

**Determinants and strategies for physical activity maintenance in chronic health conditions: a qualitative study**

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**Introduction**

2 Cardiovascular diseases (CVD) are the primary cause of death globally, accounting for more  
3 than 30% of all deaths.<sup>1</sup> Thirty minutes a day of moderate physical activity is recommended  
4 to prevent or manage CVD and comorbidities (e.g., diabetes and hypertension).<sup>2</sup> For ongoing  
5 health benefits, moderate intensity activity needs to be maintained in the long-term, which is  
6 defined as consistently engaging in physical activity for six months or more.<sup>3,4</sup> Nevertheless,  
7 evidence suggests that adults with health conditions are less likely to maintain physical  
8 activity than "healthy" adults.<sup>4</sup> Additionally, physical activity disengagement typically occurs  
9 six months after interventions cease.<sup>5</sup> Consequently, there is an increased emphasis on the  
10 development of interventions to promote physical activity maintenance<sup>3</sup> and attention is  
11 warranted to explore the mechanisms for this behavior within adults with CVD and  
12 comorbidities.

13 It is suggested that behavior change interventions are more effective if derived from  
14 theory.<sup>6</sup> Physical activity interventions are typically informed by social cognition models,  
15 such as the transtheoretical model and social cognitive theory.<sup>7</sup> However, many theories are  
16 criticized for largely focusing on the determinants for the initiation phase (e.g., self-efficacy),  
17 which could differ to that of the maintenance phase (e.g., perceived satisfaction) of behavior  
18 change.<sup>8</sup> The transtheoretical model is an exception which defines the stages of change from  
19 pre-contemplation to maintenance and relapse.<sup>7</sup> Despite this, interventions derived from the  
20 model are no more effective than a control group for promoting physical activity maintenance  
21 after intervention cessation.<sup>9</sup> A suggested explanation for this is that the transtheoretical  
22 model was largely developed for behavioral cessation (e.g., smoking cessation) and, therefore,  
23 fails to consider the mechanisms associated with behavioral adoption (e.g., physical  
24 activity).<sup>10</sup> Consequently, the specific determinants for physical activity maintenance are

1 unclear which limits the development of effective interventions. A previous review of the  
 2 literature has recommended that research should focus on distinguishing the determinants that  
 3 differentiate successful and unsuccessful physical activity maintenance to develop better  
 4 long-term interventions.<sup>4</sup>

5         Studies specifically focusing on the determinants for successful and unsuccessful  
 6 physical activity maintenance within chronic health conditions are scant.<sup>11,12,13,14</sup> In healthy  
 7 adults, evidence suggests that cognitive-behavioral processes distinguish between successful  
 8 and unsuccessful maintainers, such as decreased perceived costs (e.g., physical activity is too  
 9 time consuming), increased perceived behavioral control, and increased perceived  
 10 satisfaction.<sup>12,13</sup> Additionally, maintainers are more likely than unsuccessful maintainers to  
 11 have enhanced self-efficacy for overcoming barriers, such as boredom, and inclement  
 12 weather.<sup>11</sup> Only one study confirmed that increased self-efficacy, increased outcome  
 13 expectations, and enhanced self-determination led to successful maintenance in adults with  
 14 CVD risk factors.<sup>14</sup> The lack of research within adults with CVD and comorbidities warrants  
 15 further exploration into the determinants for physical activity maintenance.

16         In addition to determinants, the appropriate behavior change techniques need to be  
 17 implemented in interventions to successfully promote change.<sup>15</sup> The 40-item taxonomy of  
 18 behavior change techniques outlines the cognitive-behavioral strategies used to promote  
 19 physical activity and healthy eating.<sup>15</sup> Specifically, self-monitoring, feedback on performance,  
 20 and goal-setting have been shown to be effective.<sup>16</sup> It is unclear, however, if such strategies  
 21 promote physical activity maintenance. Furthermore, the taxonomy focused on 'healthy'  
 22 sedentary individuals, which limits its generalizability to chronically ill adults, as additional  
 23 strategies have been found to promote physical activity, such as pain management and  
 24 relaxation techniques.<sup>17</sup> Thus, successful physical activity maintenance in adults with chronic



1 occurred (where no new themes or information emerged from new participants) at 15  
2 participants for successful maintainers but 20 were obtained to adhere to recommendations  
3 for achieving saturation.<sup>20</sup> The response rate was low for unsuccessful maintainers and so  
4 purposive sampling ended when theme saturation was achieved resulting in 12 participants.

## 5 **Instrumentation**

6 To categorize participants as successful or unsuccessful maintainers, the Physical  
7 Activity Stages of Change Questionnaire adapted from the Scottish Physical Activity  
8 Questionnaire (SPAQ) was used.<sup>21</sup> The questionnaire invites participants to choose one  
9 statement from five that best described their physical activity over the previous six months  
10 (e.g., "I am regularly physically active and have been so far longer than six months"). While  
11 there is consensus that maintenance is defined as sustaining a behavior for six months or  
12 more, there is no consensus on what constitutes unsuccessful maintenance.<sup>4</sup> For the purpose  
13 of this study, if participants stated to have engaged in physical activity for six months or more,  
14 they were considered to be in the maintenance phase. If participants reported engaging in no  
15 physical activity, or had done so for less than six months, they were considered to be  
16 unsuccessful maintainers given that a lapse would have occurred after the referral scheme.

17 Current physical activity status was also measured to validate participant categories  
18 using the International Physical Activity Questionnaire (IPAQ) long-form.<sup>22</sup> It was assumed  
19 that successful maintainers would perform more activity than the unsuccessful maintainers.<sup>23</sup>  
20 The IPAQ measures vigorous-intensity, moderate-intensity, walking activity, and sitting time  
21 based on metabolic equivalent of task per minute (MET-minute). The scale has acceptable  
22 test-retest reliability (spearman's  $\rho = 0.80$ ) and has been tested in a range of populations.<sup>22</sup>

23 The interview schedule consisted of approximately 20 open-ended questions focusing  
24 on participants' activity participation, strategies, and related experiences before, during, and  
25 after the referral scheme (e.g., 'Tell me about your experiences of physical activity before the

1 referral scheme?' 'What strategies do you use to stay active?'). This included an exploration of  
2 their most recent experiences and reasons for physical activity participation (e.g., 'What  
3 prompts you to exercise (or not exercise) now?'). Two pilot interviews were conducted to  
4 ascertain the appropriateness of the interview schedule. Repetitive questions were removed  
5 and included a question on the use of technology as a strategy because this was an emerging  
6 theme from the pilot interviews (e.g., 'What do you think to using technology such as  
7 pedometers to help you stay active?').

## 8 **Procedures**

9 PARS completers were identified from a database owned by the PARS coordinator,  
10 which contained information on attendance and physical activity status at six months post-  
11 PARS (e.g., 'yes, I'm still active' or ' No, I'm not as active'). Recruitment packs, consisting of  
12 study information and questionnaires were distributed by the PARS coordinator to eligible  
13 participants. After obtaining informed consent, each participant engaged in a one-hour semi-  
14 structured face-to-face audio-recorded interview, which was transcribed verbatim.  
15 Pseudonyms were used to ensure confidentiality. Telephone interviews were conducted if  
16 participants could not attend a face-to-face interview. The interviews were conducted by the  
17 principal researcher who used a combination of open-ended questions, reflections, and  
18 paraphrases to elicit relevant information.<sup>20</sup>

## 19 **Data Analysis**

20 Framework analysis was used to analyze the data and is a popular method employed  
21 in health-related research during intervention development.<sup>24</sup> Data analysis consists of five  
22 inter-connected but distinct stages. In Stage 1 (familiarization), each transcript was read  
23 through and uploaded to QSR-Nvivo (Version 9). Notes were made for potential themes  
24 using the memo and annotation tool. In Stage 2 (identification of a thematic framework), a  
25 thematic framework was developed based on a random selection of the transcripts and

1 consisted of a hierarchical structure of higher-order and lower-order themes (Table 2). In  
2 Stage 3 (indexing), the thematic framework was applied to the remaining transcripts and new  
3 or similar themes were integrated. Frequencies of successful and unsuccessful maintainers for  
4 each theme were obtained to aid the analysis. All investigators conducted theme triangulation  
5 until agreement was reached.<sup>20</sup> Inter-coder reliability was conducted with an independent  
6 researcher and achieved 86 percent and deemed acceptable.<sup>25</sup> In Stage 4 (charting), charts  
7 were created to highlight associations between determinants and strategies, which were  
8 identified using the coding tool in QSR-Nvivo. In Stage 5 (mapping and interpretation), the  
9 association charts were transformed into process maps and the mechanisms were understood  
10 by applying existing literature on behavior change theories and strategies. Meetings were  
11 held with all investigators to reach consensus on interpretations of themes.

12 Descriptive statistics were calculated for IPAQ scores, which were computed in SPSS  
13 version 19. The total median METs-minute for all activities was used. Data was not normally  
14 distributed and a Mann-Whitney U test was performed to compare the level of activity  
15 between successful and unsuccessful maintainers.

## 16 Results

### 17 Participant Characteristics

18 Thirty-two participants were interviewed and participant characteristics are outlined  
19 in Table 1. The median METs-minute for total activity performed in an average week for the  
20 sample was  $3244.5 \pm 4948.3$ . The successful maintainers performed nearly 8-fold more  
21 activity ( $Mdn = 6203.5 \pm 4940.7$ ) than the unsuccessful maintainers ( $Mdn = 777.0 \pm 2655.9$ )  
22 and this difference was statistically significant ( $U = 22, p < .001, r = -.67$ ).

23 \*\*\*\*INSERT TABLE 1 HERE\*\*\*\*

### 24 Determinants and Strategies for Successful and Unsuccessful Maintenance.

1           The thematic framework outlined in Table 2 reports the 11 major themes and  
2 associated lower-order themes that emerged for both successful and unsuccessful maintainers.  
3 These include: (1) outcome expectations; (2) outcome experiences; (3) core values; (4)  
4 attitudes towards physical activity; (5) trial and error; (6) social and practical support; (7)  
5 psychological barriers; (8) physical barriers; (9) environmental barriers; (10) physical activity  
6 self-management strategies; and, (11) condition management strategies. Each theme will be  
7 described in relation to successful and unsuccessful maintenance.

8   \*\*\*\*INSERT TABLE 2 HERE\*\*\*\*

### 9 **Physical Activity Outcome Expectations and Experiences**

10           All participants, including unsuccessful maintainers, reported expectations of gains  
11 from physical activity, such as improving health and functional independence ( $n = 32$ ). This  
12 is illustrated by a male maintainer, "I expect to get fitter and healthier" and a male  
13 unsuccessful maintainer, "I want to put five years on my life ...of being fit... It's not how long  
14 you live it's the quality of life."

15           By engaging in physical activity through the referral scheme, the majority of  
16 participants reported experiences of benefits by observing physiological or psychological  
17 improvements ( $n = 31$ ), receiving compliments from others ( $n = 9$ ), or observing  
18 improvements in others ( $n = 5$ ). One male successful maintainer stated, "I struggled with  
19 bending down to put my socks on but I'm not now". Nevertheless, physical activity  
20 disengagement was still reported by the unsuccessful maintainers. The lower-order theme 'no  
21 experience' confirmed that the majority of unsuccessful maintainers ( $n = 8$ ) reported  
22 experiencing little or no improvement in a prioritized outcome expectation, as one female  
23 discussed, "the main thing is to lose weight and I enjoyed it [physical activity] when I was  
24 there. I used to think to myself, this is better than sitting down, but I never noticed any  
25 [weight loss] really." The lack of experienced benefit for a prioritized outcome appeared to



1 result in incongruence between physical activity outcome expectations and experiences  
2 leading to disappointment and disengagement. Furthermore, unrealistic expectations about  
3 one's own ability, effort, and length of time needed to experience benefits appeared to  
4 contribute to this incongruence in unsuccessful maintainers ( $n = 5$ ). For example the length of  
5 time needed to lose weight appeared unrealistic as a female unsuccessful maintainer  
6 mentioned, "Well I'd probably do it [physical activity] for a couple of days and then go off it  
7 and think 'oh, I've done it now'."

8 *Strategies associated with outcome expectations and experiences* included goal  
9 setting ( $n = 15$ ), and self-monitoring ( $n = 9$ ) of physiological changes, such as improved  
10 blood pressure and fitness. Technological devices, such as the internet and heart-rate  
11 monitors were used, which provided feedback on performance, thus enabling self-  
12 management of a health condition. A male successful maintainer recovering from a heart-  
13 attack, triple bypass, and angina discussed the use of a heart-rate monitor to observe fitness  
14 progress and manage his heart condition, "I got it to a hundred and four today. I could feel it  
15 [angina] coming on and I don't want to push it so each day I try and go as long and hard as I  
16 can." Condition management strategies also appeared to encourage positive experiences by  
17 managing unpleasant symptoms and allowing continual physical activity engagement. For  
18 example, pacing ( $n = 16$ ) involved engaging in enough activity and rest so to avoid pain,  
19 fatigue, and other symptoms. One male successful maintainer stated, "You've got to pace  
20 yourself. If I went out of here and dug a garden, I'm going to be knackered the next day and I  
21 think...next time, I'm only gonna do half of that." These techniques were mainly used by  
22 successful maintainers compared to the few unsuccessful maintainers (*cf.* Table 2).

### 23 **Core values**

24 Core values, such as a health value, family value, or independence value, appeared to  
25 influence both successful and unsuccessful maintainers ( $n = 31$ ). A core value existed

1 independently to physical activity (e.g., family or health) and was reported to be a "means to  
2 an end" that could be influenced by exercise participation. For example, since the diagnosis of  
3 a chronic health condition, one male successful maintainer stated, "I value health more than  
4 anything". If congruence existed between physical activity expectations, experiences, and a  
5 value, then successful maintenance occurred. For example, successful maintainers discussed  
6 the impact of exercise on fitness levels and the importance (value) of family since the onset of  
7 a health condition ( $n = 10$ ), "I like to think being active is helping me since the operation...I'd  
8 like to think I can keep helping the family...which I can still do so that's the important part as  
9 far as I'm concerned." In contrast, if incongruence existed between physical activity  
10 expectations, experiences, and values then exercise was perceived as a barrier resulting in  
11 disengagement. For example, unsuccessful maintainers also reported a family value ( $n = 6$ )  
12 but was seen as more important than exercise, "If one of my kids wanted me to do something  
13 I'd do it...and then I think 'no I really need to go [to the gym]'. I put my family first, which I  
14 think is the most important thing."

15 *Strategies Associated with Core Values* were a range of time management strategies,  
16 such as planning ( $n = 15$ ), prioritizing ( $n = 8$ ), developing a routine ( $n = 9$ ), flexibility ( $n = 8$ ),  
17 and planning "me time" ( $n = 7$ ). Only successful maintainers reported using the strategies to  
18 negotiate competing demands between exercise and core values. One female successful  
19 maintainer discussed managing her health condition, prioritizing exercise, and her family  
20 value, "I look after the family a lot but I manage by having a day off. I get to do some  
21 exercise and recharge my batteries... I have to prioritise what I do." In contrast, only  
22 unsuccessful maintainers ( $n = 5$ ) reported being unable to manage disruption of an exercise  
23 routine, "I've had to cover some holiday to work so that's totally sent my routine out".

24 **Trial and Error**

1           A "trial and error" learning process appeared to be a method by which both successful  
2 ( $n = 11$ ) and unsuccessful ( $n = 6$ ) maintainers learned their physical limitations, capabilities,  
3 and strategies for physical activity engagement. The process appeared to involve "pushing  
4 yourself" which leads to a "knowing" of physical limitations and capabilities. The difference  
5 between successful and unsuccessful maintainers appeared to be that the maintainers  
6 accepted their limitations and worked within them but the unsuccessful maintainers were still  
7 in denial. For example, a male maintainer described, "You just keep pushing and pushing...In  
8 the past I've pushed myself too much and felt it for the next week but now I get to a point  
9 where I KNOW I can push myself to that level." Alternatively, the inability for unsuccessful  
10 maintainers to accept their physical limitations led to over exertion and exercise  
11 disengagement, despite knowing their capabilities, "I still think I'm nineteen and I can do  
12 what I did then, and I'd try that and suffer for...the conscious argument isn't there...and I  
13 suppose the trick is to maintain that level of consciousness."

14           *Strategies Associated with Trial and Error* were pacing ( $n = 15$ ) and graded activity  
15 ( $n = 3$ ) which appeared to be learnt through this process. Only successful maintainers  
16 reflected on the strategies. One female successful maintainer discussed learning the necessity  
17 of pacing and graded activity after an operation, "I was impatient and I started walking too far.  
18 I got quite ill because my body was trying to tell me to stop. After that, I was very careful to  
19 gradually just do a bit and pace myself." In contrast, unsuccessful maintainers had not learnt  
20 to pace ( $n = 5$ ), "I tried to do things too quickly... but I was angry with myself for not losing  
21 the weight...so I would go at it too hard...always trying to prove myself."

## 22 **Social and Practical Support**

23           All participants reported receiving social and practical support ( $n = 32$ ). During the  
24 referral scheme, both successful ( $n = 8$ ) and unsuccessful ( $n = 4$ ) maintainers reported a  
25 cathartic effect from receiving support from group exercise and compared it to "group

1 therapy". One female unsuccessful maintainer said, "I met other people who had the same  
2 problems I had...so seeing other people cope gave me a boost." Once the scheme ended,  
3 however, the majority of successful maintainers ( $n = 13$ ) appeared to receive social support  
4 from health professionals or family as one male stated, "my wife keeps pushing me to come  
5 to the gym". Additionally, group exercise classes appeared to provide a substitute for the loss  
6 of routine, purpose, and structure during retirement that was once gained from past  
7 employment largely for successful maintainers ( $n = 8$ ), "the work has gone now so therefore  
8 I've got to look at something as a substitute ...when you've finished work, you think 'what  
9 am I going to do now?'" In contrast, fewer unsuccessful maintainers ( $n = 5$ ) received support  
10 from family which would prevent total sedentary behavior; "I do go to the gym sometimes  
11 when I feel guilty and get shouted at by my son or daughter". Additionally, unsuccessful  
12 maintainers ( $n = 5$ ) discussed that the loss of support and monitoring was demotivating as  
13 "once you've left the referral, you don't have to produce anything to say what you're doing.  
14 You've got to do it all yourself and that's hard". Successful maintainers also expressed a  
15 concern about support ending ( $n = 7$ ), accompanied by limited confidence to independently  
16 continue with exercise. It was reported, "I want to know what's going to happen when Derek  
17 does pack the class up because...I just don't motivate myself unless there's something there."

18 *Strategies Associated with Social Support* from health professionals and significant  
19 others included encouragement ( $n = 19$ ), health advice ( $n = 16$ ), monitoring by others ( $n =$   
20 15), and a reminder to pace activity ( $n = 10$ ). A successful maintainer explained the benefits  
21 of encouragement and monitoring, "the staff encourage you and I think knowing that  
22 somebody is going to keep checking up on you helps motivate you". These strategies were  
23 experienced to a similar extent for both successful and unsuccessful maintainers (*cf.* table 2).

24 **Attitudes for Physical Activity Maintenance**

1 Positive attitudes, such as commitment, and self-responsibility were held largely by  
2 successful maintainers (*cf.* Table 2) who stated it was "commitment more than anything" that  
3 helped maintain physical activity and stated, "you should take responsibility for your own  
4 health". Nevertheless, some unsuccessful maintainers also held positive attitudes that  
5 appeared to be negatively influenced by other factors, such as the referral scheme terminating,  
6 not experiencing benefits, and depression. For example, a female unsuccessful maintainer  
7 mentioned, "It's only me who can get myself there...but I've been feeling very low and I just  
8 can't motivate myself to do much". Also, only unsuccessful maintainers ( $n = 7$ ) held negative  
9 attitudes as they reported feeling "fed up", and "can't be bothered" as a reason for not  
10 engaging in physical activity.

11 *A Strategy Associated with Attitudes for Physical Activity Maintenance* appeared to  
12 be cognitive reframing to overcome negative attitudes by successful maintainers ( $n = 10$ ). For  
13 example, similarities were drawn between commitment for maintaining physical activity and  
14 work as it was stated: "I've always enjoyed my job but you always get that day where you  
15 don't want to go but you just do it and it's the same with going to the gym, you just do it."  
16 Unsuccessful maintainers had not reported any strategies specifically for overcoming negative  
17 attitudes.

### 18 **Barriers to Physical Activity Maintenance**

19 Both successful and unsuccessful maintainers experienced barriers ( $n = 32$ ; *cf.* Table  
20 2). These were categorized into physical (e.g., illness), environmental (e.g., accessibility), and  
21 psychological barriers (e.g., boredom). The difference between successful and unsuccessful  
22 maintainers was their ability to overcome barriers. For example, all unsuccessful maintainers  
23 ( $n = 12$ ) discussed barriers, such as illness, currently preventing exercise participation as it  
24 was stated, "I've not been going [to the gym] since before Christmas because of how ill I've  
25 been". In contrast, the majority of successful maintainers ( $n = 17$ ) discussed a barrier that

1 occurred in the past and had been overcome, such as a past caregiver duty, "In the day time I  
2 was looking after my wife so I didn't have time to do anything else... but now I find the  
3 time".

4 A physical barrier labeled "the plateau" also emerged and was experienced by some  
5 maintainers ( $n = 5$ ) and unsuccessful maintainers ( $n = 2$ ). It was defined as a point in an  
6 exercise regimen where physiological or psychological improvements would "taper off so  
7 you're not seeing any extra benefit". This appeared to result in dissatisfaction with any  
8 experiences of physical activity leading to disengagement, "When I first came doing things  
9 [physical activity], I was losing weight, looking better and feeling better but after I had  
10 plateaued, what is the reward?"

11 *Strategies Associated with Overcoming Barriers* were those outlined in Table 2.  
12 Although all participants mentioned using strategies at some point, only successful  
13 maintainers mentioned strategies specifically for overcoming barriers ( $n = 17$ ). Maintainers  
14 appeared to use different strategies to overcome the same barrier. For example, cognitive  
15 reframing helped some participants to manage a health condition, "I've got diabetes and I can  
16 sit there at home and feel sorry for myself or I can...say 'what can I do?'" where other  
17 participants used graded exercise: "I do the exercises to the limit it [the gout] lets me and try  
18 and push me that little bit further each time." Furthermore, the same strategy appeared to  
19 have more than one purpose. For example, finding alternatives for exercise helped some  
20 participants overcome exercising alone, "the chap I used to play [squash] with dropped out  
21 and we both stopped coming...then I took up scuba diving," whereas the same strategy  
22 helped others deal with pain, "I've tried the gym but I'm in too much pain...I can hardly move  
23 but swimming and water aerobics I'm fine." Only two successful maintainers had knowledge  
24 of strategies to overcome the plateau, such as goal setting and adding variety to an exercise

1 routine, “Because I knew what was happening, I wasn’t de-motivated...you set yourself new  
2 goals and change what you do in the gym like adding an extra set...”

3 **Discussion**

4 This qualitative study explored the determinants and strategies that promote physical  
5 activity maintenance or relapse in adults with chronic health conditions. The results  
6 demonstrate that physical activity maintenance is a complex trial and error process where  
7 both successful and unsuccessful maintainers have expectations, experiences, values, social  
8 support, attitudes and barriers. This study adds by highlighting the factors which determine  
9 maintenance or relapse.

10 **Determinants**

11 Consistent with previous research, the current study suggested outcome expectations  
12 and experiences play a role in physical activity maintenance in adults with chronic health  
13 conditions.<sup>14,26</sup> Moreover, the findings suggest that congruence between prioritized outcome  
14 expectations and experiences of physical activity benefits determines whether one maintains  
15 or disengages with exercise. This is consistent with expectancy-value theory whereby  
16 physical activity disengagement is found to be the result of violations for a prioritized  
17 outcome expectation, often due to unrealistic expectations.<sup>27</sup> This study also provides further  
18 evidence that outcome experiences play a larger role in maintenance than outcome  
19 expectations.<sup>8</sup> Health professionals could promote physical activity maintenance by eliciting  
20 prioritized outcome expectations, identifying unrealistic expectations, and tailoring  
21 interventions to encourage congruence between expectations and experiences to prevent  
22 relapse.

23 Additionally, while all participants have core values, the level of congruence between  
24 core values (e.g., family), outcome expectations, and experiences appeared to influence  
25 successful or unsuccessful maintenance. For example, if physical activity was seen to

1 enhance fitness (outcome expectation) and such fitness was perceived to allow the individual  
2 to spend time with the family (core value) then maintenance occurred. The values identified  
3 in this study are consistent with existing theories and definitions of value priorities.<sup>28</sup>  
4 Moreover, the finding supports existing evidence that congruence between underlying values  
5 and beliefs, attitudes, or intentions towards physical activity leads to maintenance.<sup>10</sup> This  
6 further highlights the need for health professionals to elicit values and identify any  
7 incongruence between values, outcome expectations, and experiences to prevent relapse. An  
8 example technique is motivational interviewing, which has been found to be effective in  
9 value matching for physical activity,<sup>29</sup> but is yet to be tested for promoting behavioral  
10 maintenance in those with chronic illness.

11 Social and practical support from significant others and health professionals could  
12 influence physical activity maintenance as it provided encouragement and a cathartic outlet  
13 when living with a health condition. Although both successful and unsuccessful maintainers  
14 received social support whilst participating in PARS, those who maintained after completion  
15 of the scheme sought further support as opposed to becoming de-motivated. Existing research  
16 has indicated that social support is influential for behavioral initiation and could be influential  
17 for behavioral maintenance, which is supported by this study.<sup>30</sup> Nonetheless, the results in  
18 this study also indicated that a reliance on social support can encourage a dependency that is  
19 detrimental for long-term physical activity. Thus, approaches are needed to encourage  
20 autonomy so individuals are equipped to continue exercising after support ends. Both  
21 motivational interviewing and cognitive-behavioral strategies (e.g., action planning and goal  
22 setting) are found to encourage autonomy and increase self-efficacy for physical activity  
23 initiation.<sup>31</sup> Future research, however, needs to explore whether such strategies could promote  
24 behavioral maintenance.



1 Previous research has indicated that attitudes, such as commitment and self-  
2 responsibility are associated with increased adherence to exercise programs.<sup>32</sup> Within this  
3 study, successful maintainers largely held positive attitudes, while negative attitudes were  
4 only expressed by unsuccessful maintainers. Additionally, some unsuccessful maintainers  
5 also held positive attitudes but other circumstances, such as support terminating, meant that  
6 the attitude did not influence behavior. Consequently, interventions need to do more to  
7 increase and challenge the factors which negatively interfere with positive attitudes towards  
8 physical activity. For example, previous research has indicated that health education and  
9 behavioral contracts can foster commitment and increase activity.<sup>15</sup> The current research also  
10 adds that cognitive reframing can help overcome negative attitudes. Nevertheless, further  
11 research is needed to test the direct effect of such strategies on enhancing long-term  
12 commitment to physical activity.

13 Trial and error emerged as a process where individuals would initially push  
14 themselves too hard with activity resulting in exacerbated symptoms and activity  
15 disengagement. Although both successful and unsuccessful maintainers reported the process,  
16 maintainers had learnt their limitations, capabilities and effective condition management  
17 strategies, whereas unsuccessful maintainers had not. Pacing appeared to be a strategy learnt  
18 through this process that helped manage any excessive physical activity, thereby limiting pain  
19 and fatigue, thus facilitating continual exercise engagement. These findings are consistent  
20 with previous research in chronic illness self-management.<sup>33,34</sup> At present, research largely  
21 focuses on activity pacing in the context of pain or fatigue management.<sup>34</sup> Further research is  
22 needed to directly test the role of activity pacing on physical activity maintenance.

### 23 **Barriers to Physical Activity**

24 A range of psychological barriers (e.g., boredom), physical barriers (e.g., illness, the  
25 plateau), and environmental barriers (e.g., time, appointments) were found. The factor which

1 distinguished between successful and unsuccessful maintenance was the ability to overcome  
2 such barriers. Maintainers largely reported implementing a range of strategies (e.g., self-  
3 management or graded activity) to overcome barriers. These findings are consistent with  
4 previous research, which suggests that such barriers can prevent physical activity initiation  
5 and increased self-efficacy is needed to challenge barriers for continual exercise  
6 engagement.<sup>11</sup> Consequently, continual barrier identification is needed for physical activity  
7 maintenance.

8         One barrier new to physical activity maintenance research was the ‘plateau’. This was  
9 defined as a reduction in physiological gains over time, such as reduced weight loss. The  
10 plateau appeared to prevent experiences of benefits leading to dissatisfaction with the  
11 outcome unless strategies were implemented. While the plateau is a new phenomenon to  
12 physical activity maintenance research, it is consistent with periodization in sports training.<sup>35</sup>  
13 Athletes are encouraged to incorporate monthly changes to a training program (e.g.,  
14 implementing a new activity) to prevent the plateau and ensure continual improvement.  
15 Drawing from this, educating individuals in how to recognize a plateau and implement  
16 specific strategies could help patients to experience benefits and maintain activity.

### 17 **Cognitive-Behavioral Strategies**

18         A range of cognitive-behavioral strategies for self-management of physical activity  
19 (e.g., self-monitoring, goal-setting, and feedback) and condition management (e.g., pacing  
20 and acceptance of limitations) supported physical activity maintenance. The strategies found  
21 were consistent with the taxonomy of behavior change techniques,<sup>15</sup> and self-management of  
22 chronic health conditions.<sup>33</sup> Although successful maintainers mainly used strategies,  
23 unsuccessful maintainers reported using some strategies which suggests continual attempts at  
24 being active. These findings highlight the importance of supporting individuals by teaching  
25 self-management strategies for physical activity maintenance.<sup>33</sup> Additionally, condition

1 management strategies are also needed for physical activity maintenance in adults with  
2 chronic health conditions.<sup>17</sup> This presents a new challenge for those delivering interventions  
3 as training will be required to effectively deliver the range of strategies needed.

4         The current study also gave insight into the self-management strategies that regulated  
5 the determinants. For example, self-monitoring and goal-setting allowed physical activity  
6 benefits to be experienced. Consistent with previous research, such strategies for physical  
7 activity promotion have been found effective.<sup>15</sup> Additionally, successful maintainers mainly  
8 used strategies whereas unsuccessful maintainers lacked the resources or knowledge needed  
9 in this study. This suggests that health care practitioners need to do more to focus on teaching  
10 self-management strategies.<sup>33</sup> Furthermore, these findings support that strategies can be  
11 tailored to change specific determinants (e.g., tailor self-monitoring to prioritized outcome  
12 expectations).<sup>18</sup> Nevertheless, it must be noted that the study was conducted within the UK  
13 healthcare system, which questions the effectiveness of these strategies across different  
14 cultural contexts. Further research is needed into the strategies which change specific  
15 determinants within different contexts.

## 16 **Limitations**

17         There were a number of possible limitations to this study. First, a bias in participant  
18 characteristics might exist because incentives were offered to boost recruitment to the study.  
19 Second, there was a low response rate from male unsuccessful maintainers and were under-  
20 represented in the study. Research has highlighted that males are more likely to complete  
21 PARS and adhere to physical activity than females and could account for this finding.<sup>36</sup> Third,  
22 self-report measures were used to verify participant categories but are associated with over-  
23 reporting of physical activity which could produce a misclassification error and could explain  
24 the large difference between successful and unsuccessful maintainers.<sup>37</sup> Fourth, the majority  
25 of participants had multiple health conditions of differing severities which produces a lack of

1 homogeneity in the sample. Although this also enhances the transferability of the findings,  
2 further research could benefit from replicating the research in specific health conditions,  
3 cultural contexts, and socio-demographic variables (e.g., gender). Finally, although present  
4 experiences of physical activity were discussed, the retrospective nature of inviting  
5 individuals to consider past experiences could introduce memory bias.<sup>38</sup>

## 6 **Conclusion**

7 In conclusion, the exploratory qualitative study has identified the determinants and  
8 cognitive-behavioral strategies for successful and unsuccessful physical activity maintenance.  
9 Determinants that are found to influence the initiation phase in previous research were also  
10 found to influence physical activity maintenance in the present study (e.g., outcome  
11 expectations). However, determinants specific to maintenance also emerged, such as  
12 experiences of physiological benefits, and a specific physical barrier labeled 'the plateau'.  
13 Cognitive-behavioral strategies emerged for both physical activity self-management (e.g.,  
14 self-monitoring) and condition management (e.g., pacing), suggesting health professionals  
15 need comprehensive training to successfully promote behavioral maintenance in the  
16 chronically ill. Future research is needed to explore successful physical activity maintenance  
17 determinants and strategies within specific health conditions (e.g., diabetes) and socio-  
18 demographic variables (e.g., gender and cultural contexts). Further implications for research  
19 and practice are made throughout. Overall, such findings provide guidance for commissioners,  
20 healthcare practice, and researchers promoting long-term physical activity in adults with  
21 chronic health conditions

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