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The factors that influenced physical activity in insufficiently physically active hospital patients: a qualitative study informed by the theoretical domains framework and COM-B model

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ABSTRACT

Objective: Behaviour change interventions targeting changes in physical activity (PA) can benefit by examining the underlying mechanisms that promote change. This study explored the use of the capability, opportunity, motivation and behaviour (COM-B) model and the Theoretical Domains Framework (TDF) to code and contextualise the experiences of patients that participated in a PA coaching intervention underpinned by Motivational Interviewing (MI) and Cognitive Behaviour Therapy (CBT).

Design: Semi-structured interviews were conducted with a purposive sample of participants.

Setting: Interviews were conducted in a tertiary hospital in regional Victoria, Australia.

Participants: Eighteen patients that participated in a PA coaching intervention were interviewed.

Results: Four participant themes mapped directly onto five components of the COM-B model, and ten of the TDF domains. Increases in PA were influenced by changes in motivation and psychological capability. The autonomy-supportive PA coaching intervention helped to evoke participants own reasons (and motives) for change and influenced PA behaviours. Participants reflected on their own social and/or professional strengths, and utilised these skills to set appropriate PA goals and action plans. The structure of the PA coaching intervention provided clarity on session determinants and a framework from which to set an appropriate agenda. Relational components (e.g. non-judgemental listening, collaboration) were continually highlighted as influential for change, and should be considered in future behaviour change intervention design.

Conclusion: We demonstrate the beneficial effect of utilising theory-informed Behaviour Change Techniques (BCTs), and delivering them in a style that promotes autonomy and relatedness. The views of participants should be a key consideration in the design and implementation of PA coaching interventions.

Keywords: exercise motivation; self-determination; motivational interviewing; behaviour change

ARTICLE SUMMARY

Strengths and limitations of this study

- This is the first qualitative study to apply the COM-B model and the TDF to help understand the experiences of insufficiently physically active adults that participated in a PA coaching intervention underpinned by MI and CBT
- By utilising theoretical behaviour change models we provide a robust basis for understanding determinants of PA behaviour change, giving an indication of *what* is required to change behaviour and the BCT techniques that can influence this.
- Identifying relational components (e.g. non-judgemental listening style) provides specificity on *how* to deliver behaviour change interventions to support PA behaviour change.
- The findings of this study can be used to influence future intervention design, delivery as well as monitoring and evaluation.
- The sample was exclusively non-admitted hospital patients that participated in a PA coaching intervention, and additional perspectives may provide a broader overview to inform intervention development.

INTRODUCTION

Regular physical activity (PA) is positively associated with numerous health-related benefits and a marked reduction in risk for chronic disease.[1,2] Although the importance of regular PA has been widely publicised, large numbers of adults do not undertake the recommended levels of PA.[3] For example, only 50% of adults in the USA and 56% in Australia undertake the required amount of PA to be deemed sufficiently physically active.[4,5] Behaviour change interventions have been increasingly used in an attempt to influence PA change, however numerous systematic reviews and meta-analyses demonstrate that high proportions of participants revert to insufficient PA levels once the behaviour change intervention is ceased.[6-8] The marked reductions or cessation of PA can nullify the health improvements gained from temporary PA increases.[9] Consequently, there is a need to develop behaviour change interventions that strengthen the maintenance of PA over time.[10]

Rothman suggested that theory-informed interventions can be effective for promoting maintenance of behaviour change.[11] Michie and colleagues expanded on this more recently, proposing that behaviour change interventions need to address specific determinants of change, namely capability, opportunity, and motivation (COM-B model).[12] These determinants of behaviour change differ substantially from initiation of change to maintenance.[12,13] The techniques required to influence motivation to initiate change can be different to those require to influence motivation to maintain change.[13] Most behaviour change interventions predominantly focus on behaviour change initiation, and strategies and determinants for behaviour change maintenance are often ignored.[10,14] The majority of individuals people drop out of lifestyle behaviour change interventions up to 12 weeks, emphasising the need for action planning that emphasises strategies for maintenance.[10] Using the same theoretical constructs for behaviour change initiation and maintenance might not account for variations in capability, opportunity, and motivation, many of which can be driven by intentions, past experience, and environment.[12] There is a need to explore the potential determinants of successful PA maintenance to assist in the development of interventions to produce lasting change.

Motivational Interviewing (MI) was developed to elicit motivation for behaviour change from the individual.[14] Motivational interviewing is an autonomy supportive intervention and seeks to empower clients to voice their own reasons and strategies for change.[14,15] As MI strategies for behaviour change maintenance are less specific, and are not emphasised as part of the four MI processes, the integration of action-orientated interventions such as cognitive-behavioural therapy (CBT) has been recommended.[16] Cognitive-behavioural therapy involves assisting clients develop strategies and skills to change behaviours.[17] Instead of being passive recipients of CBT skills training, the integration of MI and CBT (MI-CBT) can ensure that clients' have autonomy around the focus and direction of change, which might support maintained change.[10] Integrated MI-CBT has demonstrated effectiveness for the maintenance of PA behaviour change across a number of studies,[18,19] however participant experiences of the intervention are absent from the literature.

Qualitative approaches are beneficial to capture individuals in-depth perspectives of the phenomenon studied, in this case, their experience of the PA coaching intervention.[20] This study examines the views of insufficiently physically active individuals enrolled in a randomised controlled trial that examined the effectiveness of a MI-CBT based PA coaching intervention for changes in PA and health-related outcomes.[19] Relative to control, the intervention group demonstrated significant changes in PA that were maintained 9 months after the commencement of the PA coaching intervention.[19] At present, we do not understand what influence contextual factors (mode of delivery, behaviour change techniques, therapeutic alliance) within the coaching intervention might have had on these findings. Thus, the aim of this current study was to qualitatively explore the experiences and perceptions of individuals who received the MI-CBT based PA coaching intervention to identify determinants and facilitating factors that influenced PA behaviour change. These insights will provide a deeper understanding of their experiences, and might offer valuable information to assist health professionals to improve intervention effectiveness and uptake.

METHODS

This study employed a qualitative design using an interpretive description approach,[21] and adopted the Consolidated Criteria for Reporting Qualitative Research.[22] Semi-structured interviews were conducted with a purposeful sample of insufficiently physically active adults who participated in a PA coaching intervention. A detailed description of the PA coaching intervention (H4U-2) including the intervention schedule, theories and techniques is available in the published literature.[19] Ethical approval was obtained from the research Ethics Committees of the study hospital and associated university.

Sampling and recruitment

All H4U-2 trial participants were asked to complete an evaluation form at the 9-month follow-up which included a question about whether they would be willing to participate in a semi-structured interview. Individuals who responded with "yes" (n = 72) were considered as the sample eligible to participate in this study. A purposive sampling procedure was used. We aimed for a variation in the participants' (i) change in PA, measured using accelerometers; (ii) engagement with the behaviour change intervention, identified by the intervention provider; (iii) gender and age to reflect the sample in the population; (iv) geographic location (rural or regional); and, (v) socio-economic status, using postcodes as a proxy. A research assistant contacted the individuals to confirm their wish to participate. Permission was sought to give their contact details to the interviewers.

Twenty five people were invited to participate. Two individuals declined; one reported no longer wishing to participate and the other individual cited health issues. The participant recruitment ceased when we met our variation sampling requirements and reached data saturation. Data saturation was considered to be reached when the analysis indicated that additional interviews were not providing new concepts and the data provided were sufficient to address the research aims.[23] No new significant information was derived between the seventeenth and eighteenth interviews, indicating that data

saturation was reached and interviewing was ceased.[23]

Interview process

Written informed consent was obtained from all participants at the start of the interviews. Face-to-face interviews were carried out in the Health Promotion department of the associated hospital between June and September 2020. The interviews were carried out by the first author who was a PhD candidate with experience in carrying out qualitative interviews. A semi-structured interview schedule was developed based on existing literature[24,25] and was used to facilitate the discussion (Supplementary Material 1). The interview schedule and process were piloted by interviewing three individuals that took part in a MI-CBT based PA coaching intervention delivered by the Health Promotion department of the associated hospital. Following this pilot, additional questions, probes and prompts were included to further explore individuals' experiences in terms of engaging in the behaviour change intervention. The pilot interviews were not included in the final sample as the individuals were not enrolled into the study.

Data analysis

Interviews were audio recorded, transcribed verbatim and rendered anonymous. Participants were identified as participant 1, participant 2 and so forth. The transcripts were analysed using an interpretive description method.[21] NVivo 12 software (QSR International, Cambridge, MA, USA) was used to facilitate data analysis. The interpretive description approach requires emersion into the data to identify thematic patterns, and an inductive analysis to permit theorising about explanatory factors.[21] We developed a draft coding frame to capture codes and emerging categories. The coding frame was trialled by authors (SB[1] and KR) who independently coded 20% of the transcripts. A revised version of the framework was co-developed and tested; this version was used to code all transcripts. The first author independently coded 18 transcripts, and two authors (KR and GB) independently coded 9 transcripts each. The level of agreement between independent coders was

substantial. Disagreements were resolved through discussion amongst all coders.

Following this stage, the identified categories were mapped against the TDF[26] and COM-B model.[12] We mapped the broad categories onto the TDF domains, as well as directly onto the six components of the COM-B model. Participants' responses were analysed for descriptions of BCTs and skills used as part of the PA coaching intervention. The technical components of the interventions were mapped against Michie's BCT taxonomy,[27] and MI processes, relational components and micro-skills.[28] The mapping of draft themes and findings were discussed amongst all authors to investigate a broad perspective on thematic interpretations. Disagreements between the team were resolved through discussion. The vigour of the qualitative research was strengthened through the implementation of independent coding; triangulation of data, and the critical appraisal of developing themes.[29]

Patient and public involvement

The research was designed and conducted without patient or public involvement.

RESULTS

Eighteen people participated in semi-structured interviews, where 13 (72%) were women and 5 (28%) were men. The average age of participants was 54 (± 5) years, with participants ranging in age from 42 to 66 years. Table 1 provides details of the participants' characteristics. All participants had completed the PA coaching intervention when the interviews took place. The interviews ranged in duration from 26 to 45 minutes, with an average duration of 34 minutes.

Perceptions of the PA coaching intervention were positive, including those participants who did not find the intervention beneficial for maintaining PA change. The structural components (i.e. defined session times and parameters) of the PA coaching intervention provided the participants with a clear indication of what was involved, while the relational components (i.e. MI spirit; collaboration, empathy, evocation, autonomy) provided a platform for the participants to engage and focus on their

reasons for change. The structural and relational components highlighted by participants are detailed in Table 2.

Table 1 Profile characteristics of participants (N = 18)

Marital Status	
Married/living together	15
Widowed	1
Single	2
Highest completed education	
Secondary/high school	4
Post-school vocational	8
University	6
Employment	
Working full-time	13
Working part-time	3
Retired	2
Geographic location	
Regional	12
Rural	6
Socioeconomic area [a]	
1	4
2	4
3	6
4	4
5	3
Physical activity level at end of intervention [b]	
Meets guidelines	13
Does not meet guidelines	5
Pattern of physical activity from baseline to final measurement [a]	
Increased	13
No change	4
Decreased	1

[a] Index of Relative Socio-economic Disadvantage (IRSD) SEIFA scores. IRSD data is presented as quintiles where 1 represents most disadvantaged, and 5 represents least disadvantaged.

[b] Physical activity measurements taken from accelerometer data

Four themes were identified that mapped across 5 of the COM-B components and 10 domains of the TDF framework (Table 3). The themes included strength based coaching, autonomy-supportive listening, reframing PA goals, and self-regulation. As evidenced in Table 3, the themes mapped to multiple COM-B components and TDF domains; as such the findings are presented below under the identified COM-B heading, and related TDF domain sub-heading. These findings are described in detail below and supported using illustrative quotes from participants. The categories that informed

these themes are presented in Supplementary Material 2.

Capability – psychological

Knowledge

Increased knowledge was not described as a key component that participants needed in order to increase PA. The participants repeatedly stated that they did not need to be told they would benefit from increasing PA.

> Anyone who is unfit knows they need to get fit – simple. But just telling them won't make a difference. (Female, 51)

The participants highlighted how the PA coaching intervention used their existing skills to facilitate changes in PA. This strength-based, person-centred, approach did not seek to impart knowledge, rather it sought to evoke personal capabilities from the individual, and to build their autonomy in applying this knowledge towards initiating and sustaining changes in PA.

> The coaching was good, and I think spent lots of time looking at things I was good at, and sort of, how to apply these to my exercise. But it forced me to have a good look at myself, and what I was good at and probably not too good at, and at the time it took me a while to be comfortable with both. (Male, 52)

Table 2 Technical, relational and structural components of the physical activity coaching intervention

Component	Description	Illustrative quotes
Technical/Relational		
Being heard	Listening to the individuals' unique issues and needs.	*"And I liked being listened to – I think that was another big one. I find sometimes if you are talking to someone who works in health, or it could be any profession but you get the feeling that they aren't even listening. They sit there looking at you and the head is bobbing away, but they are just waiting for you to stop talking so they can get their opinion in. But to be listened to, and I mean really listened to is quite important. Not a token gesture" (Female, 61)*
Collaboration	Participants reported that they did not feel like they were being told what to do. The intervention helped support their decisions.	*"So you feel listened to, but there isn't a pressure to do what you don't want. You are driving the bus, and you know where you want to go. And the coaching is like a co-pilot, trying to navigate the best route. Both heading in the same route, but with freedom in how to get there". (Female, 56)*
Guiding style	Autonomy supportive style, directive towards physical activity changes that were chosen by the individual.	*"It was clear with what we wanted to do – get me fitter. But I really felt like I was in control, nothing was forced upon me, and I could do things at my own speed". (Female, 53)* *I think that it's not just a conversation, but the kind of conversation. . So its guidance towards what's right, not a push. Because you push me and I'll push right back". (Male, 51)*
Supporting self-efficacy	Recognising that the individuals had the self-knowledge to manage their health; support was to draw these strengths out from them.	*"How can I run, and forgive me for saying, a successful business, and I can't manage my own fitness. That wasn't the question, but the process made me think about it. How do I use my skills, skills I already have to make the changes"? (Male, 56)*

Big picture perspectives	Participants mentioned the implementation of strategies to support maintained change from early in the intervention.	*"Questions like 'how will you manage if you cannot attend your exercise group?' seemed odd to me. But then you know, months later and the gym is shut and I had to change tact to be active elsewhere. So it was good to have considered the what-if type thing". (Male, 49)*
Structural		
Defined parameters	The use of clear descriptions for intervention sessions help clarify the goals of the sessions.	*"I felt I was kind of allowed to map the route for myself, I wasn't forced down an alleyway. I didn't have free reign, because the sessions started and ended with a rough guide of what we would do, so there was some bit of boundaries on it from that". (Female, 50)*
One to one	Provided an environment where participants felt comfortable to be open.	*"I just know I wouldn't be comfortable expressing doubts about myself in a groups setting". (Female, 60)*
Telephone delivery	Beneficial for practical reasons such as travel. Some individuals enjoyed the 1:1 relationship without the face-to-face requirement.	*For me it was great, I was able to schedule a session towards the end of the work day, did it from the office and then I was able to leave work and concentrate on me". (Male, 53)* *"I found it comforting to not have to look face to face while we were doing it. So having that physical distance allowed me to, to pace the hallways when I spoke if I needed, to laugh at myself or, frown or whatever. And that I think would have made me more relaxed overall". (Female, 52)*
Session timeframes	The number of session and their spread over time permitted relationship to grown, and allowed time to plans into action. Knowing sessions were coming up influenced accountability.	*I've been to session before, with the physio say, and 15 minutes in he is writing my goals for me. But they aren't my goals at all…. It was nice to be able to decide for myself, at my own pace". (Male, 55)*

Table 3 Mapping of themes to TDF domains and COM-B model with the associated BCTs

Theme	COM-B component	TDF Domain	BCT [a] [b]
	Capability – Psychological	Knowledge	Identification of self as role model [a] Evoke personal capabilities [b]
• Strength based coaching	Capability – Psychological	Skills	Goal setting (behaviour) [a] Goal setting (outcome) [a] Acceptance [b] Evoke reasons for goals [b]
	Capability – Psychological	Behaviour regulation	Self-monitoring of behaviour [a] Problem solving [a] Anticipated regret [a] Evoke (commitment) [b] Plan [b]
	Opportunity - Physical	Environmental context and resources	Reframing [a] Commitment [a] Salience of consequences [a]
• Autonomy-supportive listening	Opportunity - Social	Social influences	Compassion [b] Acceptance [b]

	Motivation - Automatic	Emotion	Monitoring of behaviour by others without feedback [a] Engage [b] Reflective listening [b] Evoke (reasons for change) [b] Compassion [b]
• Reframing physical activity goals	Motivation - Reflective	Intentions	Discrepancy between current behaviour and goal [a] Pros and cons [a] Reframing [a] Focus to clarify agenda [b]
	Motivation - Reflective	Goals	Discrepancy between current behaviour and goal [a] Identification of self as role model [a] Evoke (reasons for goals) [b] Acceptance [b]
• Self-regulation	Motivation - Reflective	Social/professional role and identity	Focus on past success [a] Identification of self as role model [a] Evoke (personal capabilities) [b]
	Motivation - Reflective	Beliefs about capability	Comparative imagining of future outcomes [a] Review behaviour goal(s) [a] Acceptance [b] Evoke (personal capabilities) [b]

[a] BCT taxonomy (Michie, van Stralen, and West 2011) [b] Motivational Interviewing techniques (Hardcastle et al. 2017; Miller and Rollnick 2012)
BCT: Behaviour change technique; COM-B: Capability, Opportunity, Motivation, Behaviour; TDF: Theoretical Domains Framework

Emotion - (Complex reactions - fear, anxiety, affect, stress, depression, positive and negative effect, burn out)
Intentions (A conscious decision to perform a behaviour)
Social/professional role and identity (Set of behaviours and displayed personal qualities in a social or work setting)
Skills (An ability or proficiency acquired through practice)
Beliefs about capability (Acceptance of the truth, reality or validity about an ability, perceived behavioural control, self-esteem, confidence)
Environmental context and resources (Person's situation or environment)
Social influences (Process that can change thoughts feelings or behaviours – social pressure).
Knowledge (Awareness of the existence of something: knowledge of condition)
Behaviour regulation (Managing or changes action – self monitoring)
Goals (Mental representations of outcome or end states that an individual wants to achieve)

Skills

Although the individuals were recruited from a secondary care hospital clinic, physical capability was not discussed as a barrier to increasing PA. The participants did not indicate that they needed to be provided education on what exercise to do, or the skills required to do it. Instead, participants noted how in the past they felt that they did not have the ability to increase or maintain PA from a psychological or emotional perspective.

> What was stopping me from being fit before…it was the mind. Not the body. I could physically do it, but not mentally. (Male, 50)

Similar to the construct of knowledge, participants expressed how the intervention strategies sought to evoke from them examples of the skills that they possessed.

> On paper being fit is easy right. You want to walk, get up and walk. And yet I sat at home on the couch feeling bad for myself for not exercising, even though I can walk. Me, a grown woman, house, kids, job. Can run them all and I wasn't able get off the couch. So I needed a shift in perspective. (Female, 55)

Behavioural regulation

Many of the participants described making numerous attempts at increasing PA in the past, only to lapse back to being insufficiently physically active. The inability to maintain regular PA over repeated attempts had diminished their self-efficacy to be physically active. The MI-CBT intervention used in the H4U-2 study employed specific BCTs to influence behaviour regulation as early as session 3 of the intervention. The process of exploring capability to maintain PA changes was new to many participants, as exemplified by the following quote.

> I think we weren't long into it, and I had started to do some exercise. And I was feeling good. He [intervention provider] started asking me about how I would manage to be fit if something happened, can't remember exactly, say, my strength training class finished up or something. And I was thinking, shouldn't he be telling me I was doing a good job. But you know, when you have to think about it, and explain yourself out loud it gets the wheels turning, and you have to think 'how would I do it?' Because I've slipped off the wagon before.

Opportunity – physical

Environmental context and resources

Physical opportunities were discussed alongside the shift in perspectives that many participants encountered, from PA being something that they had to do, to something that they wanted to do. The reframing of PA to something that was attainable and enjoyable resulted in individuals placing a higher value on PA; when PA was afforded a higher value, people made time for it irrespective of previously cited situational or environmental barriers.

> I used to drive to work every day. Its 2.2 KMs, which I know now because of walking. And of course you know how bad parking can be, so I'd probably spend ages looking for a park. Now I walk every day, to and from work. If it rains I can bring brolly, or drive if it's really bad. But I don't think of driving anymore, I enjoy the walk and it's a part of my day. (Female, 46)

Opportunity – social

Social influences

Some of the participants enrolled in community exercise programs, for example walking groups and strength training programs. The building of social links within groups was highlighted by some as an important factor for continuing attendance, though many others were not concerned with building

social connections within PA groups.

> A large part of what kept me going back to the group was the friendship I made with other people. I was only there for a few sessions and a bunch of them invited me to come along for coffee afterwards. That was always helpful in getting me along to sessions. (Female, 58)

The social influence of partners and significant others was regularly discussed, primarily as it related to the provision of unsolicited, didactic advice. The participants were aware that they were not undertaking sufficient PA, they did not need this to be pointed out by their partners and significant others. This didactic style of support contrasts with the relational components of the PA coaching intervention such as autonomy-supportive listening and collaboration, components that participants found beneficial in influencing PA change.

> There is always time for the right advice, and pointless advice is, well… pointless. (Female, 62)

> My husband was with me on the appointment, and he thought it was great that the surgeon discussed me getting fit. He's been on my back for a while about it. So, he is often asking when I'll do more exercise, but I'll tell you what, that makes me want to do even less in spite of him. Even though I knew I needed to do it. The fact that he was telling me to do more made me want to do less to show him. (Female, 48)

Motivation - automatic

Emotion

The repeated attempts to engage in regular PA resulted in a feeling of helplessness in many of the participants who enrolled in the PA coaching intervention. The sense of disappointment expressed by

participants was compounded by the fact that the barriers to regular PA were not physical, but psychological and specifically emotional. The inability to maintain regular PA likely influenced the participants PA self-efficacy levels, and by extension their automatic motivation.

> When you have a few cracks at it, and you keep ending up in the same place, it doesn't feel good. You tell yourself, and maybe a friend 'that's it, I'm going to get myself in shape'. Then two months later they ask you how that's going and you are ashamed that you haven't done a thing. And that does nothing for the self-confidence. (Female, 46)

> I'm not afraid to say it, I needed the support. I mean, if I didn't I wouldn't have joined the coaching. I just wasn't able to do it alone. My motivation was shot, I wasn't, maybe, thinking clearly about it. Probably fed up and disappointed trying the same thing over and over and not going anywhere. (Male, 50)

Motivation - reflective

Intentions and goals

Many participants described how previous attempts at PA were driven from a desire to lose weight. When these attempts did not result in sustained PA levels or weight loss, they were sources of frustration. It was commonly reported that the intervention looked to reframe PA from a weight loss tool to something that might deliver general health benefits. This was followed with a change in goal setting for outcomes. Shifting goal setting away from weight loss metrics changed the overall intention of being active, and having flexible goals removed the notion of a binary outcome of meeting or not meeting goals.

> For me, exercise was always about weight. Always. If I didn't reach the target I failed. And generally, I didn't meet the target. So that was no good. But now I don't exercise for weight; I

exercise for me. To make me feel good, and I am so much better for it. (Female, 55)

Social/professional role and identity

The concept of social or professional role was commonly described by participants as a tool used within the PA coaching intervention to elicit from participants areas of their life that they felt they had achieved or maintained success in, and formulated part of the strengths-based approach to making PA changes. Many participants were in full time employment with partners and dependent children. They commented how the PA intervention required them to reflect on the strengths they have and commonly use in these social and/or professional roles. This approach evokes personal or professional capabilities, and the participants were able to reflect on where a transference of skills to PA was possible.

So, they didn't use these words, but I needed to think on the lines of 'how can I run a team, which I think is reasonably successful, and I can't get myself in shape'. Not those words, but there was some, maybe, probing maybe. And you know, I thought, 'hey I am someone, and I can do this'. It wasn't a kick in the bum, but it made me sit up a bit. (Female, 51)

Beliefs about capability

Participants beliefs about their capabilities were closely linked to the TDF domains of intentions and goals. As an example, exercising for weight loss and failing to attain weight loss goals resulted in a negative mindset and low self-efficacy. By reviewing and revising behavioural goals and learning from previous attempts, the participants noted a shift in their perceptions on capability. When discussing their attempts to be active before the PA coaching intervention some of the foremost feelings that prevailed were those of frustration and disappointment. By reframing intentions and altering their goals participants expressed a greater degree of confidence in their ability to maintain

regular PA.

> Once I got going, then talking about reviewing the goals, and modifying, making harder, or easier as needed, [that] was all fine. The actual tasks right, the exercise itself, or the goal setting – they aren't hard to do. It's not overly complicated. But… but you need to be smart about it and sometimes we get ourselves into a right spot that we can't see the timber from the forest. And the coaching can pull your head in a bit and give you perspective. (Female, 52)

DISCUSSION

The aim of this study was to explore participants' perceptions of the factors that influenced their behaviour change throughout the course of a PA coaching intervention delivered using a MI-CBT framework. Inductive analyses resulted in the identification of several BCTs that participants found influenced their PA, and the patients' experiences of the PA coaching intervention was systematically mapped to the TDF and COM-B models. The interviews identified a wide range of barriers that influenced participants' capability, opportunity, and motivation to undertake regular PA, as well as the key elements of the PA coaching intervention that addressed these barriers. These key elements identified by participants included the combination of relational factors, namely the MI spirit used to underpin the intervention, and the technical factors which were the CBT skills that were utilised. The PA coaching intervention was designed to ensure that MI and CBT were integrated together in all sessions, and the fidelity of delivery was measured.[19] The participants highlighted the synergistic advantages of receiving both MI and CBT techniques to motivate and promote lasting PA change.

Changes in reflective motivation was one of the dominant components that influenced participants' behaviour change throughout the course of the intervention. Participants attributed a major change in intentions towards PA because of the intervention, specifically the shifting of perspectives away from PA being something they had to do to something they valued.[30] By reframing their intentions, the

participants set goals appropriate to their needs and importantly, their sense of capability.[30] Gaining a sense of control and self-belief was consistently highlighted amongst those who were successful in increasing PA. This relates closely with the need for self-efficacy for behaviour change.[31,32] Participants consistently noted that the strengths-orientated approach of the MI-CBT intervention helped build this self-belief. The evocation of personal capabilities is encouraged within MI;[14,15] participants stated that reflecting on their capabilities within their social and/or professional role highlighted their existing strengths. This demonstrated to individuals how to recognise the self-regulatory skills they already had, and how these skills could be transferred to the attainment of regular PA.[33] Instead of providing expert advice, the integration of MI-CBT permitted the individuals to voice their intentions and goals, to understand what skills were needed to achieve these goals, and recognise the need for specific action planning to attain those goals.[10,34] Positive perceptions in regards to one's own abilities has been shown to increase the likelihood of longer-term PA behaviour change.[35]

In contrast to physical capability, which was rarely brought up in the interviews, the influence that psychological capability had on PA behaviour change was widely discussed by most participants. The participants did not seek exercise prescription from the intervention, indeed they largely claimed to already know what to do. The prevailing issue was the interrelation between the lack of motivation and a decreased sense of psychological capability. When discussing how the intervention helped change behaviour, reflection on their personal capabilities and skills was a common technique mentioned by the participants. Behaviour change techniques such as identification of self as role model have been demonstrated to influence change;[27] the use of the more relational MI techniques to evoke examples of personal capacity might have influenced their confidence in their own capabilities.[28] Motivational interviewing has been shown to support psychological needs based on self-determination theory[36] as well as enhance self-efficacy,[32] and the integration of MI-CBT provides an autonomy-supportive framework for the delivery of BCTs.[10]

The interviews highlighted the importance of the relational components of the PA coaching intervention, namely the MI style or spirit (i.e. collaboration, compassion, evocation and empathy) used to underpin the intervention delivery. For most participants, the intervention was viewed as a positive experience, with a strong emphasis on the value of being listened to.[37] This reinforces the significance of person-centred interventions, and aligns with the importance of autonomy-supportive influences described within self-determination theory.[36] Self-determination theory posits that the quality of the support influences motivation and can help build self-efficacy.[36] The favourable experience of the intervention contrasts to the participants' description of support offered by partners or significant others. This support was didactic in nature, and they felt they were being informed of what they should do, without being listened to. The provision of listening support is a fundamental MI technique, and the spirit of MI communicates compassion, acceptance and partnership.[14,38] Using MI as the foundational platform provides a supportive environment in which to deliver non-judgemental understanding and empathy.[38] These relational components are likely to result in an increased sense of autonomy and build reflective motivation to increase and maintain PA changes.[10,28,38,39]

Increased beliefs about capability and use of self-regulation strategies characterised participants who were successful in maintaining their PA, which included a 6-month non-intervention period from the end of the intervention to the final measurement. Perceptions of capability and motivation are some of the internal and external processes (cognitive, self-reflective and self-regulatory) that come into play in human psychosocial functioning.[12] Indeed, behaviour- or self-regulation has been shown to mediate PA behaviours.[40] Some of the self-regulation strategies highlighted by participants included "relaxed" goal setting and planning. The MI framework of the intervention encouraged the individuals to set goals appropriate for them, and work out and plan their own strategies to regulate their PA. This is consistent with the autonomy-supportive approach of MI by offering choice over goals and demonstrating to participants that there are different ways to achieve these goals.[14,38] By empowering participants to set appropriate goals and demonstrating that it is the participant who decides what choices to make, the participants are likely to be more engaged in the process and the more

demanding CBT elements of the intervention.[41]

Applied implications

From a policy perspective, the delivery of the intervention 1:1 over the telephone was found to support change for most participants. This permitted the development of an inter-personal relationship which has been demonstrated to influence change,[42] and at the same time the telephone delivery provided participants with a sense of physical space which helped them relax. A systematic review found that 50% of MI-CBT interventions used for PA change were delivered via telephone,[18] though participants' perspectives on telephone delivery have been absent from the literature.

Participants commonly noted that the provision of defined parameters around the intervention sessions was beneficial for instilling a degree of focus within the sessions. The participants enjoyed the autonomy of goal setting and planning; goal setting is not always associated with autonomy, and goals that are not self-endorsed are likely to inhibit motivation.[43] Using MI to underpin the delivery of the PA coaching intervention likely contributed to the sense of empowerment the participants detailed they had in setting their own goals and agendas.[30] Alongside this autonomy, the participants valued being provided with clarity on the scope of each intervention session as this provided a scaffold from which to establish their agenda. Providing clear descriptions for sessions, including scope, summaries and in-between session plans are key components for intervention fidelity for MI-CBT.[44] Practitioners and researchers can be encouraged that the structural parameters provided from the fidelity framework were positively received by individuals, and potentially contributed to successful behaviour change.

From a practice perspective, a large proportion of the techniques identified by participants as being important for promoting PA change were classified as relational. The importance of relational components within interventions needs to be considered when promoting behaviour change.[45] The techniques classified in well-established BCT taxonomies have centred on the content of

interventions, and have not examined the interpersonal components of interventions.[45] The PA coaching intervention in the H4U-2 study used established BCTs, but delivered them using a MI framework.[19] The MI spirit is a style of interaction that promotes an interpersonal relationship; it represents the way that the intervention content is delivered.[38] A number of authors have proposed that relational components of interventions are likely to interact with technical components to influence behaviour change.[45,46] This is consistent with the argument put forward by Hilton and Johnston that it is important *how* behaviour change interventions are delivered, rather than exactly *what* is contained in the intervention.[47] Integrating MI with CBT permits the combination of content and relational techniques to increase the effectiveness of the intervention.[10] In this paper we have examined participant's experiences of the intervention and attempted to make the distinction between relational and content-based techniques found to influence behaviour change.

Strengths and limitations

By identifying BCT techniques and mapping successful intervention components to TDF domains, COM-B components and central tenets of self-determination theory, we have distilled some of the macro level *what* of behaviour change interventions down to the more micro level of *how*. Using the TDF provides a deeper understanding of the barriers and enablers to PA for insufficiently physically active ambulatory care patients.[26] Mapping the findings into the COM-B model and highlighting specific BCTs is a significant strength of this study due to the integration of theoretically derived domains and structural and relational BCTs. Together they demonstrate the theory-informed use of MI-CBT as an evidence-based intervention to increase and maintain PA. The design of the PA coaching intervention was based upon determinants of PA change;[12,14,19] gaining perspectives from individuals who participated in the intervention provides further evidence to assist in developing effective interventions in the future.

There were some potential limitations in this study. Some difficulty arose in the categorisation of TDF themes and associated BCTs due to a degree of ambiguity in the definitions of the theoretical

domains. Where this arose, the categorisation was determined through consensus via discussion within the research team. The sampling frame for the study was another potential limitation as all participants were recruited through an ambulatory hospital clinic in one hospital setting. The recruitment from one setting only potentially restricted the diversity in participants, in particular diversity in ethnicity, and limits the generalizability of the findings to broader populations. We made a conscious effort to recruit male and female participants, to provide understanding into the experiences of both genders.

CONCLUSIONS

This study provides an understanding of how insufficiently physically active adults perceived a PA coaching intervention and identified some of the behavioural factors that enabled or inhibited PA and the components that influenced their PA behaviour change. Using the TDF and COM-B model provides a theoretical basis for understanding behaviour factors in specific contexts, providing an indication of *what* is required to change. Identifying content and relational BCTs provides an overview of *how* to deliver autonomy-supportive interventions to support self-regulation of PA behaviour and build self-efficacy to maintain change. The findings from this study are valuable from theoretical, applied, training and commissioning perspectives because the BCTs, and the structural and relational components of the intervention that influenced behaviour change were identified firsthand by patients involved in the study. Its findings can be used to influence future intervention design, delivery and its monitoring and evaluation.

Footnotes

Author Contributions: SB[1], MK, SB[2] and PO'H conceived the project and assisted with the protocol design. SB[1] collected and analysed the data with support from KR and GB. SB[1] wrote the first draft of the manuscript. SB[1], SB[2], PO'H, JB, KR, GB and MK critically reviewed the manuscript and provided detailed feedback. All authors read, edited and approved the final manuscript as submitted.

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Competing interests: None declared.

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Data sharing statement: Data are available upon reasonable request.

References

1. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. *Compr Physiol* 2012;**2**:1143-1211.
2. Rhodes RE, Janssen I, Bredin SSD, Warburton DER, Bauman A. Physical activity: Health impact, prevalence, correlates and interventions. *Psychology & Health* 2017;**32**:942-975.
3. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *BJSM* 2020;**54**:1451-1462.
4. Fredriksson SV, Alley SJ, Rebar AL, Hayman M, Vandelanotte C, Schoeppe S. How are different levels of knowledge about physical activity associated with physical activity behaviour in Australian adults? *PLoS One* 2018;**13**:e0207003.
5. Dempsey PC, Biddle SJH, Buman MP, et al. New global guidelines on sedentary behaviour and health for adults: broadening the behavioural targets. *Int Jour Behav Nut Phys Act* 2020;**17**:1-12.
6. Sangelaji B, Smith CM, Paul L, Sampath KK, Treharne GJ, Hale LA. The effectiveness of behaviour change interventions to increase physical activity participation in people with multiple sclerosis: a systematic review and meta-analysis. *Clinical Rehab.* 2016;**30**:559-576.
7. Grimmett C, Corbett T, Brunet J, et al. Systematic review and meta-analysis of maintenance of physical activity behaviour change in cancer survivors. *Int Jour Behav Nut Phys Act* 2019;**16**:37.
8. Whatnall MC, Sharkey T, Hutchesson MJ, et al. Effectiveness of interventions and behaviour change techniques for improving physical activity in young adults: A systematic review and meta-analysis. *Jour Sports Sci* 2021;**39**:1754-1771.
9. Amireault S, Godin G, Vézina-Im L-A. Determinants of physical activity maintenance: a systematic review and meta-analyses. *Health Psychol Rev* 2013;**7**:55-91.
10. Naar-King S, Earnshaw P, Breckon J. Toward a universal maintenance intervention: integrating cognitive-behavioral treatment with motivational interviewing for maintenance of behavior change. *Journal of Cognitive Psychotherapy.* 2013;**27**:126-137.
11. Rothman AJ. Toward a theory-based analysis of behavioral maintenance. *Health Psychol* 2000;**19**:64-69.
12. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci* 2011;**6**:42-42.
13. Kwasnicka D, Dombrowski SU, White M, Sniehotta F. Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychol Rev* 2016;**10**:277-296.
14. Miller WR, Rollnick S. *Motivational interviewing: Helping people change.* Guilford press; 2012.
15. Miller WR, Rollnick S. Ten things that motivational interviewing is not. *Behav and Cognit Psychother* 2009;**37**:129-140.
16. Arkowitz H, Miller WR. Learning, applying, and extending motivational interviewing. 2008.
17. Beck AT, Weishaar M. Cognitive Therapy. In: *Comprehensive handbook of cognitive therapy.* Springer; 1989:21-36.
18. Barrett S, Begg S, O'Halloran P, Kingsley M. Integrated motivational interviewing and cognitive behaviour therapy can increase physical activity and improve health of adult ambulatory care patients in a regional hospital: the Healthy4U randomised controlled trial. *BMC Public Health.* 2018;**18**:1-11.
19. Barrett S, Begg S, O'Halloran P, Kingsley M. A physical activity coaching intervention can improve and maintain physical activity and health-related outcomes in adult ambulatory hospital patients: the Healthy4U-2 randomised controlled trial. *Int Jour Behav Nut Phys Act* 2020;**17**:156.

20. Hardcastle S, Hagger MS. "You can't do it on your own": Experiences of a motivational interviewing intervention on physical activity and dietary behaviour. *Psychol of Sport and Ex* 2011;**12**:314-323.
21. Thorne S. *Interpretive description.* Routledge; 2016.
22. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int Jour Qual in Health Care.* 2007;**19**:349-357.
23. Fusch PI, Ness LR. Are we there yet? Data saturation in qualitative research. *The Qualitative Report.* 2015;**20**:1408.
24. Barrett S, Rodda K, Begg S, O'Halloran PD, Kingsley MI. Exercise and COVID-19: reasons individuals sought coaching support to assist them to increase physical activity during COVID-19. *Aust and New Zeal Jour Pub Health* 2021;**45**:133-137.
25. Sander AP, Wilson J, Izzo N, Mountford SA, Hayes KW. Factors that affect decisions about physical activity and exercise in survivors of breast cancer: a qualitative study. *Physical Therapy.* 2012**;92**:525-536.
26. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Sci* 2012;**7**:1-17.
27. Michie S, Richardson M, Johnston M, et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Annals of Behav Med* 2013;**46**:81-95.
28. Hardcastle SJ, Fortier M, Blake N, Hagger MS. Identifying content-based and relational techniques to change behaviour in motivational interviewing. *Health Psychol Rev* 2017;**11**:1-16.
29. Elliott R, Timulak L. Descriptive and interpretive approaches to qualitative research. *A Handbook of Research Methods for Clinical and Health Psychology.* 2005;**1**:147-159.
30. Markland D, Ryan RM, Tobin VJ, Rollnick S. Motivational interviewing and self–determination theory. *Jour Social Clin Psychol* 2005;**24**:811-831.
31. Ashford S, Edmunds J, French DP. What is the best way to change self-efficacy to promote lifestyle and recreational physical activity? A systematic review with meta-analysis. *Bri Jour Health Psychol* 2010;**15**:265-288.
32. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev* 1977;**84**:191-215.
33. Bell BS, Kozlowski SWJ. Active learning: effects of core training design elements on self-regulatory processes, learning, and adaptability. *Jour Appl Psychol* 2008;**93**:296.
34. Skinner EA. A guide to constructs of control. *J Pers Soc Psychol* 1996;**71**:549.
35. Hutchison AJ, Johnston LH, Breckon JD. A grounded theory of successful long-term physical activity behaviour change. *Qual Res* Sport *Exerc Health* 2013;**5**:109-126.
36. Deci EL, Ryan RM. *Intrinsic motivation and self-determination in human behavior.* Springer Science & Business Media; 2013.
37. Miller WR, Rose GS. Toward a theory of motivational interviewing. *American Psychologist* 2009;**64**:527.
38. Miller WR, Moyers TB. Eight stages in learning motivational interviewing. *Jour Teach Addic* 2006;**5**:3-17.
39. Hagger M, Chatzisarantis N. Self-determination theory and the psychology of exercise. *Int Rev Sport Exerc Psychol* 2008;**1**:79-103.
40. Hallam JS, Petosa R. The long-term impact of a four-session work-site intervention on selected social cognitive theory variables linked to adult exercise adherence. *Health Educ Behav* 2004;**31**:88-100.
41. Westra HA, Arkowitz H, Dozois DJA. Adding a motivational interviewing pretreatment to cognitive behavioral therapy for generalized anxiety disorder: a preliminary randomized controlled trial. *J Anxiety Disord.* 2009;**23**:1106-1117.

42. Arkowitz H, Miller WR, Rollnick S. *Motivational Interviewing in the Treatment of Psychological Problems.* Guilford Publications; 2015.
43. Koestner R, Otis N, Powers TA, Pelletier L, Gagnon H. Autonomous motivation, controlled motivation, and goal progress. *J Pers* 2008;**76**:1201-1230.
44. Haddock G, Beardmore R, Earnshaw P, et al. Assessing fidelity to integrated motivational interviewing and CBT therapy for psychosis and substance use: the MI-CBT fidelity scale (MI-CTS). *J Ment Health.* 2012;21(1):38-48.
45. Hagger MS, Hardcastle SJ. Interpersonal style should be included in taxonomies of behavior change techniques. *Front Psychol* 2014;**5:**254.
46. Magill M, Hallgren KA. Mechanisms of behavior change in motivational interviewing: do we understand how MI works? *Curr Opin Psychol* 2019;**30**:1-5.
47. Hilton CE, Johnston LH. Health psychology: It's not what you do, it's the way that you do it. *Health Psychology Open.* 2017;**4**:2055102917714910.

Table 1. Profile characteristics of participants

Table 2. Technical, relational and structural factors of intervention

Table 3. Mapping of themes to TDF domains and COM-B model with the associated BCTs.

H4U-2 Participants experiences - Interview guide

Topics	Questions
General	Standard opening question: What was the reason you agreed to participate in the Healthy 4U-2 study?
Expectations prior to the study	What expectations did you have prior to the Healthy 4U-2 study? Can you tell me to what extent your expectations were met? *Can you rate this 1-10?*
Perceived outcome	Can you tell me whether you think you became more physically active due to your participation in the study? *In what ways?* *How long did it take to have an impact?*
Experiences with MI-CBT intervention	Can you tell me how you experienced the telephone support you received during the consultations? Can you tell me whether you think the consultations helped you increase your physical activity? If yes, what components helped with increasing physical activity? *Which components were most helpful? (Prompt: in what ways?)* *Which components were not so helpful? (Prompt: why not)* *Would you recommend changing any components? In what ways? Why?*
Perceptions towards the MI-CBT consultation structure and most prevalent BCTs	How did you experience setting personal goals and action plans? Did the facilitator help you to set your own goals and plan your actions? *[BCTs: goal setting and action planning]* To what extent did this affect your progress?

	What is your opinion about reviewing the extent to which you attained your goals? [BCT: reviewing behavioural goal(s)] Did this affect your progress?
	Did the facilitator discuss how you can get any support from e.g., family or friends? *[BCT: social support]* To what extent did this affect your progress?
	Did you discuss strategies to maintain being physically active?
	Did you bring up the strategies yourself? *[BCTs: habit formation, problem-solving and relapse prevention].*
	Can you tell me how the facilitator supported you if you found it difficult to maintain your progress? What did you find helpful and unhelpful? *[BCT: problem-solving*]
	Can you tell me whether you think the study consultations differed compared to other consultations you have had around increasing physical activity?
Experiences with the study materials and equipment	Can you tell me how you found wearing the accelerometer and keeping the activity logbook?
	How did this affect your progress?
	Did you perceive any difficulties while wearing the accelerometer or keeping the activity log? How did you handle this?
Most and least effective components	Can you tell me what you found most helpful in becoming more physically active?
	Can you tell me what you found least helpful in becoming more physically active?
Duration of the intervention	What is your opinion about the number and length of the consultations?

	Generally, how much time did you spend on keeping the activity log? Was this helpful? Was this acceptable to you?
Satisfaction with the intervention	Can you tell me how satisfied you are with your participation in the Healthy 4U-2 study? Ask for scale rating 1-10 – *follow up with why this score.* Would you recommend this intervention to other patients? Why/why not What time of people would you recommend this intervention to?
Prevention in hospitals	You entered the study after coming into hospital to see a surgeon- how did that happen? What are your thoughts on receiving this information from the surgeon? Did receiving a referral from a surgeon influence your decision to take part? Have you discussed increasing physical activity with other health professionals in the past?
Perceptions towards maintaining physical activity	Have you made any changes to your general daily routine as a result of your participation in the study? To what extend do you think you will maintain being physically active? Now you have finished the intervention, how motivated are you to continue being more physically active? Now you have finished the intervention, how self-confident are you to continue being more physically active? How do you plan to maintain the changes you have made?

Additional questions regarding previous or not discussed topics	Do you have anything to add to the questions I have asked

Themes, categories and associated TDF domains and COM-B model components

Theme	Categories	COM-B component	TDF Domain
• Strength based coaching	• Building on existing skills to address physical activity • Focus on individuals strengths and capabilities	Capability – Psychological	Knowledge
	• Goal setting based on capabilities • Non-judgmental, autonomous decision making • Confidence in abilities • Non prescriptive / clients felt they not directed to make undesired change	Capability – Psychological	Skills
	• Building maintenance skills	Capability – Psychological	Behaviour regulation
	• When you value physical activity you can find time for it	Opportunity - Physical	Environmental context and resources
• Autonomy-supportive listening	• Didactic support from significant others does not positively influence change • Being told what to do does not lead to change • Being heard and having your opinion valued	Opportunity - Social	Social influences

Theme	Categories	COM-B components	TDF Domain
	• Feelings of helplessness based on previous failed attempts to be physically active	Motivation - Automatic	Emotion
• Reframing physical activity goals	• Gaining/shifting perspectives on being physically active • Why do I really want to be active	Motivation - Reflective	Intentions
	• Utilisation/transference of existing skills	Motivation - Reflective	Goals
• Self-regulation	• Strengths orientated approach to maintain change	Motivation - Reflective	Social/professional role and identity
	• Challenging a negative mindset • Learning from and forgetting past failures • Non-judgmental listening support	Motivation - Reflective	Beliefs about capability

Emotion - (Complex reactions - fear, anxiety, affect, stress, depression, positive and negative effect, burn out)
Intentions (A conscious decision to perform a behaviour)
Social/professional role and identity (Set of behaviours and displayed personal qualities in a social or work setting)
Skills (An ability or proficiency acquired through practice)
Beliefs about capability (Acceptance of the truth, reality or validity about an ability, perceived behavioural control, self-esteem, confidence)
Environmental context and resources (person's situation or environment)
Social influences (Process that can change thoughts feelings or behaviours – social pressure).
Knowledge (Awareness of the existence of something: knowledge of condition)
Behaviour regulation (Managing or changes action – self monitoring)
Goals (mental representations of outcome or end states that an individual wants to achieve)

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	8
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	8
Occupation	3	What was their occupation at the time of the study?	NA
Gender	4	Was the researcher male or female?	8
Experience and training	5	What experience or training did the researcher have?	8
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	NA
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	NA
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	NA
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	8
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	7-8
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	7-8
Sample size	12	How many participants were in the study?	7,9
Non-participation	13	How many people refused to participate or dropped out? Reasons?	7,9
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	8
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	8
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	9-10
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	8
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	NA
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	8
Field notes	20	Were field notes made during and/or after the inter view or focus group?	8
Duration	21	What was the duration of the inter views or focus group?	9
Data saturation	22	Was data saturation discussed?	7
Transcripts returned	23	Were transcripts returned to participants for comment and/or	NA

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	8-9
Description of the coding tree	25	Did authors provide a description of the coding tree?	NA
Derivation of themes	26	Were themes identified in advance or derived from the data?	8
Software	27	What software, if applicable, was used to manage the data?	8
Participant checking	28	Did participants provide feedback on the findings?	NA
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	11-20
Data and findings consistent	30	Was there consistency between the data presented and the findings?	11-20
Clarity of major themes	31	Were major themes clearly presented in the findings?	11-20
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	NA

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

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Factors influencing adults who participate in a physical activity coaching intervention: a theoretically informed qualitative study

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Factors influencing adults who participate in a physical activity coaching intervention: a theoretically informed qualitative study

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ABSTRACT

Objective: Behaviour change interventions targeting changes in physical activity (PA) can benefit by examining the underlying mechanisms that promote change. This study explored the use of the Capability, Opportunity, Motivation and Behaviour (COM-B) model and the Theoretical Domains Framework (TDF) to code and contextualise the experiences of participants who completed a PA coaching intervention underpinned by motivational interviewing and cognitive behaviour therapy (MI-CBT).

Design: Semi-structured interviews were conducted with a purposive sample of participants.

Setting: Interviews were conducted in a tertiary hospital in regional Victoria, Australia.

Participants: Eighteen participants who completed a PA coaching intervention were interviewed. The participants were recruited into the coaching intervention because they were insufficiently physically active at time of recruitment.

Results: Thirteen (72%) participants were women and the average age of participants was 54 (± 5) years. Four participant themes mapped directly onto five components of the COM-B model, and ten of the TDF domains. Increases in PA were influenced by changes in motivation and psychological capability. The autonomy-supportive PA coaching intervention helped to evoke participants own reasons (and motives) for change and influenced PA behaviours. Participants reflected on their own social and/or professional strengths, and utilised these skills to set appropriate PA goals and action plans. The structure of the PA coaching intervention provided clarity on session determinants and a framework from which to set an appropriate agenda. Relational components (e.g. non-judgemental listening, collaboration) were continually highlighted as influential for change, and should be considered in future behaviour change intervention design.

Conclusions: We demonstrate the beneficial effect of utilising theory-informed behaviour change techniques, and delivering them in a style that promotes autonomy and relatedness. The views of participants should be a key consideration in the design and implementation of PA coaching interventions

ARTICLE SUMMARY

Strengths and limitations of this study

- Semi-structured interviews enabled in-depth exploration of the experiences of individuals who participated in a physical activity coaching intervention.
- Including the perspectives of individuals who did not increase physical activity as well as those who did increase physical activity as a result of the intervention can be considered a strength of this study.
- Another strength of this study is the application of the COM-B model and the TDF to explore the experiences of individuals that participated in a physical activity coaching intervention underpinned by motivational interviewing and cognitive behaviour therapy.
- The sample was exclusively non-admitted hospital patients that participated in a physical activity coaching intervention, and additional perspectives may provide a broader overview to inform intervention development.

INTRODUCTION

Regular physical activity (PA) is positively associated with numerous health-related benefits and a marked reduction in risk for chronic disease.[1,2] Although the importance of regular PA has been widely publicised, large numbers of adults do not undertake the recommended levels of PA.[3] For example, only 50% of adults in the USA and 56% in Australia undertake the required amount of PA to be deemed sufficiently physically active.[4,5] Behaviour change interventions have been increasingly used in an attempt to influence PA change, however numerous systematic reviews and meta-analyses demonstrate that high proportions of participants revert to insufficient PA levels once the behaviour change intervention is ceased.[6-8] The marked reductions or cessation of PA can nullify the health improvements gained from temporary PA increases.[9] Consequently, there is a need to develop behaviour change interventions that strengthen the maintenance of PA over time.[10]

Rothman suggested that theory-informed (e.g social-cognitive theory) interventions can be effective for promoting maintenance of behaviour change.[11] Michie and colleagues expanded on this more recently, proposing that behaviour change interventions need to address specific components of change, namely an individual's capability, opportunity, and motivation to change.[12] The factors that influence initiation of behaviour change differ substantially to those that influence maintenance.[12,13] Using the same theoretical constructs for behaviour change initiation and maintenance might not account for variations in capability, opportunity, and motivation, many of which can be driven by intentions, past experience, and environment.[12] There is a need to explore the potential determinants of successful PA maintenance to assist in the development of interventions to produce lasting change.

Motivational Interviewing (MI) was developed to elicit motivation for behaviour change from the individual.[14] MI is an autonomy supportive intervention and seeks to empower clients to voice their own reasons and strategies for change.[14,15] MI strategies for behaviour change maintenance are less specific, and are not emphasised as part of the four processes of MI (engaging, focusing, evoking, and planning).[14] As a result, the integration of action-orientated interventions such as cognitive-

behavioural therapy (CBT) has been recommended.[16] Cognitive-behavioural therapy involves assisting clients develop strategies and skills (e.g. activity scheduling, successive approximation) to change behaviours.[17] Instead of being passive recipients of CBT skills training, the integration of MI and CBT (MI-CBT) can ensure that clients' have autonomy around the focus and direction of change, which might support maintained change.[10] Integrated MI-CBT has demonstrated effectiveness for the maintenance of PA behaviour change across a number of studies,[18,19] however participant experiences of the intervention are absent from the literature.

Qualitative approaches are beneficial to capture individuals' in-depth perspectives of the phenomenon studied, in this case, their experience of the PA coaching intervention.[20] This study examines the views of individuals who participated in a MI-CBT based PA coaching intervention as part of a randomised controlled trial (RCT).[19] Relative to control, the intervention group demonstrated significant changes in PA at post-intervention (3-months) and these changes were maintained 9 months after the commencement of the intervention.[19] At present, we do not understand what influence contextual factors (mode of delivery, behaviour change techniques, therapeutic alliance) within the coaching intervention might have had on these findings. Thus, the aim of this current study was to qualitatively explore the experiences and perceptions of individuals who received the MI-CBT based PA coaching intervention to identify determinants and facilitating factors that influenced PA behaviour change. These insights will provide a deeper understanding of their experiences, and might offer valuable information to assist health professionals to improve intervention effectiveness and uptake.

METHODS

This study employed a qualitative design using an interpretive description approach,[21] and adopted the Consolidated Criteria for Reporting Qualitative Research (Supplementary Material 1).[22] Semi-structured interviews were conducted with a purposeful sample of adults who participated in a PA

coaching intervention in the H4U-2 RCT to explore their experiences and perceptions of the intervention to identify factors that influenced PA behaviour change.

A detailed description of the PA coaching intervention (H4U-2) including the intervention schedule, theories and techniques is available in the published literature.[19] In brief, in the H4U-2 study, 120 insufficiently active adults (aged 18-69) were recruited from an ambulatory hospital clinic and randomised to an intervention group that received an education session and PA coaching, or to a control group that received the education session only. The PA coaching intervention comprised integrated MI-CBT and was delivered in five 20-min sessions over 12 weeks via the telephone. The intervention used an MI framework and microskills (open-ended questions, affirmations, reflections and summaries) to underpin all sessions. The CBT skills training (e.g. goal setting, problem solving and coping strategies) was delivered using the MI framework. The intervention was delivered by a physiotherapist trained in MI-CBT through workshop attendances, and individual coaching from an experienced practicing psychologist.

The H4U-2 participants completed outcome measures at baseline, post-intervention (3 months) and follow-up (9 months). This provided a 6-month non-intervention time to assess maintenance of behaviour change. At baseline, the mean age of the H4U-2 participants was 53 ± 8 years and accelerometer-measured PA for was 15 ± 5 mins/day of moderate-to-vigorous PA (MVPA). The intervention group increased MVPA at post-intervention (23 ± 10 mins/day) and maintained this at 9-month follow-up (22 ± 10 mins/day). In contrast, the control group decreased MVPA at post-intervention (13 ± 6 mins/day) and at follow-up (10 ± 6 mins/day). Ethical approval was obtained from the research Ethics Committees of the study hospital and associated university. All participants provided written consent prior to starting the study.

Sampling and recruitment

All H4U-2 trial participants were asked to complete an evaluation form at the 9-month follow-up which included a question about whether they would be willing to participate in a semi-structured interview. Individuals who responded with "yes" (n = 72) were considered as the sample eligible to participate in this study. A purposive sampling procedure was used. We aimed for a variation in the participants' (i) change in PA, measured using accelerometers; (ii) engagement with the behaviour change intervention, identified by the intervention provider; (iii) gender and age to reflect the sample in the population; (iv) geographic location (rural or regional); and, (v) socio-economic status, using postcodes as a proxy. A research assistant contacted the individuals to confirm their wish to participate. Permission was sought to give their contact details to the interviewers.

Twenty five people were invited to participate. Two individuals declined; one reported no longer wishing to participate and the other individual cited health issues. The participant recruitment ceased when we met our variation sampling requirements and reached data saturation. Data saturation was considered to be reached when the analysis indicated that additional interviews were not providing new concepts and the data provided were sufficient to address the research aims.[23] No new significant information was derived between the seventeenth and eighteenth interviews, indicating that data saturation was reached and interviewing was ceased.[23]

Interview process

Written informed consent was obtained from all participants at the start of the interviews. Face-to-face interviews were carried out in the Health Promotion department of the associated hospital between June and September 2020. The interviews were carried out by the first author. A semi-structured interview guide was developed based on existing literature[24,25] and was used to facilitate the discussion (Supplementary Material 2). The interview guide was piloted by interviewing three individuals that took part in a MI-CBT based PA coaching intervention delivered by the Health Promotion department of the associated hospital; these three individuals did not participate in the

H4U-2 study, but did receive the same 5 x 20 min session of PA coaching as the H4U-2 study participants which was offered as part of standard health promotion practice in the associated hospital. Following this pilot, additional questions, probes and prompts were included to further explore individuals' experiences in terms of engaging in the behaviour change intervention. The pilot interviews were not included in the final sample as the individuals were not enrolled into the study.

Data analysis

Interviews were audio recorded, transcribed verbatim and rendered anonymous. Participants were identified as participant 1, participant 2 and so forth. The transcripts were analysed using an interpretive description method.[21] NVivo 12 software (QSR International, Cambridge, MA, USA) was used to facilitate data analysis. The interpretive description approach requires emersion into the data to identify thematic patterns, and an inductive analysis to permit theorising about explanatory factors.[21] We developed a draft coding frame to capture codes and emerging categories. The coding frame was trialled by authors (SB[1] and KR) who independently coded 20% of the transcripts. A revised version of the framework was developed and tested by the research team; this version was used to code all transcripts. The first author independently coded 18 transcripts, and two authors (KR and GB) independently coded 9 transcripts each. The level of agreement between independent coders was substantial. Disagreements were resolved through discussion amongst all coders.

Following this stage, the identified categories were mapped against the Theoretical Domains Framework (TDF)[26] and COM-B model.[12] The TDF and COM-B model provide the theoretical basis for understanding behaviour change. The TDF integrates 33 theories and 128 psychological constructs into 14 domains underpinned by psychological theory.[26] The TDF domains include individual-level factors (knowledge, skills), social factors (social influences, social support), environment and resource factors (cost of resources to facilitate change).[26] Taken together the 14 domains prompt the consideration of a wide range of influences on behaviour change. The 14 validated domains are included in Supplementary Material 3.

Michie and colleagues identified three components that need to be present to influence behaviour (B): capability (C), opportunity (O) and motivation (M); together these components make up the COM-B model.[12] Capability refers to having the knowledge and skills required to engage in a behaviour; it can be broken down into two components, psychological capability and physical capability. Opportunity refers to the external factors which make undertaking a behaviour possible. Its two components are physical opportunity and social opportunity. Motivation refers to the internal processes which influence decision making and behaviours. Its two components are reflective motivation and automatic motivation. The COM-B model is widely used to contextualise individual-level change and determine what needs to change for behaviour change interventions to be effective.[12]

We mapped the broad categories onto the TDF domains, as well as directly onto the six components of the COM-B model to identify factors that are likely to influence PA behaviour change and could be targeted in future interventions. Participants' responses were analysed for descriptions of BCTs and skills used as part of the PA coaching intervention. The technical components of the interventions were mapped against Michie's taxonomy of behaviour change techniques (BCT),[27] and MI processes, relational components and micro-skills.[28] The mapping of draft themes and findings were discussed amongst all authors to investigate a broad perspective on thematic interpretations. Disagreements between the team were resolved through discussion. The vigour of the qualitative research was strengthened through the implementation of independent coding; triangulation of data, and the critical appraisal of developing themes.[29]

Patient and public involvement

The research was designed and conducted without patient or public involvement.

RESULTS

Eighteen people participated in semi-structured interviews, where 13 (72%) were women and 5 (28%) were men. The average age of participants was 54 (± 5) years, with participants ranging in age from 42 to 66 years. Table 1 provides details of the participants' characteristics. The interviews ranged in duration from 26 to 45 minutes, with an average duration of 34 minutes.

Table 1 Profile characteristics of participants (N = 18)

Marital Status	
Married/living together	15
Widowed	1
Single	2
Highest completed education	
Secondary/high school	4
Post-school vocational	8
University	6
Employment	
Working full-time	13
Working part-time	3
Retired	2
Geographic location [a]	
Regional	12
Rural	6
Socioeconomic area [b]	
1	4
2	4
3	6
4	4
5	3
Physical activity level at end of intervention [c]	
Meets guidelines	13
Does not meet guidelines	5
Pattern of physical activity from baseline to final measurement [c]	
Increased	13
No change	4
Decreased	1

[a] The term 'regional and rural' encompasses all areas outside Australia's major cities. Regional indicates living in a regional city. Rural indicates living in an area outside of a regional city.

[b] Index of Relative Socio-economic Disadvantage (IRSD) Socio-Economic Indexes for Areas (SEIFA) scores. IRSD data is presented as quintiles where 1 represents most disadvantaged, and 5 represents least disadvantaged.

[c] Physical activity measurements taken from accelerometer data

Perceptions of the PA coaching intervention were positive, including those participants who did not find the intervention beneficial for maintaining PA change. The structural components (i.e. defined session times and parameters) of the PA coaching intervention provided the participants with a clear indication of what was involved, while the relational components (i.e. MI spirit: collaboration, empathy, evocation, autonomy) provided a platform for the participants to engage and focus on their reasons for change. The structural and relational components highlighted by participants are detailed in Table 2. The delivery of the intervention via phone was reported as favourable by the majority of the participants. The telephone delivery provided flexibility around participation in the intervention with 16 participants in gainful employment during the intervention period.

Four themes were identified that mapped across 5 of the COM-B components and 10 domains of the TDF framework (Table 3). The themes included strength based coaching, autonomy-supportive listening, reframing PA goals, and self-regulation. As evidenced in Table 3, the themes mapped to multiple COM-B components and TDF domains; as such the findings are presented below under the identified COM-B heading, and related TDF domain sub-heading. These findings are described in detail below and supported using illustrative quotes from participants. The participant's gender, age and change in PA as a result of the PA coaching intervention are provided alongside each quote. The categories that informed these themes are presented in Supplementary Material 4.

265 Table 2 Technical, relational and structural components of the physical activity coaching intervention

Component	Description	Illustrative quotes
Technical/Relational		
Being heard	Listening to the individuals' unique issues and needs.	*"And I liked being listened to – I think that was another big one. I find sometimes if you are talking to someone who works in health, or it could be any profession but you get the feeling that they aren't even listening. They sit there looking at you and the head is bobbing away, but they are just waiting for you to stop talking so they can get their opinion in. But to be listened to, and I mean really listened to is quite important. Not a token gesture" (Female, 61)*
Collaboration	Participants reported that they did not feel like they were being told what to do. The intervention helped support their decisions.	*"So you feel listened to, but there isn't a pressure to do what you don't want. You are driving the bus, and you know where you want to go. And the coaching is like a co-pilot, trying to navigate the best route. Both heading in the same route, but with freedom in how to get there". (Female, 56)*
Guiding style	Autonomy supportive style, directive towards physical activity changes that were chosen by the individual.	*"It was clear with what we wanted to do – get me fitter. But I really felt like I was in control, nothing was forced upon me, and I could do things at my own speed". (Female, 53)* *I think that it's not just a conversation, but the kind of conversation. . So its guidance towards what's right, not a push. Because you push me and I'll push right back". (Male, 51)*
Supporting self-efficacy	Recognising that the individuals had the self-knowledge to manage their health; support was to draw these strengths out from them.	*"How can I run, and forgive me for saying, a successful business, and I can't manage my own fitness. That wasn't the question, but the process made me think about it. How do I use my skills, skills I already have to make the changes"? (Male, 56)*

Big picture perspectives	Participants mentioned the implementation of strategies to support maintained change from early in the intervention.	*"Questions like 'how will you manage if you cannot attend your exercise group?' seemed odd to me. But then you know, months later and the gym is shut and I had to change tact to be active elsewhere. So it was good to have considered the what-if type thing". (Male, 49)*
Structural		
Defined parameters	The use of clear descriptions for intervention sessions help clarify the goals of the sessions.	*"I felt I was kind of allowed to map the route for myself, I wasn't forced down an alleyway. I didn't have free reign, because the sessions started and ended with a rough guide of what we would do, so there was some bit of boundaries on it from that". (Female, 50)*
One to one	Provided an environment where participants felt comfortable to be open.	*"I just know I wouldn't be comfortable expressing doubts about myself in a groups setting". (Female, 60)*
Telephone delivery	Beneficial for practical reasons such as travel. Some individuals enjoyed the 1:1 relationship without the face-to-face requirement.	*For me it was great, I was able to schedule a session towards the end of the work day, did it from the office and then I was able to leave work and concentrate on me". (Male, 53)* *"I found it comforting to not have to look face to face while we were doing it. So having that physical distance allowed me to, to pace the hallways when I spoke if I needed, to laugh at myself or, frown or whatever. And that I think would have made me more relaxed overall". (Female, 52)*
Session timeframes	The number of session and their spread over time permitted relationship to grown, and allowed time to plans into action. Knowing sessions were coming up influenced accountability.	*I've been to session before, with the physio say, and 15 minutes in he is writing my goals for me. But they aren't my goals at all…. It was nice to be able to decide for myself, at my own pace". (Male, 55)*

267 Table 3 Mapping of themes to TDF domains and COM-B model with the associated BCTs

Theme	COM-B component	TDF Domain	BCT [a] [b]
	Capability – Psychological	Knowledge	Identification of self as role model [a] Evoke personal capabilities [b]
• Strength based coaching	Capability – Psychological	Skills	Goal setting (behaviour) [a] Goal setting (outcome) [a] Acceptance [b] Evoke reasons for goals [b]
	Capability – Psychological	Behaviour regulation	Self-monitoring of behaviour [a] Problem solving [a] Anticipated regret [a] Evoke (commitment) [b] Plan [b]
	Opportunity - Physical	Environmental context and resources	Reframing [a] Commitment [a] Salience of consequences [a]
• Autonomy-supportive listening	Opportunity - Social	Social influences	Compassion [b] Acceptance [b]

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	Motivation - Automatic	Emotion	Monitoring of behaviour by others without feedback [a] Engage [b] Reflective listening [b] Evoke (reasons for change) [b] Compassion [b]
• Reframing physical activity goals	Motivation - Reflective	Intentions	Discrepancy between current behaviour and goal [a] Pros and cons [a] Reframing [a] Focus to clarify agenda [b]
	Motivation - Reflective	Goals	Discrepancy between current behaviour and goal [a] Identification of self as role model [a] Evoke (reasons for goals) [b] Acceptance [b]
• Self-regulation	Motivation - Reflective	Social/professional role and identity	Focus on past success [a] Identification of self as role model [a] Evoke (personal capabilities) [b]
	Motivation - Reflective	Beliefs about capability	Comparative imagining of future outcomes [a] Review behaviour goal(s) [a] Acceptance [b] Evoke (personal capabilities) [b]

[a] BCT taxonomy (Michie, van Stralen, and West 2011) [b] Motivational Interviewing techniques (Hardcastle et al. 2017; Miller and Rollnick 2012)
BCT: Behaviour change technique; COM-B: Capability, Opportunity, Motivation, Behaviour; TDF: Theoretical Domains Framework

Emotion - (Complex reactions - fear, anxiety, affect, stress, depression, positive and negative effect, burn out)
Intentions (A conscious decision to perform a behaviour)
Social/professional role and identity (Set of behaviours and displayed personal qualities in a social or work setting)
Skills (An ability or proficiency acquired through practice)
Beliefs about capability (Acceptance of the truth, reality or validity about an ability, perceived behavioural control, self-esteem, confidence)
Environmental context and resources (Person's situation or environment)
Social influences (Process that can change thoughts feelings or behaviours – social pressure).
Knowledge (Awareness of the existence of something: knowledge of condition)
Behaviour regulation (Managing or changes action – self monitoring)
Goals (Mental representations of outcome or end states that an individual wants to achieve)

Capability – psychological

Knowledge

Increased knowledge was not described as a key component that participants needed in order to increase PA. The participants repeatedly stated that they did not need to be told they would benefit from increasing PA.

> Anyone who is unfit knows they need to get fit – simple. But just telling them won't make a difference. (Female, 51, no change in PA)

The participants highlighted how the PA coaching intervention used their existing skills to facilitate changes in PA. This strength-based, person-centred, approach did not seek to impart knowledge, rather it sought to evoke personal capabilities from the individual, and to build their autonomy in applying this knowledge towards initiating and sustaining changes in PA.

> The coaching was good, and I think spent lots of time looking at things I was good at, and sort of, how to apply these to my exercise. But it forced me to have a good look at myself, and what I was good at and probably not too good at, and at the time it took me a while to be comfortable with both. (Male, 52, increased PA)

Skills

Although the individuals were recruited from a secondary care hospital clinic, physical capability was not discussed as a barrier to increasing PA. The participants did not indicate that they needed to be provided education on what exercise to do, or the skills required to do it. Instead, participants noted how in the past they felt that they did not have the ability to increase or maintain PA from a psychological or emotional perspective.

> What was stopping me from being fit before…it was the mind. Not the body. I could physically do it, but not mentally. (Male, 50, increased PA)

Similar to the construct of knowledge, participants expressed how the intervention strategies sought to evoke from them examples of the skills that they possessed.

> On paper being fit is easy right. You want to walk, get up and walk. And yet I sat at home on the couch feeling bad for myself for not exercising, even though I can walk. Me, a grown woman, house, kids, job. Can run them all and I wasn't able get off the couch. So I needed a shift in perspective. (Female, 55, no change in PA)

Behavioural regulation

Many of the participants described making numerous attempts at increasing PA in the past, only to lapse back to being insufficiently physically active. The inability to maintain regular PA over repeated attempts had diminished their self-efficacy to be physically active. The MI-CBT intervention used in the H4U-2 study employed specific BCTs to influence behaviour regulation as early as session 3 (week 4 of 12) of the intervention. The process of exploring capability to maintain PA changes was new to many participants, as exemplified by the following quote:

> I think we weren't long into it, and I had started to do some exercise. And I was feeling good. He [intervention provider] started asking me about how I would manage to be fit if something happened, can't remember exactly, say, my strength training class finished up or something. And I was thinking, shouldn't he be telling me I was doing a good job. But you know, when you have to think about it, and explain yourself out loud it gets the wheels turning, and you have to think 'how would I do it?' Because I've slipped off the wagon before. (Female, 49,

increased PA)

Opportunity – physical

Environmental context and resources

Physical opportunities were discussed alongside the shift in perspectives that many participants encountered, from PA being something that they had to do, to something that they wanted to do. The reframing of PA to something that was attainable and enjoyable resulted in individuals placing a higher value on PA; when PA was afforded a higher value, people made time for it irrespective of previously cited situational or environmental barriers.

> I used to drive to work every day. Its 2.2 KMs, which I know now because of walking. And of course you know how bad parking can be, so I'd probably spend ages looking for a park. Now I walk every day, to and from work. If it rains I can bring brolly, or drive if it's really bad. But I don't think of driving anymore, I enjoy the walk and it's a part of my day. (Female, 46, increased PA)

Opportunity – social

Social influences

Some of the participants enrolled in community exercise programs, for example walking groups and strength training programs. The building of social links within groups was highlighted by some as an important factor for continuing attendance, though many others were not concerned with building social connections within PA groups.

> A large part of what kept me going back to the group was the friendship I made with other people. I was only there for a few sessions and a bunch of them invited me to come along for

coffee afterwards. That was always helpful in getting me along to sessions. (Female, 58, increased PA)

I did wonder if sometimes there was a bit too much chat about exercise groups and exercising with other people. If I'm going to exercise I'll do it for myself, I don't need to be going with someone for company. That's not important for me. (Male, 54; decreased PA)

The social influence of partners and significant others was regularly discussed, primarily as it related to the provision of unsolicited, didactic advice. The participants were aware that they were not undertaking sufficient PA, they did not need this to be pointed out by their partners and significant others. This didactic style of support contrasts with the relational components of the PA coaching intervention such as autonomy-supportive listening and collaboration, components that participants found beneficial in influencing PA change.

There is always time for the right advice, and pointless advice is, well… pointless. (Female, 62, no change in PA)

My husband was with me on the appointment, and he thought it was great that the surgeon discussed me getting fit. He's been on my back for a while about it. So, he is often asking when I'll do more exercise, but I'll tell you what, that makes me want to do even less in spite of him. Even though I knew I needed to do it. The fact that he was telling me to do more made me want to do less to show him. (Female, 48, increased PA)

Motivation - automatic

Emotion

The repeated attempts to engage in regular PA resulted in a feeling of helplessness in many of the participants who enrolled in the PA coaching intervention. The sense of disappointment expressed by participants was compounded by the fact that the barriers to regular PA were not physical, but psychological and specifically emotional. The inability to maintain regular PA likely influenced the participants PA self-efficacy levels, and by extension their automatic motivation.

> When you have a few cracks at it, and you keep ending up in the same place, it doesn't feel good. You tell yourself, and maybe a friend 'that's it, I'm going to get myself in shape'. Then two months later they ask you how that's going and you are ashamed that you haven't done a thing. And that does nothing for the self-confidence. (Female, 46, increased PA)

> I'm not afraid to say it, I needed the support. I mean, if I didn't I wouldn't have joined the coaching. I just wasn't able to do it alone. My motivation was shot, I wasn't, maybe, thinking clearly about it. Probably fed up and disappointed trying the same thing over and over and not going anywhere. (Male, 50, no change in PA)

Motivation - reflective

Intentions and goals

Many participants described how previous attempts at PA were driven from a desire to lose weight. When these attempts did not result in sustained PA levels or weight loss, they were sources of frustration. It was commonly reported that the intervention looked to reframe PA from a weight loss tool to something that might deliver general health benefits. This was followed with a change in goal setting for outcomes. Shifting goal setting away from weight loss metrics changed the overall intention of being active, and having flexible goals removed the notion of a binary outcome of meeting or not meeting goals.

> For me, exercise was always about weight. Always. If I didn't reach the target I failed. And generally, I didn't meet the target. So that was no good. But now I don't exercise for weight; I exercise for me. To make me feel good, and I am so much better for it. (Female, 55, increased PA)

Social/professional role and identity

The concept of social or professional role was commonly described by participants as a tool used within the PA coaching intervention to elicit from participants areas of their life that they felt they had achieved or maintained success in, and formulated part of the strengths-based approach to making PA changes. Many participants were in full time employment with partners and dependent children. They commented how the PA intervention required them to reflect on the strengths they have and commonly use in these social and/or professional roles. This approach evokes personal or professional capabilities, and the participants were able to reflect on where a transference of skills to PA was possible.

> So, they didn't use these words, but I needed to think on the lines of 'how can I run a team, which I think is reasonably successful, and I can't get myself in shape'. Not those words, but there was some, maybe, probing maybe. And you know, I thought, 'hey I am someone, and I can do this'. It wasn't a kick in the bum, but it made me sit up a bit. (Female, 51, increased PA)

Beliefs about capability

Participants beliefs about their capabilities were closely linked to the TDF domains of intentions and goals. As an example, exercising to lose weight and failing to attain weight loss goals resulted in a negative mindset and low self-efficacy. By reviewing and revising behavioural goals and learning from previous attempts, the participants noted a shift in their perceptions on capability. When

discussing their attempts to be active before the PA coaching intervention some of the foremost feelings that prevailed were those of frustration and disappointment. By reframing intentions and altering their goals participants expressed a greater degree of confidence in their ability to maintain regular PA.

> Once I got going, then talking about reviewing the goals, and modifying, making harder, or easier as needed, [that] was all fine. The actual tasks right, the exercise itself, or the goal setting – they aren't hard to do. It's not overly complicated. But… but you need to be smart about it and sometimes we get ourselves into a right spot that we can't see the timber from the forest. And the coaching can pull your head in a bit and give you perspective. (Female, 52, increased PA)

DISCUSSION

The aim of this study was to explore participants' perceptions of the factors that influenced their behaviour change throughout the course of a PA coaching intervention delivered using a MI-CBT framework. The interviews identified a wide range of barriers that influenced participants' capability, opportunity, and motivation to undertake regular PA, as well as the key elements of the PA coaching intervention that addressed these barriers. These key elements identified by participants included the combination of relational factors, namely the MI spirit used to underpin the intervention, and the technical factors which were the CBT skills that were utilised. The PA coaching intervention was designed to ensure that MI and CBT were integrated together in all sessions, and the fidelity of delivery was measured.[19] The participants highlighted the synergistic advantages of receiving both MI and CBT techniques to motivate and promote lasting PA change.

Changes in reflective motivation was one of the dominant components that influenced participants' behaviour change throughout the course of the intervention. Participants attributed a major change in

intentions towards PA because of the intervention, specifically the shifting of perspectives away from PA being something they had to do to something they valued.[30] By reframing their intentions, the participants set goals appropriate to their needs and importantly, their sense of capability.[30] This relates closely with the need for self-efficacy for behaviour change.[31,32] Participants consistently noted that the strengths-orientated approach of the MI-CBT intervention helped build this self-belief. The evocation of personal capabilities is encouraged within MI;[14,15] participants stated that reflecting on their capabilities within their social and/or professional role highlighted their existing strengths. This demonstrated to individuals how to recognise the self-regulatory skills they already had, and how these skills could be transferred to the attainment of regular PA.[33] Instead of providing expert advice, the integration of MI-CBT permitted the individuals to voice their intentions and goals, and to understand what skills were needed to achieve these goals.[10,34] Positive perceptions in regards to one's own abilities has been shown to increase the likelihood of longer-term PA behaviour change.[35]

In contrast to physical capability, which was rarely brought up in the interviews, the influence that psychological capability had on PA behaviour change was widely discussed by most participants. The participants in this study did not seek exercise prescription from the intervention, indeed they largely claimed to already know how to exercise. The prevailing issue was the interrelation between the lack of motivation and a decreased sense of psychological capability, resulting in them not exercising. When discussing how the intervention helped change behaviour, reflection on their personal capabilities and skills was a common technique mentioned by the participants. Behaviour change techniques such as identification of self as role model have been demonstrated to influence change;[27] the use of MI techniques to evoke examples of personal capacity might have influenced their confidence in their own capabilities.[28] MI has been shown to support psychological needs based on self-determination theory[36] as well as enhance self-efficacy,[32] and the integration of MI-CBT provides an autonomy-supportive framework for the delivery of BCTs.[10]

The interviews highlighted the importance of the relational components of the PA coaching intervention, namely the MI style or spirit (i.e. collaboration, compassion, evocation and empathy) used to underpin the intervention delivery. For most participants, the intervention was viewed as a positive experience, with a strong emphasis on the value of being listened to.[37] This reinforces the significance of person-centred interventions, and aligns with the importance of autonomy-supportive influences described within self-determination theory.[36] Self-determination theory posits that the quality of the support influences motivation and can help build self-efficacy.[36] The favourable experience of the intervention contrasts to the participants' description of support offered by partners or significant others. This support was didactic in nature, and they felt they were being informed of what they should do, without being listened to. The provision of listening support is a fundamental MI technique, and the spirit of MI communicates compassion, acceptance and partnership.[14,38] Using MI as the foundational platform provides a supportive environment in which to deliver non-judgemental understanding and empathy.[38] These relational components are likely to result in an increased sense of autonomy and build reflective motivation to increase and maintain PA changes.[10,28,38,39]

Increased beliefs about capability and use of self-regulation strategies characterised participants who were successful in maintaining their PA, which included a 6-month non-intervention period from the end of the intervention to the final measurement. Perceptions of capability and motivation are some of the internal and external processes (cognitive, self-reflective and self-regulatory) that come into play in human psychosocial functioning.[12] Indeed, behaviour- or self-regulation has been shown to mediate PA behaviours.[40] Some of the self-regulation strategies highlighted by participants included "relaxed" goal setting and planning. The MI framework of the intervention encouraged the individuals to set goals appropriate for them, and work out and plan their own strategies to regulate their PA. This is consistent with the autonomy-supportive approach of MI by offering choice over goals and demonstrating to participants that there are different ways to achieve these goals.[14,38] By empowering participants to set appropriate goals and demonstrating that it is the participant who decides what choices to make, the participants are likely to be more engaged in the process and the more

demanding CBT elements of the intervention.[41]

Applied implications

From a policy perspective, the delivery of the intervention 1:1 over the telephone was found to be favourable for most participants. This permitted the development of an inter-personal relationship which has been demonstrated to influence change,[42] and at the same time the telephone delivery provided participants with a sense of physical space which helped them relax. For health-service delivery is it encouraging that many participants found the coaching via telephone effective as telephone delivery permits offering services to wide geographic regions and can be delivered at participants' convenience.

Participants commonly noted that the provision of defined parameters around the intervention sessions was beneficial for instilling a degree of focus within the sessions. The participants enjoyed the autonomy of goal setting and planning; goal setting is not always associated with autonomy, and goals that are not self-endorsed are likely to inhibit motivation.[43] Using MI to underpin the delivery of the PA coaching intervention likely contributed to the sense of empowerment the participants detailed they had in setting their own goals and agendas.[30] Alongside this autonomy, the participants valued being provided with clarity on the scope of each intervention session as this provided a scaffold from which to establish their agenda. Providing clear descriptions for sessions, including scope, summaries and in-between session plans are key components for intervention fidelity for MI-CBT.[44] Practitioners and researchers can be encouraged that the structural parameters provided from the fidelity framework were positively received by individuals, and potentially contributed to successful behaviour change.

From a practice perspective, a large proportion of the techniques identified by participants as being important for promoting PA change were classified as relational. The importance of relational components within interventions needs to be considered when promoting behaviour change.[45] The

techniques classified in well-established BCT taxonomies have centred on the content of interventions, and have not examined the interpersonal components of interventions.[45] The PA coaching intervention in the H4U-2 study used established BCTs, but delivered them using a MI framework.[19] The MI spirit is a style of interaction that promotes an interpersonal relationship; it represents the way that the intervention content is delivered.[38] A number of authors have proposed that relational components of interventions are likely to interact with technical components to influence behaviour change.[45,46] This is consistent with the argument put forward by Hilton and Johnston that it is important *how* behaviour change interventions are delivered, rather than exactly *what* is contained in the intervention.[47] Integrating MI with CBT permits the combination of content and relational techniques to increase the effectiveness of the intervention.[10] In this paper we have examined participant's experiences of the intervention and attempted to make the distinction between relational and content-based techniques found to influence behaviour change.

Strengths and limitations

By identifying BCT techniques and mapping successful intervention components to TDF domains, COM-B components and central tenets of self-determination theory, we have distilled some of the macro level *what* of behaviour change interventions down to the more micro level of *how*. Using the TDF provides a deeper understanding of the barriers and enablers to PA for insufficiently physically active ambulatory care patients.[26] Mapping the findings into the COM-B model and highlighting specific BCTs is a significant strength of this study due to the integration of theoretically derived domains and structural and relational BCTs. Together they demonstrate the theory-informed use of MI-CBT as an evidence-based intervention to increase and maintain PA. The design of the PA coaching intervention was based upon determinants of PA change;[12,14,19] gaining perspectives from individuals who participated in the intervention provides further evidence to assist in developing effective interventions in the future.

There were some potential limitations in this study. Some difficulty arose in the categorisation of TDF themes and associated BCTs due to a degree of ambiguity in the definitions of the theoretical domains. Where this arose, the categorisation was determined through consensus via discussion within the research team. The sampling frame for the study was another potential limitation as all participants were recruited through an ambulatory hospital clinic in one hospital setting. The recruitment from one setting only potentially restricted the diversity in participants, in particular diversity in ethnicity, and limits the generalizability of the findings to broader populations. The participants who agreed to take part in this qualitative study may have been motivated and willing to talk about PA. The H4U-2 trial participants were asked if they were willing to participate in this study and we purposely recruited participants who did not increase PA as a result of the intervention to provide a broad sample. We made a conscious effort to recruit male and female participants, to provide understanding into the experiences of both genders.

CONCLUSIONS

This study provides an understanding of how participants perceived a PA coaching intervention and identified some of the behavioural factors that enabled or inhibited PA and the components that influenced their PA behaviour change. Using the TDF and COM-B model provides a theoretical basis for understanding behaviour factors in specific contexts, providing an indication of *what* is required to change. Identifying content and relational BCTs provides an overview of *how* to deliver autonomy-supportive interventions to support self-regulation of PA behaviour and build self-efficacy to maintain change. The findings from this study are valuable from theoretical, applied, training and commissioning perspectives because the BCTs, and the structural and relational components of the intervention that influenced behaviour change were identified firsthand by participants involved in the study. Its findings can be used to influence future intervention design, delivery and its monitoring and evaluation.

Footnotes

Author Contributions: SB[1], MK, SB[2] and PO'H conceived the project and assisted with the protocol design. SB[1] collected and analysed the data with support from KR and GB. SB[1] wrote the first draft of the manuscript. SB[1], SB[2], PO'H, JB, KR, GB and MK critically reviewed the manuscript and provided detailed feedback. All authors read, edited and approved the final manuscript as submitted.

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Competing interests: None declared.

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Data sharing statement: Data are available upon reasonable request.

References

1. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. *Compr Physiol* 2012;**2**:1143-1211.
2. Rhodes RE, Janssen I, Bredin SSD, Warburton DER, Bauman A. Physical activity: Health impact, prevalence, correlates and interventions. *Psychology & Health* 2017;**32**:942-975.
3. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *BJSM* 2020;**54**:1451-1462.
4. Fredriksson SV, Alley SJ, Rebar AL, Hayman M, Vandelanotte C, Schoeppe S. How are different levels of knowledge about physical activity associated with physical activity behaviour in Australian adults? *PLoS One* 2018;**13**:e0207003.
5. Dempsey PC, Biddle SJH, Buman MP, et al. New global guidelines on sedentary behaviour and health for adults: broadening the behavioural targets. *Int Jour Behav Nut Phys Act* 2020;**17**:1-12.
6. Sangelaji B, Smith CM, Paul L, Sampath KK, Treharne GJ, Hale LA. The effectiveness of behaviour change interventions to increase physical activity participation in people with multiple sclerosis: a systematic review and meta-analysis. *Clinical Rehab.* 2016;**30**:559-576.
7. Grimmett C, Corbett T, Brunet J, et al. Systematic review and meta-analysis of maintenance of physical activity behaviour change in cancer survivors. *Int Jour Behav Nut Phys Act* 2019;**16**:37.
8. Whatnall MC, Sharkey T, Hutchesson MJ, et al. Effectiveness of interventions and behaviour change techniques for improving physical activity in young adults: A systematic review and meta-analysis. *Jour Sports Sci* 2021;**39**:1754-1771.
9. Amireault S, Godin G, Vézina-Im L-A. Determinants of physical activity maintenance: a systematic review and meta-analyses. *Health Psychol Rev* 2013;**7**:55-91.
10. Naar-King S, Earnshaw P, Breckon J. Toward a universal maintenance intervention: integrating cognitive-behavioral treatment with motivational interviewing for maintenance of behavior change. *Journal of Cognitive Psychotherapy.* 2013;**27**:126-137.
11. Rothman AJ. Toward a theory-based analysis of behavioral maintenance. *Health Psychol* 2000;**19**:64-69.
12. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci* 2011;**6**:42-42.
13. Kwasnicka D, Dombrowski SU, White M, Sniehotta F. Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychol Rev* 2016;**10**:277-296.
14. Miller WR, Rollnick S. *Motivational interviewing: Helping people change.* Guilford press; 2012.
15. Miller WR, Rollnick S. Ten things that motivational interviewing is not. *Behav and Cognit Psychother* 2009;**37**:129-140.
16. Arkowitz H, Miller WR. Learning, applying, and extending motivational interviewing. 2008.
17. Beck AT, Weishaar M. Cognitive Therapy. In: *Comprehensive handbook of cognitive therapy.* Springer; 1989:21-36.
18. Barrett S, Begg S, O'Halloran P, Kingsley M. Integrated motivational interviewing and cognitive behaviour therapy can increase physical activity and improve health of adult ambulatory care patients in a regional hospital: the Healthy4U randomised controlled trial. *BMC Public Health.* 2018;**18**:1-11.
19. Barrett S, Begg S, O'Halloran P, Kingsley M. A physical activity coaching intervention can improve and maintain physical activity and health-related outcomes in adult ambulatory hospital patients: the Healthy4U-2 randomised controlled trial. *Int Jour Behav Nut Phys Act* 2020;**17**:156.

20. Hardcastle S, Hagger MS. "You can't do it on your own": Experiences of a motivational interviewing intervention on physical activity and dietary behaviour. *Psychol of Sport and Ex* 2011;**12**:314-323.
21. Thorne S. *Interpretive description.* Routledge; 2016.
22. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int Jour Qual in Health Care.* 2007;**19**:349-357.
23. Fusch PI, Ness LR. Are we there yet? Data saturation in qualitative research. *The Qualitative Report.* 2015;**20**:1408.
24. Barrett S, Rodda K, Begg S, O'Halloran PD, Kingsley MI. Exercise and COVID-19: reasons individuals sought coaching support to assist them to increase physical activity during COVID-19. *Aust and New Zeal Jour Pub Health* 2021;**45**:133-137.
25. Sander AP, Wilson J, Izzo N, Mountford SA, Hayes KW. Factors that affect decisions about physical activity and exercise in survivors of breast cancer: a qualitative study. *Physical Therapy.* 2012**;92**:525-536.
26. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Sci* 2012;**7**:1-17.
27. Michie S, Richardson M, Johnston M, et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Annals of Behav Med* 2013;**46**:81-95.
28. Hardcastle SJ, Fortier M, Blake N, Hagger MS. Identifying content-based and relational techniques to change behaviour in motivational interviewing. *Health Psychol Rev* 2017;**11**:1-16.
29. Elliott R, Timulak L. Descriptive and interpretive approaches to qualitative research. *A Handbook of Research Methods for Clinical and Health Psychology.* 2005;**1**:147-159.
30. Markland D, Ryan RM, Tobin VJ, Rollnick S. Motivational interviewing and self–determination theory. *Jour Social Clin Psychol* 2005;**24**:811-831.
31. Ashford S, Edmunds J, French DP. What is the best way to change self-efficacy to promote lifestyle and recreational physical activity? A systematic review with meta-analysis. *Bri Jour Health Psychol* 2010;**15**:265-288.
32. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev* 1977;**84**:191-215.
33. Bell BS, Kozlowski SWJ. Active learning: effects of core training design elements on self-regulatory processes, learning, and adaptability. *Jour Appl Psychol* 2008;**93**:296.
34. Skinner EA. A guide to constructs of control. *J Pers Soc Psychol* 1996;**71**:549.
35. Hutchison AJ, Johnston LH, Breckon JD. A grounded theory of successful long-term physical activity behaviour change. *Qual Res* Sport *Exerc Health* 2013;**5**:109-126.
36. Deci EL, Ryan RM. *Intrinsic motivation and self-determination in human behavior.* Springer Science & Business Media; 2013.
37. Miller WR, Rose GS. Toward a theory of motivational interviewing. *American Psychologist* 2009;**64**:527.
38. Miller WR, Moyers TB. Eight stages in learning motivational interviewing. *Jour Teach Addic* 2006;**5**:3-17.
39. Hagger M, Chatzisarantis N. Self-determination theory and the psychology of exercise. *Int Rev Sport Exerc Psychol* 2008;**1**:79-103.
40. Hallam JS, Petosa R. The long-term impact of a four-session work-site intervention on selected social cognitive theory variables linked to adult exercise adherence. *Health Educ Behav* 2004;**31**:88-100.
41. Westra HA, Arkowitz H, Dozois DJA. Adding a motivational interviewing pretreatment to cognitive behavioral therapy for generalized anxiety disorder: a preliminary randomized controlled trial. *J Anxiety Disord.* 2009;**23**:1106-1117.

42. Arkowitz H, Miller WR, Rollnick S. *Motivational Interviewing in the Treatment of Psychological Problems.* Guilford Publications; 2015.
43. Koestner R, Otis N, Powers TA, Pelletier L, Gagnon H. Autonomous motivation, controlled motivation, and goal progress. *J Pers* 2008;**76**:1201-1230.
44. Haddock G, Beardmore R, Earnshaw P, et al. Assessing fidelity to integrated motivational interviewing and CBT therapy for psychosis and substance use: the MI-CBT fidelity scale (MI-CTS). *J Ment Health.* 2012;21(1):38-48.
45. Hagger MS, Hardcastle SJ. Interpersonal style should be included in taxonomies of behavior change techniques. *Front Psychol* 2014;**5:**254.
46. Magill M, Hallgren KA. Mechanisms of behavior change in motivational interviewing: do we understand how MI works? *Curr Opin Psychol* 2019;**30**:1-5.
47. Hilton CE, Johnston LH. Health psychology: It's not what you do, it's the way that you do it. *Health Psychology Open.* 2017;**4**:2055102917714910.

726 Table 1. Profile characteristics of participants

727 Table 2. Technical, relational and structural factors of intervention

728 Table 3. Mapping of themes to TDF domains and COM-B model with the associated BCTs.

729

730

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	8
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	8
Occupation	3	What was their occupation at the time of the study?	NA
Gender	4	Was the researcher male or female?	8
Experience and training	5	What experience or training did the researcher have?	8
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	NA
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	NA
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	NA
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	8
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	7-8
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	7-8
Sample size	12	How many participants were in the study?	7,9
Non-participation	13	How many people refused to participate or dropped out? Reasons?	7,9
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	8
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	8
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	9-10
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	8
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	NA
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	8
Field notes	20	Were field notes made during and/or after the inter view or focus group?	8
Duration	21	What was the duration of the inter views or focus group?	9
Data saturation	22	Was data saturation discussed?	7
Transcripts returned	23	Were transcripts returned to participants for comment and/or	NA

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	8-9
Description of the coding tree	25	Did authors provide a description of the coding tree?	NA
Derivation of themes	26	Were themes identified in advance or derived from the data?	8
Software	27	What software, if applicable, was used to manage the data?	8
Participant checking	28	Did participants provide feedback on the findings?	NA
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	11-20
Data and findings consistent	30	Was there consistency between the data presented and the findings?	11-20
Clarity of major themes	31	Were major themes clearly presented in the findings?	11-20
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	NA

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

H4U-2 Participants experiences - Interview guide

Topics	Questions
General	Standard opening question: What was the reason you agreed to participate in the Healthy 4U-2 study?
Expectations prior to the study	What expectations did you have prior to the Healthy 4U-2 study? Can you tell me to what extent your expectations were met? *Can you rate this 1-10?*
Perceived outcome	Can you tell me whether you think you became more physically active due to your participation in the study? *In what ways?* *How long did it take to have an impact?*
Experiences with MI-CBT intervention	Can you tell me how you experienced the telephone support you received during the consultations? Can you tell me whether you think the consultations helped you increase your physical activity? If yes, what components helped with increasing physical activity? *Which components were most helpful? (Prompt: in what ways?)* *Which components were not so helpful? (Prompt: why not)* *Would you recommend changing any components? In what ways? Why?*
Perceptions towards the MI-CBT consultation structure and most prevalent BCTs	How did you experience setting personal goals and action plans? Did the facilitator help you to set your own goals and plan your actions? *[BCTs: goal setting and action planning]* To what extent did this affect your progress?

	What is your opinion about reviewing the extent to which you attained your goals? [BCT: reviewing behavioural goal(s)] Did this affect your progress?
	Did the facilitator discuss how you can get any support from e.g., family or friends? *[BCT: social support]* To what extent did this affect your progress?
	Did you discuss strategies to maintain being physically active?
	Did you bring up the strategies yourself? *[BCTs: habit formation, problem-solving and relapse prevention].*
	Can you tell me how the facilitator supported you if you found it difficult to maintain your progress? What did you find helpful and unhelpful? *[BCT: problem-solving*]
	Can you tell me whether you think the study consultations differed compared to other consultations you have had around increasing physical activity?
Experiences with the study materials and equipment	Can you tell me how you found wearing the accelerometer and keeping the activity logbook?
	How did this affect your progress?
	Did you perceive any difficulties while wearing the accelerometer or keeping the activity log? How did you handle this?
Most and least effective components	Can you tell me what you found most helpful in becoming more physically active?
	Can you tell me what you found least helpful in becoming more physically active?
Duration of the intervention	What is your opinion about the number and length of the consultations?

	Generally, how much time did you spend on keeping the activity log? Was this helpful? Was this acceptable to you?
Satisfaction with the intervention	Can you tell me how satisfied you are with your participation in the Healthy 4U-2 study? Ask for scale rating 1-10 – *follow up with why this score.* Would you recommend this intervention to other patients? Why/why not What time of people would you recommend this intervention to?
Prevention in hospitals	You entered the study after coming into hospital to see a surgeon- how did that happen? What are your thoughts on receiving this information from the surgeon? Did receiving a referral from a surgeon influence your decision to take part? Have you discussed increasing physical activity with other health professionals in the past?
Perceptions towards maintaining physical activity	Have you made any changes to your general daily routine as a result of your participation in the study? To what extend do you think you will maintain being physically active? Now you have finished the intervention, how motivated are you to continue being more physically active? Now you have finished the intervention, how self-confident are you to continue being more physically active? How do you plan to maintain the changes you have made?

Additional questions regarding previous or not discussed topics	Do you have anything to add to the questions I have asked

The Theoretical Domains Framework (TDF)

TDF domain	Description
Knowledge	An awareness of the existence of something.
Skills	An ability or proficiency acquired through practice.
Social/professional role and identity	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting.
Beliefs about capabilities	Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use.
Optimism	The confidence that things will happen for the best, or that desired goals will be attained.
Beliefs about consequences	Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation.
Reinforcement	Increasing the probability of a response by arranging a dependent relationship or contingency, between the response and a given stimulus.
Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way.
Goals	Mental representation of outcomes or end states that an individual wants to achieve.
Memory, attention and decision processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives.
Environmental context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour.
Social influences	Those interpersonal processes that can cause an individual to change their thoughts, feelings or behaviours.
Emotion	A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event.
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions.

Themes, categories and associated TDF domains and COM-B model components

Theme	Categories	COM-B component	TDF Domain
• Strength based coaching	• Building on existing skills to address physical activity • Focus on individuals strengths and capabilities	Capability – Psychological	Knowledge
	• Goal setting based on capabilities • Non-judgmental, autonomous decision making • Confidence in abilities • Non prescriptive / clients felt they not directed to make undesired change	Capability – Psychological	Skills
	• Building maintenance skills	Capability – Psychological	Behaviour regulation
	• When you value physical activity you can find time for it	Opportunity - Physical	Environmental context and resources
• Autonomy-supportive listening	• Didactic support from significant others does not positively influence change • Being told what to do does not lead to change • Being heard and having your opinion valued	Opportunity - Social	Social influences

Theme	Categories	COM-B components	TDF Domain
	• Feelings of helplessness based on previous failed attempts to be physically active	Motivation - Automatic	Emotion
• Reframing physical activity goals	• Gaining/shifting perspectives on being physically active • Why do I really want to be active	Motivation - Reflective	Intentions
	• Utilisation/transference of existing skills	Motivation - Reflective	Goals
• Self-regulation	• Strengths orientated approach to maintain change	Motivation - Reflective	Social/professional role and identity
	• Challenging a negative mindset • Learning from and forgetting past failures • Non-judgmental listening support	Motivation - Reflective	Beliefs about capability

Emotion - (Complex reactions - fear, anxiety, affect, stress, depression, positive and negative effect, burn out)
Intentions (A conscious decision to perform a behaviour)
Social/professional role and identity (Set of behaviours and displayed personal qualities in a social or work setting)
Skills (An ability or proficiency acquired through practice)
Beliefs about capability (Acceptance of the truth, reality or validity about an ability, perceived behavioural control, self-esteem, confidence)
Environmental context and resources (person's situation or environment)
Social influences (Process that can change thoughts feelings or behaviours – social pressure).
Knowledge (Awareness of the existence of something: knowledge of condition)
Behaviour regulation (Managing or changes action – self monitoring)
Goals (mental representations of outcome or end states that an individual wants to achieve)

BMJ Open

Factors influencing adults who participate in a physical activity coaching intervention: a theoretically informed qualitative study

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Factors influencing adults who participate in a physical activity coaching intervention: a theoretically informed qualitative study

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ABSTRACT

Objective: Behaviour change interventions targeting changes in physical activity (PA) can benefit by examining the underlying mechanisms that promote change. This study explored the use of the Capability, Opportunity, Motivation and Behaviour (COM-B) model and the Theoretical Domains Framework (TDF) to code and contextualise the experiences of participants who completed a PA coaching intervention underpinned by motivational interviewing and cognitive behaviour therapy (MI-CBT).

Design: Semi-structured interviews were conducted with a purposive sample of participants.

Setting: Interviews were conducted in a tertiary hospital in regional Victoria, Australia.

Participants: Eighteen participants who completed a PA coaching intervention were interviewed. The participants were recruited into the coaching intervention because they were insufficiently physically active at time of recruitment.

Results: Thirteen (72%) participants were women and the average age of participants was 54 (± 5) years. Four participant themes mapped directly onto five components of the COM-B model, and ten of the TDF domains. Increases in PA were influenced by changes in motivation and psychological capability. The autonomy-supportive PA coaching intervention helped to evoke participants own reasons (and motives) for change and influenced PA behaviours. Participants reflected on their own social and/or professional strengths, and utilised these skills to set appropriate PA goals and action plans. The structure of the PA coaching intervention provided clarity on session determinants and a framework from which to set an appropriate agenda. Relational components (e.g. non-judgemental listening, collaboration) were continually highlighted as influential for change, and should be considered in future behaviour change intervention design.

Conclusions: We demonstrate the beneficial effect of utilising theory-informed behaviour change techniques, and delivering them in a style that promotes autonomy and relatedness. The views of participants should be a key consideration in the design and implementation of PA coaching interventions

ARTICLE SUMMARY

Strengths and limitations of this study

- Semi-structured interviews enabled in-depth exploration of the experiences of individuals who participated in a physical activity coaching intervention.
- Including the perspectives of individuals who did not increase physical activity as well as those who did increase physical activity as a result of the intervention can be considered a strength of this study.
- Another strength of this study is the application of the COM-B model and the TDF to explore the experiences of individuals that participated in a physical activity coaching intervention underpinned by motivational interviewing and cognitive behaviour therapy.
- The sample was exclusively non-admitted hospital patients that participated in a physical activity coaching intervention, and additional perspectives may provide a broader overview to inform intervention development.

INTRODUCTION

Regular physical activity (PA) is positively associated with numerous health-related benefits and a marked reduction in risk for chronic disease.[1,2] Although the importance of regular PA has been widely publicised, large numbers of adults do not undertake the recommended levels of PA.[3] For example, only 50% of adults in the USA and 56% in Australia undertake the required amount of PA to be deemed sufficiently physically active.[4,5] Behaviour change interventions have been increasingly used in an attempt to influence PA change, however numerous systematic reviews and meta-analyses demonstrate that high proportions of participants revert to insufficient PA levels once the behaviour change intervention is ceased.[6-8] The marked reductions or cessation of PA can nullify the health improvements gained from temporary PA increases.[9] Consequently, there is a need to develop behaviour change interventions that strengthen the maintenance of PA over time.[10]

Rothman suggested that theory-informed (e.g social-cognitive theory) interventions can be effective for promoting maintenance of behaviour change.[11] Michie and colleagues expanded on this more recently, proposing that behaviour change interventions need to address specific components of change, namely an individual's capability, opportunity, and motivation to change.[12] The factors that influence initiation of behaviour change differ substantially to those that influence maintenance.[12,13] Using the same theoretical constructs for behaviour change initiation and maintenance might not account for variations in capability, opportunity, and motivation, many of which can be driven by intentions, past experience, and environment.[12] There is a need to explore the potential determinants of successful PA maintenance to assist in the development of interventions to produce lasting change.

Motivational Interviewing (MI) was developed to elicit motivation for behaviour change from the individual.[14] MI is an autonomy supportive intervention and seeks to empower clients to voice their own reasons and strategies for change.[14,15] MI strategies for behaviour change maintenance are less specific, and are not emphasised as part of the four processes of MI (engaging, focusing, evoking, and planning).[14] As a result, the integration of action-orientated interventions such as cognitive-

behavioural therapy (CBT) has been recommended.[16] Cognitive-behavioural therapy involves assisting clients develop strategies and skills (e.g. activity scheduling, successive approximation) to change behaviours.[17] Instead of being passive recipients of CBT skills training, the integration of MI and CBT (MI-CBT) can ensure that clients' have autonomy around the focus and direction of change, which might support maintained change.[10] Integrated MI-CBT has demonstrated effectiveness for the maintenance of PA behaviour change across a number of studies,[18,19] however participant experiences of the intervention are absent from the literature.

Qualitative approaches are beneficial to capture individuals' in-depth perspectives of the phenomenon studied, in this case, their experience of the PA coaching intervention.[20] This study examines the views of individuals who participated in a MI-CBT based PA coaching intervention as part of a randomised controlled trial (RCT).[19] Relative to control, the intervention group demonstrated significant changes in PA at post-intervention (3-months) and these changes were maintained 9 months after the commencement of the intervention.[19] At present, we do not understand what influence contextual factors (mode of delivery, behaviour change techniques, therapeutic alliance) within the coaching intervention might have had on these findings. Thus, the aim of this current study was to qualitatively explore the experiences and perceptions of individuals who received the MI-CBT based PA coaching intervention to identify determinants and facilitating factors that influenced PA behaviour change. These insights will provide a deeper understanding of their experiences, and might offer valuable information to assist health professionals to improve intervention effectiveness and uptake.

METHODS

This study employed a qualitative design using an interpretive description approach,[21] and adopted the Consolidated Criteria for Reporting Qualitative Research (Supplementary Material 1).[22] Semi-structured interviews were conducted with a purposeful sample of adults who participated in a PA

coaching intervention in the H4U-2 RCT to explore their experiences and perceptions of the intervention to identify factors that influenced PA behaviour change.

A detailed description of the PA coaching intervention (H4U-2) including the intervention schedule, theories and techniques is available in the published literature.[19] In brief, in the H4U-2 study, 120 insufficiently active adults (aged 18-69) were recruited from an ambulatory hospital clinic and randomised to an intervention group that received an education session and PA coaching, or to a control group that received the education session only. The PA coaching intervention comprised integrated MI-CBT and was delivered in five 20-min sessions over 12 weeks via the telephone. The intervention used an MI framework and microskills (open-ended questions, affirmations, reflections and summaries) to underpin all sessions. The CBT skills training (e.g. goal setting, problem solving and coping strategies) was delivered using the MI framework. The intervention was delivered by a physiotherapist trained in MI-CBT through workshop attendances, and individual coaching from an experienced practicing psychologist.

The H4U-2 participants completed outcome measures at baseline, post-intervention (3 months) and follow-up (9 months). This provided a 6-month non-intervention time to assess maintenance of behaviour change. At baseline, the mean age of the H4U-2 participants was 53 ± 8 years and accelerometer-measured PA was 15 ± 5 mins/day of moderate-to-vigorous PA (MVPA). The intervention group increased MVPA at post-intervention (23 ± 10 mins/day) and maintained this at 9-month follow-up (22 ± 10 mins/day). In contrast, the control group decreased MVPA at post-intervention (13 ± 6 mins/day) and at follow-up (10 ± 6 mins/day). Ethical approval was obtained from the research Ethics Committees of the study hospital and associated university. All participants provided written consent prior to starting the study.

Sampling and recruitment

All H4U-2 trial participants were asked to complete an evaluation form at the 9-month follow-up which included a question about whether they would be willing to participate in a semi-structured interview. Individuals who were in the intervention arm of the study and responded with "yes" (n = 46) were considered as the sample eligible to participate in this study. A purposive sampling procedure was used. We aimed for a variation in the participants' (i) change in PA (an increase, decrease or no change in PA between baseline and follow-up measured using accelerometers); (ii) engagement with the behaviour change intervention, identified by the intervention provider; (iii) gender and age to reflect the sample in the population; (iv) geographic location (rural or regional); and, (v) socio-economic status, using postcodes as a proxy. A research assistant contacted the individuals to confirm their wish to participate. Permission was sought to give their contact details to the interviewers.

Twenty five people were invited to participate. Two individuals declined; one reported no longer wishing to participate and the other individual cited health issues. The participant recruitment ceased when we met our variation sampling requirements and reached data saturation. Data saturation was considered to be reached when the analysis indicated that additional interviews were not providing new concepts and the data provided were sufficient to address the research aims.[23] No new significant information was derived between the seventeenth and eighteenth interviews, indicating that data saturation was reached and interviewing was ceased.[23]

Interview process

Written informed consent was obtained from all participants at the start of the interviews. Face-to-face interviews were carried out in the Health Promotion department of the associated hospital between June and September 2020. The interviews were carried out by the first author. A semi-structured interview guide was developed based on existing literature[24,25] and was used to facilitate the discussion (Supplementary Material 2). The interview guide was piloted by interviewing three

individuals who took part in a MI-CBT based PA coaching intervention delivered by the Health Promotion department of the associated hospital; these three individuals did not participate in the H4U-2 study, but did receive the same 5 x 20 min session of PA coaching as the H4U-2 study participants which was offered as part of standard health promotion practice in the associated hospital. Following this pilot, additional questions, probes and prompts were included to further explore individuals' experiences in terms of engaging in the behaviour change intervention. The pilot interviews were not included in the final sample as the individuals were not enrolled into the study.

Data analysis

Interviews were audio recorded, transcribed verbatim and rendered anonymous. Participants were identified as participant 1, participant 2 and so forth. The transcripts were analysed using an interpretive description method.[21] NVivo 12 software (QSR International, Cambridge, MA, USA) was used to facilitate data analysis. The interpretive description approach requires emersion into the data to identify thematic patterns, and an inductive analysis to permit theorising about explanatory factors.[21] We developed a draft coding frame to capture codes and emerging categories. The coding frame was trialled by authors (SB[1] and KR) who independently coded 20% of the transcripts. A revised version of the framework was developed and tested by the research team; this version was used to code all transcripts. The first author independently coded 18 transcripts, and two authors (KR and GB) independently coded 9 transcripts each. The level of agreement between independent coders was substantial. Disagreements were resolved through discussion amongst all coders.

Following this stage, the identified categories were mapped against the Theoretical Domains Framework (TDF)[26] and COM-B model.[12] The TDF and COM-B model provide the theoretical basis for understanding behaviour change. The TDF integrates 33 theories and 128 psychological constructs into 14 domains underpinned by psychological theory.[26] The TDF domains include individual-level factors (knowledge, skills), social factors (social influences, social support), environment and resource factors (cost of resources to facilitate change).[26] Taken together the 14 domains prompt the

consideration of a wide range of influences on behaviour change. The 14 validated domains are included in Supplementary Material 3.

Michie and colleagues identified three components that need to be present to influence behaviour (B): capability (C), opportunity (O) and motivation (M); together these components make up the COM-B model.[12] Capability refers to having the knowledge and skills required to engage in a behaviour; it can be broken down into two components, psychological capability and physical capability. Opportunity refers to the external factors which make undertaking a behaviour possible. Its two components are physical opportunity and social opportunity. Motivation refers to the internal processes which influence decision making and behaviours. Its two components are reflective motivation and automatic motivation. The COM-B model is widely used to contextualise individual-level change and determine what needs to change for behaviour change interventions to be effective.[12]

We mapped the broad categories onto the TDF domains, as well as directly onto the six components of the COM-B model to identify factors that are likely to influence PA behaviour change and could be targeted in future interventions. Participants' responses were analysed for descriptions of BCTs and skills used as part of the PA coaching intervention. The technical components of the interventions were mapped against Michie's taxonomy of behaviour change techniques (BCT),[27] and MI processes, relational components and micro-skills.[28] The mapping of draft themes and findings were discussed amongst all authors to investigate a broad perspective on thematic interpretations. Disagreements between the team were resolved through discussion. The vigour of the qualitative research was strengthened through the implementation of independent coding; triangulation of data, and the critical appraisal of developing themes.[29]

Patient and public involvement

The research was designed and conducted without patient or public involvement.

RESULTS

Eighteen people participated in semi-structured interviews, where 13 (72%) were women and 5 (28%) were men. The average age of participants was 54 (± 5) years, with participants ranging in age from 42 to 66 years. Table 1 provides details of the participants' characteristics. The interviews ranged in duration from 26 to 45 minutes, with an average duration of 34 minutes.

Table 1 Profile characteristics of participants (N = 18)

Marital Status	
Married/living together	15
Widowed	1
Single	2
Highest completed education	
Secondary/high school	4
Post-school vocational	8
University	6
Employment	
Working full-time	13
Working part-time	3
Retired	2
Geographic location [a]	
Regional	12
Rural	6
Socioeconomic area [b]	
1	4
2	4
3	6
4	4
5	3
Physical activity level at end of intervention [c]	
Meets guidelines	13
Does not meet guidelines	5
Pattern of physical activity from baseline to final measurement [c]	
Increased	13
No change	4
Decreased	1

[a] The term 'regional and rural' encompasses all areas outside Australia's major cities. Regional indicates living in a regional city. Rural indicates living in an area outside of a regional city.

[b] Index of Relative Socio-economic Disadvantage (IRSD) Socio-Economic Indexes for Areas (SEIFA) scores. IRSD data is presented as quintiles where 1 represents most disadvantaged, and 5 represents least disadvantaged.

[c] Physical activity measurements taken from accelerometer data

Perceptions of the PA coaching intervention were positive, including those participants who did not find the intervention beneficial for maintaining PA change. The structural components (i.e. defined session times and parameters) of the PA coaching intervention provided the participants with a clear indication of what was involved, while the relational components (i.e. MI spirit: collaboration, empathy, evocation, autonomy) provided a platform for the participants to engage and focus on their reasons for change. The structural and relational components highlighted by participants are detailed in Table 2. The delivery of the intervention via phone was reported as favourable by the majority of the participants. The telephone delivery provided flexibility around participation in the intervention with 16 participants in gainful employment during the intervention period.

Four themes were identified that mapped across 5 of the COM-B components and 10 domains of the TDF framework (Table 3). The themes included strength based coaching, autonomy-supportive listening, reframing PA goals, and self-regulation. As evidenced in Table 3, the themes mapped to multiple COM-B components and TDF domains; as such the findings are presented below under the identified COM-B heading, and related TDF domain sub-heading. These findings are described in detail below and supported using illustrative quotes from participants. The participant's gender, age and change in PA as a result of the PA coaching intervention are provided alongside each quote. The categories that informed these themes are presented in Supplementary Material 4.

267 Table 2 Technical, relational and structural components of the physical activity coaching intervention

Component	Description	Illustrative quotes
Technical/Relational		
Being heard	Listening to the individuals' unique issues and needs.	*"And I liked being listened to – I think that was another big one. I find sometimes if you are talking to someone who works in health, or it could be any profession but you get the feeling that they aren't even listening. They sit there looking at you and the head is bobbing away, but they are just waiting for you to stop talking so they can get their opinion in. But to be listened to, and I mean really listened to is quite important. Not a token gesture" (Female, 61, increased PA)*
Collaboration	Participants reported that they did not feel like they were being told what to do. The intervention helped support their decisions.	*"So you feel listened to, but there isn't a pressure to do what you don't want. You are driving the bus, and you know where you want to go. And the coaching is like a co-pilot, trying to navigate the best route. Both heading in the same route, but with freedom in how to get there". (Female, 55, no change in PA)*
Guiding style	Autonomy supportive style, directive towards physical activity changes that were chosen by the individual.	*"It was clear with what we wanted to do – get me fitter. But I really felt like I was in control, nothing was forced upon me, and I could do things at my own speed". (Female, 52, increased PA)* *I think that it's not just a conversation, but the kind of conversation. . So its guidance towards what's right, not a push. Because you push me and I'll push right back". (Male, 51, no change in PA)*
Supporting self-efficacy	Recognising that the individuals had the self-knowledge to manage their health; support was to draw these strengths out from them.	*"How can I run, and forgive me for saying, a successful business, and I can't manage my own fitness. That wasn't the question, but the process made me think about it. How do I use my skills, skills I already have to make the changes"? (Male, 52, increased PA)*

Big picture perspectives	Participants mentioned the implementation of strategies to support maintained change from early in the intervention.	*"Questions like 'how will you manage if you cannot attend your exercise group?' seemed odd to me. But then you know, months later and the gym is shut and I had to change tact to be active elsewhere. So it was good to have considered the what-if type thing". (Male, 50, increased PA)*
Structural		
Defined parameters	The use of clear descriptions for intervention sessions help clarify the goals of the sessions.	*"I felt I was kind of allowed to map the route for myself, I wasn't forced down an alleyway. I didn't have free reign, because the sessions started and ended with a rough guide of what we would do, so there was some bit of boundaries on it from that". (Female, 51, increased PA)*
One to one	Provided an environment where participants felt comfortable to be open.	*"I just know I wouldn't be comfortable expressing doubts about myself in a groups setting". (Female, 62, no change in PA)*
Telephone delivery	Beneficial for practical reasons such as travel. Some individuals enjoyed the 1:1 relationship without the face-to-face requirement.	*For me it was great, I was able to schedule a session towards the end of the work day, did it from the office and then I was able to leave work and concentrate on me". (Male, 52, increased PA)* *"I found it comforting to not have to look face to face while we were doing it. So having that physical distance allowed me to, to pace the hallways when I spoke if I needed, to laugh at myself or, frown or whatever. And that I think would have made me more relaxed overall". (Female, 52, increased PA)*
Session timeframes	The number of session and their spread over time permitted relationship to grown, and allowed time to plans into action. Knowing sessions were coming up influenced accountability.	*I've been to session before, with the physio say, and 15 minutes in he is writing my goals for me. But they aren't my goals at all…. It was nice to be able to decide for myself, at my own pace". (Male, 54, decreased PA)*

269 Table 3 Mapping of themes to TDF domains and COM-B model with the associated BCTs

Theme	COM-B component	TDF Domain	BCT [a] [b]
	Capability – Psychological	Knowledge	Identification of self as role model [a] Evoke personal capabilities [b]
• Strength based coaching	Capability – Psychological	Skills	Goal setting (behaviour) [a] Goal setting (outcome) [a] Acceptance [b] Evoke reasons for goals [b]
	Capability – Psychological	Behaviour regulation	Self-monitoring of behaviour [a] Problem solving [a] Anticipated regret [a] Evoke (commitment) [b] Plan [b]
	Opportunity - Physical	Environmental context and resources	Reframing [a] Commitment [a] Salience of consequences [a]
• Autonomy-supportive listening	Opportunity - Social	Social influences	Compassion [b] Acceptance [b]

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	Motivation - Automatic	Emotion	Monitoring of behaviour by others without feedback [a] Engage [b] Reflective listening [b] Evoke (reasons for change) [b] Compassion [b]
• Reframing physical activity goals	Motivation - Reflective	Intentions	Discrepancy between current behaviour and goal [a] Pros and cons [a] Reframing [a] Focus to clarify agenda [b]
	Motivation - Reflective	Goals	Discrepancy between current behaviour and goal [a] Identification of self as role model [a] Evoke (reasons for goals) [b] Acceptance [b]
• Self-regulation	Motivation - Reflective	Social/professional role and identity	Focus on past success [a] Identification of self as role model [a] Evoke (personal capabilities) [b]
	Motivation - Reflective	Beliefs about capability	Comparative imagining of future outcomes [a] Review behaviour goal(s) [a] Acceptance [b] Evoke (personal capabilities) [b]

[a] BCT taxonomy (Michie, van Stralen, and West 2011) [b] Motivational Interviewing techniques (Hardcastle et al. 2017; Miller and Rollnick 2012)
BCT: Behaviour change technique; COM-B: Capability, Opportunity, Motivation, Behaviour; TDF: Theoretical Domains Framework

Emotion - (Complex reactions - fear, anxiety, affect, stress, depression, positive and negative effect, burn out)
Intentions (A conscious decision to perform a behaviour)
Social/professional role and identity (Set of behaviours and displayed personal qualities in a social or work setting)
Skills (An ability or proficiency acquired through practice)
Beliefs about capability (Acceptance of the truth, reality or validity about an ability, perceived behavioural control, self-esteem, confidence)
Environmental context and resources (Person's situation or environment)
Social influences (Process that can change thoughts feelings or behaviours – social pressure).
Knowledge (Awareness of the existence of something: knowledge of condition)
Behaviour regulation (Managing or changes action – self monitoring)
Goals (Mental representations of outcome or end states that an individual wants to achieve)

Capability – psychological

Knowledge

Increased knowledge was not described as a key component that participants needed in order to increase PA. The participants repeatedly stated that they did not need to be told they would benefit from increasing PA.

> Anyone who is unfit knows they need to get fit – simple. But just telling them won't make a difference. (Female, 51, no change in PA)

The participants highlighted how the PA coaching intervention used their existing skills to facilitate changes in PA. This strength-based, person-centred, approach did not seek to impart knowledge, rather it sought to evoke personal capabilities from the individual, and to build their autonomy in applying this knowledge towards initiating and sustaining changes in PA.

> The coaching was good, and I think spent lots of time looking at things I was good at, and sort of, how to apply these to my exercise. But it forced me to have a good look at myself, and what I was good at and probably not too good at, and at the time it took me a while to be comfortable with both. (Male, 52, increased PA)

Skills

Although the individuals were recruited from a secondary care hospital clinic, physical capability was not discussed as a barrier to increasing PA. The participants did not indicate that they needed to be provided education on what exercise to do, or the skills required to do it. Instead, participants noted how in the past they felt that they did not have the ability to increase or maintain PA from a psychological or emotional perspective.

> What was stopping me from being fit before…it was the mind. Not the body. I could physically do it, but not mentally. (Male, 50, increased PA)

Similar to the construct of knowledge, participants expressed how the intervention strategies sought to evoke from them examples of the skills that they possessed.

> On paper being fit is easy right. You want to walk, get up and walk. And yet I sat at home on the couch feeling bad for myself for not exercising, even though I can walk. Me, a grown woman, house, kids, job. Can run them all and I wasn't able get off the couch. So I needed a shift in perspective. (Female, 55, no change in PA)

Behavioural regulation

Many of the participants described making numerous attempts at increasing PA in the past, only to lapse back to being insufficiently physically active. The inability to maintain regular PA over repeated attempts had diminished their self-efficacy to be physically active. The MI-CBT intervention used in the H4U-2 study employed specific BCTs to influence behaviour regulation as early as session 3 (week 4 of 12) of the intervention. The process of exploring capability to maintain PA changes was new to many participants, as exemplified by the following quote:

> I think we weren't long into it, and I had started to do some exercise. And I was feeling good. He [intervention provider] started asking me about how I would manage to be fit if something happened, can't remember exactly, say, my strength training class finished up or something. And I was thinking, shouldn't he be telling me I was doing a good job. But you know, when you have to think about it, and explain yourself out loud it gets the wheels turning, and you have to think 'how would I do it?' Because I've slipped off the wagon before. (Female, 49,

increased PA)

Opportunity – physical

Environmental context and resources

Physical opportunities were discussed alongside the shift in perspectives that many participants encountered, from PA being something that they had to do, to something that they wanted to do. The reframing of PA to something that was attainable and enjoyable resulted in individuals placing a higher value on PA; when PA was afforded a higher value, people made time for it irrespective of previously cited situational or environmental barriers.

> I used to drive to work every day. Its 2.2 KMs, which I know now because of walking. And of course you know how bad parking can be, so I'd probably spend ages looking for a park. Now I walk every day, to and from work. If it rains I can bring brolly, or drive if it's really bad. But I don't think of driving anymore, I enjoy the walk and it's a part of my day. (Female, 46, increased PA)

Opportunity – social

Social influences

Some of the participants enrolled in community exercise programs, for example walking groups and strength training programs. The building of social links within groups was highlighted by some as an important factor for continuing attendance, though many others were not concerned with building social connections within PA groups.

> A large part of what kept me going back to the group was the friendship I made with other people. I was only there for a few sessions and a bunch of them invited me to come along for

coffee afterwards. That was always helpful in getting me along to sessions. (Female, 58, increased PA)

I did wonder if sometimes there was a bit too much chat about exercise groups and exercising with other people. If I'm going to exercise I'll do it for myself, I don't need to be going with someone for company. That's not important for me. (Male, 54; decreased PA)

The social influence of partners and significant others was regularly discussed, primarily as it related to the provision of unsolicited, didactic advice. The participants were aware that they were not undertaking sufficient PA, they did not need this to be pointed out by their partners and significant others. This didactic style of support contrasts with the relational components of the PA coaching intervention such as autonomy-supportive listening and collaboration, components that participants found beneficial in influencing PA change.

There is always time for the right advice, and pointless advice is, well… pointless. (Female, 62, no change in PA)

My husband was with me on the appointment, and he thought it was great that the surgeon discussed me getting fit. He's been on my back for a while about it. So, he is often asking when I'll do more exercise, but I'll tell you what, that makes me want to do even less in spite of him. Even though I knew I needed to do it. The fact that he was telling me to do more made me want to do less to show him. (Female, 48, increased PA)

Motivation - automatic

Emotion

The repeated attempts to engage in regular PA resulted in a feeling of helplessness in many of the participants who enrolled in the PA coaching intervention. The sense of disappointment expressed by participants was compounded by the fact that the barriers to regular PA were not physical, but psychological and specifically emotional. The inability to maintain regular PA likely influenced the participants' PA self-efficacy levels, and by extension their automatic motivation.

> When you have a few cracks at it, and you keep ending up in the same place, it doesn't feel good. You tell yourself, and maybe a friend 'that's it, I'm going to get myself in shape'. Then two months later they ask you how that's going and you are ashamed that you haven't done a thing. And that does nothing for the self-confidence. (Female, 46, increased PA)

> I'm not afraid to say it, I needed the support. I mean, if I didn't I wouldn't have joined the coaching. I just wasn't able to do it alone. My motivation was shot, I wasn't, maybe, thinking clearly about it. Probably fed up and disappointed trying the same thing over and over and not going anywhere. (Male, 50, no change in PA)

Motivation - reflective

Intentions and goals

Many participants described how previous attempts at PA were driven by a desire to lose weight. When these attempts did not result in sustained PA levels or weight loss, they were sources of frustration. It was commonly reported that the intervention looked to reframe PA from a weight loss tool to something that might deliver general health benefits. This was followed with a change in goal setting for outcomes. Shifting goal setting away from weight loss metrics changed the overall intention of being active, and having flexible goals removed the notion of a binary outcome of meeting or not meeting goals.

> For me, exercise was always about weight. Always. If I didn't reach the target I failed. And generally, I didn't meet the target. So that was no good. But now I don't exercise for weight; I exercise for me. To make me feel good, and I am so much better for it. (Female, 55, increased PA)

Social/professional role and identity

The concept of social or professional role was commonly described by participants as a tool used within the PA coaching intervention to elicit from participants areas of their life that they felt they had achieved or maintained success in, and formulated part of the strengths-based approach to making PA changes. Many participants were in full time employment with partners and dependent children. They commented how the PA intervention required them to reflect on the strengths they have and commonly use in these social and/or professional roles. This approach evokes personal or professional capabilities, and the participants were able to reflect on where a transference of skills to PA was possible.

> So, they didn't use these words, but I needed to think on the lines of 'how can I run a team, which I think is reasonably successful, and I can't get myself in shape'. Not those words, but there was some, maybe, probing maybe. And you know, I thought, 'hey I am someone, and I can do this'. It wasn't a kick in the bum, but it made me sit up a bit. (Female, 51, increased PA)

Beliefs about capability

Participants beliefs about their capabilities were closely linked to the TDF domains of intentions and goals. As an example, exercising to lose weight and failing to attain weight loss goals resulted in a negative mindset and low self-efficacy. By reviewing and revising behavioural goals and learning from previous attempts, the participants noted a shift in their perceptions on capability. When

discussing their attempts to be active before the PA coaching intervention some of the foremost feelings that prevailed were those of frustration and disappointment. By reframing intentions and altering their goals participants expressed a greater degree of confidence in their ability to maintain regular PA.

> Once I got going, then talking about reviewing the goals, and modifying, making harder, or easier as needed, [that] was all fine. The actual tasks right, the exercise itself, or the goal setting – they aren't hard to do. It's not overly complicated. But… but you need to be smart about it and sometimes we get ourselves into a right spot that we can't see the timber from the forest. And the coaching can pull your head in a bit and give you perspective. (Female, 52, increased PA)

DISCUSSION

The aim of this study was to explore participants' perceptions of the factors that influenced their behaviour change throughout the course of a PA coaching intervention delivered using a MI-CBT framework. The interviews identified a wide range of barriers that influenced participants' capability, opportunity, and motivation to undertake regular PA, as well as the key elements of the PA coaching intervention that addressed these barriers. These key elements identified by participants included the combination of relational factors, namely the MI spirit used to underpin the intervention, and the technical factors which were the CBT skills that were utilised. The PA coaching intervention was designed to ensure that MI and CBT were integrated together in all sessions, and the fidelity of delivery was measured.[19] The participants highlighted the synergistic advantages of receiving both MI and CBT techniques to motivate and promote lasting PA change.

Changes in reflective motivation was one of the dominant components that influenced participants' behaviour change throughout the course of the intervention. Participants attributed a major change in

intentions towards PA because of the intervention, specifically the shifting of perspectives away from PA being something they had to do (e.g. participants highlighted the erroneous assumption that PA was necessary to lose weight) to PA being something they valued.[30] By reframing their intentions, the participants set goals appropriate to their needs and importantly, their sense of capability.[30] This relates closely with the need for self-efficacy for behaviour change.[31,32] Participants consistently noted that the strengths-orientated approach of the MI-CBT intervention helped build this self-belief. The evocation of personal capabilities is encouraged within MI;[14,15] participants stated that reflecting on their capabilities within their social and/or professional role highlighted their existing strengths. This demonstrated to individuals how to recognise the self-regulatory skills they already had, and how these skills could be transferred to the attainment of regular PA.[33] Instead of providing expert advice, the integration of MI-CBT permitted the individuals to voice their intentions and goals, and to understand what skills were needed to achieve these goals.[10,34] Positive perceptions in regards to one's own abilities have been shown to increase the likelihood of longer-term PA behaviour change.[35]

In contrast to physical capability, which was rarely brought up in the interviews, the influence that psychological capability had on PA behaviour change was widely discussed by most participants. The participants in this study did not seek exercise prescription from the intervention, indeed they largely claimed to already know how to undertake their preferred exercise. The prevailing issue was the interrelation between the lack of motivation and a decreased sense of psychological capability, resulting in them not exercising. When discussing how the intervention helped change behaviour, reflection on their personal capabilities and skills was a common technique mentioned by the participants. Behaviour change techniques such as identification of self as role model have been demonstrated to influence change;[27] the use of MI techniques to evoke examples of personal capacity might have influenced their confidence in their own capabilities.[28] MI has been shown to support psychological needs based on self-determination theory[36] as well as enhance self-efficacy,[32] and the integration of MI-CBT provides an autonomy-supportive framework for the delivery of BCTs.[10]

The interviews highlighted the importance of the relational components of the PA coaching intervention, namely the MI style or spirit (i.e. collaboration, compassion, evocation and empathy) used to underpin the intervention delivery. For most participants, the intervention was viewed as a positive experience, with a strong emphasis on the value of being listened to.[37] This reinforces the significance of person-centred interventions, and aligns with the importance of autonomy-supportive influences described within self-determination theory.[36] Self-determination theory posits that the quality of the support influences motivation and can help build self-efficacy.[36] The favourable experience of the intervention contrasts to the participants' description of support offered by partners or significant others. This support was didactic in nature, and they felt they were being informed of what they should do, without being listened to. The provision of listening support is a fundamental MI technique, and the spirit of MI communicates compassion, acceptance and partnership.[14,38] Using MI as the foundational platform provides a supportive environment in which to deliver non-judgemental understanding and empathy.[38] These relational components are likely to result in an increased sense of autonomy and build reflective motivation to increase and maintain PA changes.[10,28,38,39]

Increased beliefs about capability and use of self-regulation strategies characterised participants who were successful in maintaining their PA, which included a 6-month non-intervention period from the end of the intervention to the final measurement. Perceptions of capability and motivation are some of the internal and external processes (cognitive, self-reflective and self-regulatory) that come into play in human psychosocial functioning.[12] Indeed, behaviour- or self-regulation has been shown to mediate PA behaviours.[40] Some of the self-regulation strategies highlighted by participants included "relaxed" goal setting and planning. The MI framework of the intervention encouraged the individuals to set goals appropriate for them, and work out and plan their own strategies to regulate their PA. This is consistent with the autonomy-supportive approach of MI by offering choice over goals and demonstrating to participants that there are different ways to achieve these goals.[14,38] By empowering participants to set appropriate goals and demonstrating that it is the participant who decides what choices to make, the participants are likely to be more engaged in the process and the more

demanding CBT elements of the intervention.[41]

Applied implications

From a policy perspective, the delivery of the intervention 1:1 over the telephone was found to be favourable for most participants. This permitted the development of an inter-personal relationship which has been demonstrated to influence change,[42] and at the same time the telephone delivery provided participants with a sense of physical space which helped them relax. For health-service delivery is it encouraging that many participants found the coaching via telephone effective as telephone delivery permits offering services to wide geographic regions and can be delivered at participants' convenience.

Participants commonly noted that the provision of defined parameters around the intervention sessions was beneficial for instilling a degree of focus within the sessions. The participants enjoyed the autonomy of goal setting and planning; goal setting is not always associated with autonomy, and goals that are not self-endorsed are likely to inhibit motivation.[43] Using MI to underpin the delivery of the PA coaching intervention likely contributed to the sense of empowerment the participants detailed they had in setting their own goals and agendas.[30] Alongside this autonomy, the participants valued being provided with clarity on the scope of each intervention session as this provided a scaffold from which to establish their agenda. Providing clear descriptions for sessions, including scope, summaries and between session plans are key components for intervention fidelity for MI-CBT.[44] Practitioners and researchers can be encouraged that the structural parameters provided from the fidelity framework were positively received by individuals, and potentially contributed to successful behaviour change.

From a practice perspective, a large proportion of the techniques identified by participants as being important for promoting PA change were classified as relational. The importance of relational components within interventions needs to be considered when promoting behaviour change.[45] The

techniques classified in well-established BCT taxonomies have centred on the content of interventions, and have not examined the interpersonal components of interventions.[45] The PA coaching intervention in the H4U-2 study used established BCTs, but delivered them using a MI framework.[19] The MI spirit is a style of interaction that promotes an interpersonal relationship; it represents the way that the intervention content is delivered.[38] A number of authors have proposed that relational components of interventions are likely to interact with technical components to influence behaviour change.[45,46] This is consistent with the argument put forward by Hilton and Johnston that it is important *how* behaviour change interventions are delivered, rather than exactly *what* is contained in the intervention.[47] Integrating MI with CBT permits the combination of content and relational techniques to increase the effectiveness of the intervention.[10] In this paper we have examined participants' experiences of the intervention and attempted to make the distinction between relational and content-based techniques found to influence behaviour change.

Strengths and limitations

By identifying BCT techniques and mapping successful intervention components to TDF domains, COM-B components and central tenets of self-determination theory, we have distilled some of the macro level *what* of behaviour change interventions down to the more micro level of *how*. Using the TDF provides a deeper understanding of the barriers and enablers to PA for insufficiently physically active ambulatory care patients.[26] Mapping the findings into the COM-B model and highlighting specific BCTs is a significant strength of this study due to the integration of theoretically derived domains and structural and relational BCTs. Together they demonstrate the theory-informed use of MI-CBT as an evidence-based intervention to increase and maintain PA. The design of the PA coaching intervention was based upon determinants of PA change;[12,14,19] gaining perspectives from individuals who participated in the intervention provides further evidence to assist in developing effective interventions in the future.

There were some potential limitations in this study. Some difficulty arose in the categorisation of TDF themes and associated BCTs due to a degree of ambiguity in the definitions of the theoretical domains. Where this arose, the categorisation was determined through consensus via discussion within the research team. The sampling frame for the study was another potential limitation as all participants were recruited through an ambulatory hospital clinic in one hospital setting. The recruitment from one setting only potentially restricted the diversity in participants, in particular diversity in ethnicity, and limits the generalizability of the findings to broader populations. The participants who agreed to take part in this qualitative study may have been motivated and willing to talk about PA. The H4U-2 trial participants were asked if they were willing to participate in this study and we purposely recruited participants who did not increase PA as a result of the intervention to provide a broad sample. We made a conscious effort to recruit male and female participants, to provide understanding into the experiences of both genders.

CONCLUSIONS

This study provides an understanding of how participants perceived a PA coaching intervention and identified some of the behavioural factors that enabled or inhibited PA and the components that influenced their PA behaviour change. Using the TDF and COM-B model provides a theoretical basis for understanding behaviour factors in specific contexts, providing an indication of *what* is required to change. Identifying content and relational BCTs provides an overview of *how* to deliver autonomy-supportive interventions to support self-regulation of PA behaviour and build self-efficacy to maintain change. The findings from this study are valuable from theoretical, applied, training and commissioning perspectives because the BCTs, and the structural and relational components of the intervention that influenced behaviour change were identified firsthand by participants involved in the study. Its findings can be used to influence future intervention design, delivery and its monitoring and evaluation.

Footnotes

Author Contributions: SB[1], MK, SB[2] and PO'H conceived the project and assisted with the protocol design. SB[1] collected and analysed the data with support from KR and GB. SB[1] wrote the first draft of the manuscript. SB[1], SB[2], PO'H, JB, KR, GB and MK critically reviewed the manuscript and provided detailed feedback. All authors read, edited and approved the final manuscript as submitted.

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Competing interests: None declared.

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Data sharing statement: Data are available upon reasonable request.

References

1. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. *Compr Physiol* 2012;**2**:1143-1211.
2. Rhodes RE, Janssen I, Bredin SSD, Warburton DER, Bauman A. Physical activity: Health impact, prevalence, correlates and interventions. *Psychology & Health* 2017;**32**:942-975.
3. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *BJSM* 2020;**54**:1451-1462.
4. Fredriksson SV, Alley SJ, Rebar AL, Hayman M, Vandelanotte C, Schoeppe S. How are different levels of knowledge about physical activity associated with physical activity behaviour in Australian adults? *PLoS One* 2018;**13**:e0207003.
5. Dempsey PC, Biddle SJH, Buman MP, et al. New global guidelines on sedentary behaviour and health for adults: broadening the behavioural targets. *Int Jour Behav Nut Phys Act* 2020;**17**:1-12.
6. Sangelaji B, Smith CM, Paul L, Sampath KK, Treharne GJ, Hale LA. The effectiveness of behaviour change interventions to increase physical activity participation in people with multiple sclerosis: a systematic review and meta-analysis. *Clinical Rehab.* 2016;**30**:559-576.
7. Grimmett C, Corbett T, Brunet J, et al. Systematic review and meta-analysis of maintenance of physical activity behaviour change in cancer survivors. *Int Jour Behav Nut Phys Act* 2019;**16**:37.
8. Whatnall MC, Sharkey T, Hutchesson MJ, et al. Effectiveness of interventions and behaviour change techniques for improving physical activity in young adults: A systematic review and meta-analysis. *Jour Sports Sci* 2021;**39**:1754-1771.
9. Amireault S, Godin G, Vézina-Im L-A. Determinants of physical activity maintenance: a systematic review and meta-analyses. *Health Psychol Rev* 2013;**7**:55-91.
10. Naar-King S, Earnshaw P, Breckon J. Toward a universal maintenance intervention: integrating cognitive-behavioral treatment with motivational interviewing for maintenance of behavior change. *Journal of Cognitive Psychotherapy.* 2013;**27**:126-137.
11. Rothman AJ. Toward a theory-based analysis of behavioral maintenance. *Health Psychol* 2000;**19**:64-69.
12. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci* 2011;**6**:42-42.
13. Kwasnicka D, Dombrowski SU, White M, Sniehotta F. Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychol Rev* 2016;**10**:277-296.
14. Miller WR, Rollnick S. *Motivational interviewing: Helping people change.* Guilford press; 2012.
15. Miller WR, Rollnick S. Ten things that motivational interviewing is not. *Behav and Cognit Psychother* 2009;**37**:129-140.
16. Arkowitz H, Miller WR. Learning, applying, and extending motivational interviewing. 2008.
17. Beck AT, Weishaar M. Cognitive Therapy. In: *Comprehensive handbook of cognitive therapy.* Springer; 1989:21-36.
18. Barrett S, Begg S, O'Halloran P, Kingsley M. Integrated motivational interviewing and cognitive behaviour therapy can increase physical activity and improve health of adult ambulatory care patients in a regional hospital: the Healthy4U randomised controlled trial. *BMC Public Health.* 2018;**18**:1-11.
19. Barrett S, Begg S, O'Halloran P, Kingsley M. A physical activity coaching intervention can improve and maintain physical activity and health-related outcomes in adult ambulatory hospital patients: the Healthy4U-2 randomised controlled trial. *Int Jour Behav Nut Phys Act* 2020;**17**:156.

20. Hardcastle S, Hagger MS. “You can’t do it on your own”: Experiences of a motivational interviewing intervention on physical activity and dietary behaviour. *Psychol of Sport and Ex* 2011;**12**:314-323.
21. Thorne S. *Interpretive description.* Routledge; 2016.
22. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int Jour Qual in Health Care.* 2007;**19**:349-357.
23. Fusch PI, Ness LR. Are we there yet? Data saturation in qualitative research. *The Qualitative Report.* 2015;**20**:1408.
24. Barrett S, Rodda K, Begg S, O'Halloran PD, Kingsley MI. Exercise and COVID-19: reasons individuals sought coaching support to assist them to increase physical activity during COVID-19. *Aust and New Zeal Jour Pub Health* 2021;**45**:133-137.
25. Sander AP, Wilson J, Izzo N, Mountford SA, Hayes KW. Factors that affect decisions about physical activity and exercise in survivors of breast cancer: a qualitative study. *Physical Therapy.* 2012**;92**:525-536.
26. Cane J, O’Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Sci* 2012;**7**:1-17.
27. Michie S, Richardson M, Johnston M, et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Annals of Behav Med* 2013;**46**:81-95.
28. Hardcastle SJ, Fortier M, Blake N, Hagger MS. Identifying content-based and relational techniques to change behaviour in motivational interviewing. *Health Psychol Rev* 2017;**11**:1-16.
29. Elliott R, Timulak L. Descriptive and interpretive approaches to qualitative research. *A Handbook of Research Methods for Clinical and Health Psychology.* 2005;**1**:147-159.
30. Markland D, Ryan RM, Tobin VJ, Rollnick S. Motivational interviewing and self–determination theory. *Jour Social Clin Psychol* 2005;**24**:811-831.
31. Ashford S, Edmunds J, French DP. What is the best way to change self-efficacy to promote lifestyle and recreational physical activity? A systematic review with meta-analysis. *Bri Jour Health Psychol* 2010;**15**:265-288.
32. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev* 1977;**84**:191-215.
33. Bell BS, Kozlowski SWJ. Active learning: effects of core training design elements on self-regulatory processes, learning, and adaptability. *Jour Appl Psychol* 2008;**93**:296.
34. Skinner EA. A guide to constructs of control. *J Pers Soc Psychol* 1996;**71**:549.
35. Hutchison AJ, Johnston LH, Breckon JD. A grounded theory of successful long-term physical activity behaviour change. *Qual Res* Sport *Exerc Health* 2013;**5**:109-126.
36. Deci EL, Ryan RM. *Intrinsic motivation and self-determination in human behavior.* Springer Science & Business Media; 2013.
37. Miller WR, Rose GS. Toward a theory of motivational interviewing. *American Psychologist* 2009;**64**:527.
38. Miller WR, Moyers TB. Eight stages in learning motivational interviewing. *Jour Teach Addic* 2006;**5**:3-17.
39. Hagger M, Chatzisarantis N. Self-determination theory and the psychology of exercise. *Int Rev Sport Exerc Psychol* 2008;**1**:79-103.
40. Hallam JS, Petosa R. The long-term impact of a four-session work-site intervention on selected social cognitive theory variables linked to adult exercise adherence. *Health Educ Behav* 2004;**31**:88-100.
41. Westra HA, Arkowitz H, Dozois DJA. Adding a motivational interviewing pretreatment to cognitive behavioral therapy for generalized anxiety disorder: a preliminary randomized controlled trial. *J Anxiety Disord.* 2009;**23**:1106-1117.

42. Arkowitz H, Miller WR, Rollnick S. *Motivational Interviewing in the Treatment of Psychological Problems.* Guilford Publications; 2015.
43. Koestner R, Otis N, Powers TA, Pelletier L, Gagnon H. Autonomous motivation, controlled motivation, and goal progress. *J Pers* 2008;**76**:1201-1230.
44. Haddock G, Beardmore R, Earnshaw P, et al. Assessing fidelity to integrated motivational interviewing and CBT therapy for psychosis and substance use: the MI-CBT fidelity scale (MI-CTS). *J Ment Health.* 2012;21(1):38-48.
45. Hagger MS, Hardcastle SJ. Interpersonal style should be included in taxonomies of behavior change techniques. *Front Psychol* 2014;**5:**254.
46. Magill M, Hallgren KA. Mechanisms of behavior change in motivational interviewing: do we understand how MI works? *Curr Opin Psychol* 2019;**30**:1-5.
47. Hilton CE, Johnston LH. Health psychology: It's not what you do, it's the way that you do it. *Health Psychology Open.* 2017;**4**:2055102917714910.

729 Table 1. Profile characteristics of participants

730 Table 2. Technical, relational and structural factors of intervention

731 Table 3. Mapping of themes to TDF domains and COM-B model with the associated BCTs.

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COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	8
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	8
Occupation	3	What was their occupation at the time of the study?	NA
Gender	4	Was the researcher male or female?	8
Experience and training	5	What experience or training did the researcher have?	8
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	NA
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	NA
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	NA
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	8
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	7-8
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	7-8
Sample size	12	How many participants were in the study?	7,9
Non-participation	13	How many people refused to participate or dropped out? Reasons?	7,9
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	8
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	8
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	9-10
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	8
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	NA
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	8
Field notes	20	Were field notes made during and/or after the inter view or focus group?	8
Duration	21	What was the duration of the inter views or focus group?	9
Data saturation	22	Was data saturation discussed?	7
Transcripts returned	23	Were transcripts returned to participants for comment and/or	NA

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	8-9
Description of the coding tree	25	Did authors provide a description of the coding tree?	NA
Derivation of themes	26	Were themes identified in advance or derived from the data?	8
Software	27	What software, if applicable, was used to manage the data?	8
Participant checking	28	Did participants provide feedback on the findings?	NA
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	11-20
Data and findings consistent	30	Was there consistency between the data presented and the findings?	11-20
Clarity of major themes	31	Were major themes clearly presented in the findings?	11-20
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	NA

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

H4U-2 Participants experiences - Interview guide

Topics	Questions
General	Standard opening question: What was the reason you agreed to participate in the Healthy 4U-2 study?
Expectations prior to the study	What expectations did you have prior to the Healthy 4U-2 study? Can you tell me to what extent your expectations were met? *Can you rate this 1-10?*
Perceived outcome	Can you tell me whether you think you became more physically active due to your participation in the study? *In what ways?* *How long did it take to have an impact?*
Experiences with MI-CBT intervention	Can you tell me how you experienced the telephone support you received during the consultations? Can you tell me whether you think the consultations helped you increase your physical activity? If yes, what components helped with increasing physical activity? *Which components were most helpful? (Prompt: in what ways?)* *Which components were not so helpful? (Prompt: why not)* *Would you recommend changing any components? In what ways? Why?*
Perceptions towards the MI-CBT consultation structure and most prevalent BCTs	How did you experience setting personal goals and action plans? Did the facilitator help you to set your own goals and plan your actions? *[BCTs: goal setting and action planning]* To what extent did this affect your progress?

	What is your opinion about reviewing the extent to which you attained your goals? [BCT: reviewing behavioural goal(s)] Did this affect your progress?
	Did the facilitator discuss how you can get any support from e.g., family or friends? *[BCT: social support]* To what extent did this affect your progress?
	Did you discuss strategies to maintain being physically active?
	Did you bring up the strategies yourself? *[BCTs: habit formation, problem-solving and relapse prevention].*
	Can you tell me how the facilitator supported you if you found it difficult to maintain your progress? What did you find helpful and unhelpful? *[BCT: problem-solving*]
	Can you tell me whether you think the study consultations differed compared to other consultations you have had around increasing physical activity?
Experiences with the study materials and equipment	Can you tell me how you found wearing the accelerometer and keeping the activity logbook?
	How did this affect your progress?
	Did you perceive any difficulties while wearing the accelerometer or keeping the activity log? How did you handle this?
Most and least effective components	Can you tell me what you found most helpful in becoming more physically active?
	Can you tell me what you found least helpful in becoming more physically active?
Duration of the intervention	What is your opinion about the number and length of the consultations?

	Generally, how much time did you spend on keeping the activity log? Was this helpful? Was this acceptable to you?
Satisfaction with the intervention	Can you tell me how satisfied you are with your participation in the Healthy 4U-2 study? Ask for scale rating 1-10 – *follow up with why this score.* Would you recommend this intervention to other patients? Why/why not What time of people would you recommend this intervention to?
Prevention in hospitals	You entered the study after coming into hospital to see a surgeon- how did that happen? What are your thoughts on receiving this information from the surgeon? Did receiving a referral from a surgeon influence your decision to take part? Have you discussed increasing physical activity with other health professionals in the past?
Perceptions towards maintaining physical activity	Have you made any changes to your general daily routine as a result of your participation in the study? To what extend do you think you will maintain being physically active? Now you have finished the intervention, how motivated are you to continue being more physically active? Now you have finished the intervention, how self-confident are you to continue being more physically active? How do you plan to maintain the changes you have made?

Additional questions regarding previous or not discussed topics	Do you have anything to add to the questions I have asked

The Theoretical Domains Framework (TDF)

TDF domain	Description
Knowledge	An awareness of the existence of something.
Skills	An ability or proficiency acquired through practice.
Social/professional role and identity	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting.
Beliefs about capabilities	Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use.
Optimism	The confidence that things will happen for the best, or that desired goals will be attained.
Beliefs about consequences	Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation.
Reinforcement	Increasing the probability of a response by arranging a dependent relationship or contingency, between the response and a given stimulus.
Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way.
Goals	Mental representation of outcomes or end states that an individual wants to achieve.
Memory, attention and decision processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives.
Environmental context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour.
Social influences	Those interpersonal processes that can cause an individual to change their thoughts, feelings or behaviours.
Emotion	A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event.
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions.

Themes, categories and associated TDF domains and COM-B model components

Theme	Categories	COM-B component	TDF Domain
• Strength based coaching	• Building on existing skills to address physical activity • Focus on individuals strengths and capabilities	Capability – Psychological	Knowledge
	• Goal setting based on capabilities • Non-judgmental, autonomous decision making • Confidence in abilities • Non prescriptive / clients felt they not directed to make undesired change	Capability – Psychological	Skills
	• Building maintenance skills	Capability – Psychological	Behaviour regulation
	• When you value physical activity you can find time for it	Opportunity - Physical	Environmental context and resources
• Autonomy-supportive listening	• Didactic support from significant others does not positively influence change • Being told what to do does not lead to change • Being heard and having your opinion valued	Opportunity - Social	Social influences

Theme	Categories	COM-B components	TDF Domain
	• Feelings of helplessness based on previous failed attempts to be physically active	Motivation - Automatic	Emotion
• Reframing physical activity goals	• Gaining/shifting perspectives on being physically active • Why do I really want to be active	Motivation - Reflective	Intentions
	• Utilisation/transference of existing skills	Motivation - Reflective	Goals
• Self-regulation	• Strengths orientated approach to maintain change	Motivation - Reflective	Social/professional role and identity
	• Challenging a negative mindset • Learning from and forgetting past failures • Non-judgmental listening support	Motivation - Reflective	Beliefs about capability

Emotion - (Complex reactions - fear, anxiety, affect, stress, depression, positive and negative effect, burn out)
Intentions (A conscious decision to perform a behaviour)
Social/professional role and identity (Set of behaviours and displayed personal qualities in a social or work setting)
Skills (An ability or proficiency acquired through practice)
Beliefs about capability (Acceptance of the truth, reality or validity about an ability, perceived behavioural control, self-esteem, confidence)
Environmental context and resources (person's situation or environment)
Social influences (Process that can change thoughts feelings or behaviours – social pressure).
Knowledge (Awareness of the existence of something: knowledge of condition)
Behaviour regulation (Managing or changes action – self monitoring)
Goals (mental representations of outcome or end states that an individual wants to achieve)