://doi.org/10.1186/s13102-021-00234-y>
- Zheng, Y., Zhao, Y., Chen, X., & Li, S. (2024). Effect of physical exercise on the emotional and cognitive levels of patients with substance use disorder: A meta-analysis. *Frontiers in Psychology*, 15, Article 1348224. <https://doi.org/10.3389/fpsyg.2024.1348224>