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## **Qualitative investigation of exercise perceptions and experiences in people with multiple sclerosis before, during, and after participation in a personally tailored exercise program**

PLEASE CITE THE PUBLISHED VERSION

<https://doi.org/10.1016/j.apmr.2017.05.022>

PUBLISHER

Elsevier © American Congress of Rehabilitation Medicine

VERSION

AM (Accepted Manuscript)

PUBLISHER STATEMENT

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REPOSITORY RECORD

Crank, Helen, Anouska Carter, Liam Humphreys, Nicky Snowdon, Amanda Daley, Nicola Woodroffe, Basil Sharrack, Jane Petty, and John M. Saxton. 2019. "Qualitative Investigation of Exercise Perceptions and Experiences in People with Multiple Sclerosis Before, During, and After Participation in a Personally Tailored Exercise Program". figshare. <https://hdl.handle.net/2134/32199>.

**Running head:** Experiences of exercise in people with MS

**A qualitative investigation of exercise perceptions and experiences in people with multiple sclerosis before, during and after participation in a personally-tailored exercise program**

Helen Crank PhD<sup>1</sup>, Anouska Carter PhD<sup>1</sup>, Liam Humphreys MSc<sup>1</sup>, Nicky Snowdon MSc<sup>2</sup>, Amanda Daley PhD<sup>3</sup>, Nicola Woodroffe PhD<sup>4</sup>, Basil Sharrack MD, PhD, FRCP, FAAN<sup>5</sup>, Jane Petty BSc<sup>6</sup> and John M Saxton PhD<sup>7</sup>

<sup>1</sup> The Centre for Sport and Exercise Science, Sheffield Hallam University, UK

<sup>2</sup> Centre for Health and Social Care Research, Sheffield Hallam University, UK

<sup>3</sup> Primary Care Clinical Sciences, University of Birmingham, UK

<sup>4</sup> Biomolecular Sciences Research Centre, Sheffield Hallam University, UK

<sup>5</sup> Academic Department of Neurology, Sheffield Teaching Hospitals NHS Foundation Trust, UK

<sup>6</sup> Multiple Sclerosis Society, UK

<sup>7</sup> Department of Sport, Exercise and Rehabilitation, Northumbria University, UK

We acknowledge the support of the UK Multiple Sclerosis Society: Project Grant 888/08

**Corresponding author:**

Professor John M Saxton  
Faculty of Health and Life Sciences  
Northumbria University  
Room 259, Northumberland Building  
Newcastle Upon Tyne  
NE1 8ST  
United Kingdom  
Tel + 44 (0)191 227 3371  
Email: john.saxton@northumbria.ac.uk

Reprints are not available

Clinical Trial Registration Number: ISRCTN41541516

ACCEPTED MANUSCRIPT

1 **A qualitative investigation of exercise perceptions and experiences in people with multiple**  
2 **sclerosis before, during and after participation in a personally-tailored exercise program**

3 **ABSTRACT**

4 **Objective:** To undertake a qualitative investigation of exercise perceptions and experiences in  
5 people with MS (PwMS) before, during and after participation in a personally-tailored program  
6 designed to promote long-term maintenance of self-directed exercise. **Design:** Focus groups and  
7 semi-structured telephone interviews. **Setting:** University Exercise Science Department close to  
8 the recruiting hospital. **Participants:** PwMS (N=33; aged 47.6±7.9 y). **Interventions:**  
9 Participants were recruited after participation in a randomized controlled exercise trial; all had  
10 been allocated to a 12-week exercise programme, comprising supervised and self-directed  
11 exercise sessions. **Main outcome measure:** Exercise perceptions and experiences before, during  
12 and after participation in the program. **Results:** Four themes emerged from the analysis: (1) the  
13 transition to inactivity; (2) lack of knowledge and confidence; (3) positive exercise experiences;  
14 (4) perspectives on exercise adherence. **Conclusion:** Lack of confidence and exercise  
15 knowledge, coupled with negative perceptions about physical capabilities after an MS diagnosis,  
16 are clear barriers to exercise participation in PwMS. These issues are not being adequately  
17 addressed as part of the healthcare pathway or in community settings. Perceptions of improved  
18 posture, ability to overcome everyday difficulties, acute mood enhancements during and after  
19 exercise and increased opportunities for social interaction were amongst the reported benefits of  
20 exercise participation. Despite the provision of a personally-tailored exercise plan and use of  
21 cognitive behavioural strategies, self-directed exercise continued to present challenges to PwMS  
22 and the importance of seeking cost-effective ways to maintain motivational support was implicit  
23 in participant responses.

24

25 **Keywords:** Multiple sclerosis, exercise, qualitative evaluation

26

## 27 INTRODUCTION

28 Studies have shown that exercise is a safe non-pharmacological treatment strategy for people  
29 with multiple sclerosis (PwMS), with the reported health benefits including improvements in  
30 muscle power, physical and psychological functioning, fatigue and health-related quality of life.<sup>1</sup>  
31 <sup>2 3</sup> However, following an MS diagnosis, perceived functional limitations, safety concerns and  
32 loss of confidence, fatigue, lack of MS-specific exercise knowledge or conflicting advice from  
33 health professionals and accessibility issues associated with inadequate transport, physical  
34 environment and social factors (e.g. social obligations, lack of social support) become important  
35 barriers to exercise participation.<sup>4-10</sup> Cross-sectional evidence suggests that only ~20% of  
36 PwMS are achieving recommended amounts of daily moderate to vigorous intensity physical  
37 activity<sup>11</sup> and strategies to address common barriers are needed to increase the level of  
38 engagement.

39  
40 Confidence in managing disease-specific symptoms, as well as positive coping styles, self-  
41 regulation skills and engagement with social support structures are salient personal  
42 characteristics of PwMS who continue to be physically active after diagnosis.<sup>9, 12</sup> In addition, the  
43 support and knowledge gained from competent health professionals, perceived physical, mental  
44 and social benefits, peer support and camaraderie during group exercise, and feelings of  
45 accomplishment, self-management and control are important facilitators that lead to improved  
46 self-efficacy for exercise.<sup>4, 6-8, 13, 14</sup> Despite this, Kayes et al<sup>10</sup> concluded that the decision to  
47 engage in physical activity is complex, individual and fluid amongst PwMS, reflecting the day-  
48 to-day uncertainty of the condition. This suggests a personalised approach to barrier  
49 management may be needed. Furthermore, programs which provide support for self-directed  
50 exercise, taking into consideration the day-to-day challenges MS symptom management,  
51 individual capabilities and personal preferences may be more effective for promoting sustainable  
52 physical activity behaviour change.

53  
54 We recently reported on health and cost utility outcomes following a randomized controlled trial  
55 which investigated a pragmatic approach to developing the skills and confidence for long-term  
56 maintenance of self-directed exercise in people with mild to moderate MS (ExIMS).<sup>15 16</sup> The  
57 program provided access to an exercise physiologist and physical therapist, who applied  
58 cognitive behavioural techniques during a graded decrease in the frequency of individually-  
59 tailored supervised exercise (three exercise sessions per week for 12 weeks, with the ratio of  
60 supervised to home-exercise sessions being 2:1 in weeks 1-6 and 1:2 in weeks 7-12). There was  
61 high adherence to supervised and home-based exercise (>80%), accompanied by improvements  
62 in fatigue and quality of life after 12 weeks, and a sustained improvement in quality of life 6  
63 months after withdrawal of supervision.<sup>15</sup>

64  
65 The purpose of this study was to undertake a qualitative investigation of exercise perceptions  
66 and experiences in people with MS (PwMS) before, during and after participation in this  
67 personally-tailored program designed to promote long-term maintenance of self-directed  
68 exercise. An improved understanding of exercise perspectives and personal experiences of  
69 engaging with programs that can develop skills to support the self-management of MS will  
70 inform future healthcare implementation strategies aimed at enhancing patient care.

71

## 72 **METHODS**

### 73 **Study design**

74 We used qualitative research methods to explore exercise perceptions and experiences. Our  
75 underlying philosophy was constructivist,<sup>17</sup> recognising the individual nature of experience and  
76 the impact of people's wider life experiences on their perspectives of exercise both before and  
77 during the trial. Data collection used both focus groups and individual interviews. An advantage  
78 of focus groups is that social interaction between group members can increase the depth of

79 inquiry, stimulating discussion of shared experiences and their meaning to each individual.  
80 Conversely, interview responses can provide participants with more opportunity to contribute so  
81 using a combination of methods can yield different viewpoints.<sup>13</sup> In addition, we were keen to  
82 understand all participants' experiences; and offering a choice of methods meant that  
83 participants unable to join focus groups could organise interviews around their availability.

84

## 85 **Participants**

86 A purposive convenience sample of 54 PwMS who had participated in the 12 week exercise  
87 program<sup>15</sup> were invited to take part in in the qualitative investigation. Of these, 33 participants  
88 agreed to participate and were recruited within 6 months of completing the program and their  
89 characteristics are presented in Table 1. Written informed consent was obtained prior to study  
90 participation and ethical approval was granted from NHS South Yorkshire Research Ethics  
91 Committee.

92

## 93 **Focus groups and telephone interviews**

94 A total of 29 participants took part in the focus groups and four participants were interviewed by  
95 telephone. Six focus groups (2-8 participants; 60-80 min duration) were facilitated by two  
96 researchers trained in qualitative research techniques. Facilitators were not directly involved in  
97 the exercise trial but do work in exercise research. Telephone interviews (~30 min duration)  
98 were conducted by a member of the trial team who had delivered some of the exercise training  
99 sessions. All participants were briefed about the purpose of the discussion, i.e. to elicit their  
100 views and experiences of exercise and engaging in the program, and the same semi-structured *a-*  
101 *priori* topic guide consisting of open-ended questions was used flexibly to guide the focus group  
102 and interview discussions (Table 2). Focus group discussions and telephone interviews were  
103 audio-taped and then transcribed verbatim by a source independent of the study. Participant  
104 anonymity was assured by the assignment of reference numbers.

105

**106 Thematic framework analysis**

107 Using framework analysis,<sup>18</sup> HC and LH independently read and re-read the transcripts several  
108 times to become familiar with the data, before coding, indexing and charting to create an initial  
109 key thematic framework with sub-themes. Analysis aimed at describing the individual's  
110 experience of exercise, searching for common, recurrent patterns but also identifying insights  
111 into participant experiences that might explain behaviour and improve advice and services in the  
112 future. NS and AC read the transcripts and independently applied the coding framework. The  
113 coding framework represented all relevant data and there was a high level of agreement between  
114 analysers. This approach to data analysis is somewhat deductive, framing the analysis within an  
115 *a-priori* topic guide, yet the data were borne out of original transcripts from focus groups and  
116 interviews.<sup>19</sup> Data saturation was achieved, in that similar themes arose repeatedly and no new  
117 themes arose in the final focus group or interview.

118

**119 RESULTS**

120 The findings are presented under four key themes, which contextualise the experiences of  
121 participants in the study. Direct quotes, with reference to either focus group and participant  
122 number, or telephone interview and participant number, are presented to illustrate the key  
123 themes and sub themes.

124

*125 Theme 1: The transition to inactivity*

126 Prior to MS, many participants had valued the personal, social and health benefits of a  
127 physically active lifestyle, however, their MS diagnosis caused a transition into physical  
128 inactivity. Several participants recounted how regular exercise was a part of 'normal life' before  
129 MS and helped to define their self-identity. Comments included: "*I used to play a lot of sport.*  
130 *So I was pretty active*" (FG1:3) and "*I was a gymnast...did loads of exercise, running*" (FG3:1).



131 For others, an active lifestyle before MS had been a shared and valued experience with family  
132 and friends, a social activity or something that was done for fitness, recreation and health: “I  
133 *became like one of those people who use the swimming pool, jacuzzi, sauna and things like that*  
134 *on a Sunday morning*” (FG1:1).

135  
136 However, a diagnosis of MS had created a transition toward physical inactivity and a perceived  
137 reduction in exercise capacity for many participants: “*I would say I became very inactive*”  
138 (FG1:2). Other participants attempted to maintain their exercise levels but found it difficult: “*I*  
139 *was still a member of a gym but it ended up that I would drive to the gym and then I would be*  
140 *sat in tears in the car thinking I can't do that... so I gave up going to the gym because it is*  
141 *supposed to be there to help me but it was carving me up and making my symptoms worse*”  
142 (FG1:4). A small minority of participants were able to maintain regular exercise by becoming  
143 adept at pre-empting situations, planning ahead and making adaptations to their lifestyle with a  
144 positive frame of mind.

145

#### 146 *Theme 2: Lack of knowledge and confidence*

147 There was general consensus that exercise advice from health professionals was either non-  
148 existent or not relevant for the needs of PwMS. Participants recalled that exercise and lifestyle  
149 advice was not generally offered after their MS diagnosis: “*I don't recall any professionals*  
150 *mentioning anything about exercise at all and I don't believe I asked*” (FG5:2). Participants felt  
151 that endorsement from the clinical team was needed to confirm that exercise was something you  
152 were allowed to and supposed to do, but this advice was variable: “*When I was diagnosed I*  
153 *asked specifically if there was anything I could do to help myself, diet wise and exercise and I*  
154 *was told there was nothing you could do whatsoever*” (FG2:6). Other participants were referred  
155 to local facilities but the tailored exercise advice and support they needed was lacking: “*My*  
156 *physiotherapist referred me to the local sports centre and then a gentleman was trying to make*

157 *me a plan of what to do, and he hadn't dealt with anybody with MS before and actually it was a*  
158 *bit of a disaster... (FG3:1).*

159  
160 Building a rapport with knowledgeable exercise specialists who were able to adapt exercises to  
161 take account of physical limitations and provide knowledge about safe and effective activities  
162 and appropriate progression was important: “... *this was an opportunity for me to come to*  
163 *someone, a bit like a personal trainer really, who would know me, get to know me and teach me*  
164 *how to do it. Which is exactly what I got. For me that's what kept me coming...*” (FG5:2).

165 Participants felt that the exercise specialists taught them how to recognise signs that they are  
166 doing too much and how to pace themselves: “*You are scared because you immediately get the*  
167 *symptoms from the increased body temperature and everything anyway, my feet automatically*  
168 *have pins and needles all up my legs and that is murder and it is a sign that I will have to stop*  
169 *and in actual fact what I have learnt is that it will fade, that is alright, it is your body just*  
170 *reacting and increasing temperature and is perfectly normal and carry on*” (FG6:5). Participants  
171 described a shift in their perceptions by learning that they do not need to exercise to exhaustion  
172 to experience health benefits, and that they could progress slowly, at their own pace: “*Whereas I*  
173 *wanted to run she was still teaching me to walk, so from that point of view I learnt a huge*  
174 *amount and gained a huge amount and that's how I am taking it forward. Not pushing it to the*  
175 *limits where I'm dropping, but building it up very slowly*” (FG5:20) and “... *you think I can't*  
176 *possibly do that and it just seems a huge obstacle but actually now knowing that you can do a*  
177 *few minutes or a minute even at times and it will count, so it is achievable and attainable isn't*  
178 *it?*” (FG6:2). Another participant said: “*For me, I think it was taking the mystery out of exercise*  
179 *and giving the confidence that it's safe to do this and you'll get benefit from it... and I think*  
180 *guided exercise in the initial stages was the key*” (T3).

181

182

183 *Theme 3: Positive exercise experiences*

184 There were new insights in to the positive physical, mental and psychosocial experiences that  
185 engaging in an exercise program can bring. The majority of participants were grateful to have  
186 had the opportunity to take part in a tailored supervised exercise program; they recounted: "... I  
187 was looking forward to it every week, it gives you a regime to work to" (FG1:1) and "I just  
188 really enjoyed it and found it really rewarding" (FG6:2). In some cases, having a reason to  
189 leave the house was a valued benefit of taking part in the program: "I really enjoyed the social  
190 aspect of meeting people and talking because you don't always get that when you have MS. You  
191 tend to be at home a lot on your own so I enjoyed coming..." (FG6:3). For others, improved  
192 health and fitness created new opportunities to engage in recreational activities with their  
193 families: "I try harder. My little boy will be surprised when I say yeah, alright I'll go swimming  
194 or yeah OK let's go for a walk, and he'll think Oh, that doesn't sound quite right" (FG4:4).

195  
196 There were perceived improvements in physical fitness: Comments included: "...I think I felt  
197 generally stronger" (T2) and "I know for me, I felt I was a lot straighter, standing straighter"  
198 (FG1:2). Daily physical functioning was also improved: "I do find simple things like turning  
199 over in bed, which isn't a very easy task, and picking things up off the floor without collapsing;  
200 things of that nature are a lot easier" (T1) and there were reduced feelings of fatigue: "I feel as  
201 though I'm less fatigued. I don't have as many floppy days. I still get the odd one but nowhere  
202 near like it was" (FG4:7). The acute health benefits of participating in the exercise sessions  
203 were also reported, including mood enhancement and a sense of wellbeing and achievement.  
204 One participant recounted: "I always feel better having done the exercise" (FG1:4) and others  
205 spoke of: "A good sense of wellbeing and you'd achieved something" (FG3:1) and "...an  
206 adrenaline buzz, whilst you're doing it, so you feel that you've achieved something..." (FG3:4).  
207 One participant reported finding the exercises difficult and at times experiencing some pain but

208 was still able to complete the program, achieving a volume of exercise that was manageable for  
209 her.

210

211 *Theme 4: Perspectives on exercise adherence*

212 Participants universally agreed that maintaining self-directed exercise at home was more  
213 challenging than attending supervised sessions. Regarding adherence to the supervised sessions,  
214 one participant said: “...*I am the kind of person that will stick to an arrangement I've made. I*  
215 *will stick to a commitment*” (FG6:1). However, finding personal motivation to exercise and  
216 having insufficient self-control to put their exercise intentions into action were barriers to  
217 staying active at home: “*I've found that because you have no structure once you are at home you*  
218 *do tend to sit around and watch a bit more TV rather than when you have to come [to the*  
219 *centre]... when you're at home, you think I'll not bother today*” (FG6:3) and “*I've had the*  
220 *incentive to come, and I've enjoyed coming, doing it at home and now it's finished I've just gone*  
221 *back to how it was before*” (FG1.1).

222

223 For some, enjoyment of participating in exercise enhanced their motivation: “*I've tried to keep*  
224 *the willpower in my head... and it's working because I do enjoy it*” (T4). For others, the  
225 rationale for doing exercise at home was promoted by feelings of guilt: “*Being at home I must*  
226 *admit I got a bit of a guilty feeling knowing that I was supposed to be doing another two*  
227 *physical activities and thinking you can't just sit there, you've got to go out and do something.*  
228 *There was a guilt thing that made me do the home [exercise], which I did, but also my husband*  
229 *who was saying "don't you think you should be doing..." I got pressure from him which was*  
230 *good but I think for enjoyment I much preferred [attending the centre] for the structured*  
231 *[exercise]”* (FG5:1).

232

233

234 **DISCUSSION**

235 This qualitative study provides new insights into the exercise perspectives and experiences of  
236 PwMS before, during and after participation in a program that was designed to develop the  
237 confidence and skills for self-directed exercise. Following their MS diagnosis, many participants  
238 experienced a loss of confidence in relation to their perceived physical capabilities and lack  
239 knowledge of how to safely engage in exercise (Theme 1). Fear of exacerbating MS symptoms  
240 and/or making the condition worse has previously been identified as a barrier to exercise in  
241 PwMS<sup>6, 10, 20</sup> and is compounded by a lack of MS-specific exercise advice (or conflicting  
242 advice) following diagnosis (Theme 2).<sup>4, 8, 21, 22</sup> Our results reaffirm the need for confidence  
243 building and MS-specific exercise advice following diagnosis.

244  
245 In accordance with previous studies,<sup>6, 7, 13</sup> participants felt that the supervised component of the  
246 program, and particularly having access to competent health professionals (exercise physiologist  
247 and physical therapist), was important for developing confidence to exercise via an improved  
248 awareness of their physical capabilities (Theme 2). Fatigue has been identified as an important  
249 barrier to exercise in PwMS,<sup>10, 21, 23</sup> and the importance of learning how to properly pace  
250 themselves during exercise to avoid fatigue was valued, as was expert advice to progress slowly,  
251 even if some found this frustrating. Through this reassurance, some participants learned not to  
252 be afraid of the neurological sensations induced by exercise. Indeed, many experienced  
253 significant health benefits from what they felt was a surprisingly low but manageable level of  
254 physical activity. The average amount of weekly moderate intensity aerobic exercise achieved  
255 by participants was ~68 minutes,<sup>15</sup> representing only ~45% of current recommendations.<sup>24</sup>

256  
257 The reported improvements in physical functioning and perceptions of MS fatigue were  
258 consistent with previous reports,<sup>3, 22, 25</sup> but there were some new insights into how exercise can  
259 improve everyday posture and daily functioning, from being able to stand more erect to an

260 enhanced ability to reach down for things on the floor (Theme 3). The positive shift in perceived  
261 physical health and mental outlook also created new opportunities to enjoy more recreational  
262 physical activity time with their families. Acute mood enhancements and a sense of  
263 accomplishment during and after each exercise session were also experienced, as in previous  
264 studies.<sup>14, 21</sup> Other participants placed great value on the opportunity for social interaction that  
265 was presented by engaging in the exercise program, consistent with the findings of Learmonth et  
266 al,<sup>26</sup> especially where their MS had led to greater social isolation. These new insights highlight  
267 the value of qualitative investigations in identifying health and psychosocial benefits associated  
268 with exercise that are valued by PwMS.

269  
270 Participants universally agreed that maintaining self-directed exercise during and after the 12-  
271 week program was challenging, despite their positive experiences of exercise and newfound  
272 knowledge gained from personally-tailored support (Theme 4). Many emphasised the  
273 importance of attending supervised exercise sessions for maintaining their motivation for  
274 exercise. Honouring pre-arranged appointments (related to supervised exercise), the enjoyment  
275 of exercise and feelings of guilt were reported as important facilitators for self-directed exercise.  
276 Conversely, the lack of weekly structure when supervision was withdrawn was identified as an  
277 important barrier to self-directed exercise. Systematic review evidence shows that level of  
278 contact with healthcare professionals, in addition to the use of behaviour change techniques (e.g.  
279 goal-setting, self-monitoring) and engaging social support networks are important elements for  
280 the maintenance of exercise behaviour change.<sup>27</sup> In this respect, the effectiveness (and cost-  
281 effectiveness) of novel approaches to maintaining contact with a knowledgeable health  
282 professional (e.g. provision of frequent face-to-face motivational booster sessions; use of mobile  
283 and/or internet-based technologies to maintain contact, etc.) is an avenue for further research.  
284 Peer-support and camaraderie with other exercising PwMS has been highlighted as another

285 important facilitator for exercise amongst PwMS in previous research<sup>4,21</sup> and a greater  
286 emphasis on helping PwMS to develop supportive social networks is also warranted.

287

### 288 **Study limitations**

289 An important limitation of this study is that participants were recruited from a single centre  
290 serving a large catchment living within a few miles of the treating hospital. Hence, views  
291 regarding the importance of attending supervised exercise sessions may not be representative of  
292 PwMS from rural catchments living further away from appropriate MS-specific exercise classes.  
293 It is also possible that participants recruited for this study were generally more motivated to  
294 engage in exercise than PwMS from the broader population, as they had all volunteered for the  
295 intervention study. Additionally, only participants with mild to moderate MS were involved in  
296 this qualitative investigation, and further research is needed to understand the challenges and  
297 benefits of exercise participation in PwMS who have higher levels of disability.

298

### 299 **CONCLUSIONS**

300 Our participants experienced a transition to inactivity following their MS diagnosis,  
301 compounded by a lack of MS-specific exercise advice across clinical and community settings.  
302 The individually-tailored support they received from knowledgeable exercise and physical  
303 therapy instructors during participation in the program was highly valued. However, the  
304 challenge of self-directed exercise and importance of continued motivational support for long-  
305 term maintenance was clearly evident in the views of our participants. Further research aimed at  
306 developing cost-effective strategies for establishing this provision is warranted.

307

308

309

310



311 **REFERENCES**

- 312 1. Asano M, Dawes DJ, Arafah A, et al. What does a structured review of the effectiveness of  
313 exercise interventions for persons with multiple sclerosis tell us about the challenges of  
314 designing trials? *Mult Scler.* 2009;15(4):412-421.
- 315 2. Motl RW, Gosney JL. Effect of exercise training on quality of life in multiple sclerosis: a  
316 meta-analysis. *Mult Scler.* 2008;14(1):129-135.
- 317 3. Rietberg MB, Brooks D, Uitdehaag BM, et al. Exercise therapy for multiple sclerosis.  
318 *Cochrane Database Syst Rev.* 2005(1):CD003980.
- 319 4. Aubrey G, Demain, S. Perceptions of group exercise in the management of multiple  
320 sclerosis. *Int J Ther Rehab.* 2012;19:557-565.
- 321 5. Borkoles E, Nicholls AR, Bell K, et al. The lived experiences of people diagnosed with  
322 multiple sclerosis in relation to exercise. *Psychol Health.* 2008;23(4):427-441.
- 323 6. Brown C, Kitchen K, Nicoll K. Barriers and facilitators related to participation in  
324 aquafitness programs for people with multiple sclerosis: a pilot study. *Int J MS Care.*  
325 2012;14(3):132-141.
- 326 7. Christensen ME, Brincks J, Schnieber A, et al. The intention to exercise and the execution  
327 of exercise among persons with multiple sclerosis--a qualitative metasynthesis. *Disabil*  
328 *Rehabil.* 2016;38(11):1023-1033.
- 329 8. Learmonth YC, Adamson BC, Balto JM, et al. Multiple sclerosis patients need and want  
330 information on exercise promotion from healthcare providers: a qualitative study. *Health*  
331 *Expect.* 2016.
- 332 9. Plow MA, Resnik L, Allen SM. Exploring physical activity behaviour of persons with  
333 multiple sclerosis: a qualitative pilot study. *Disabil Rehabil.* 2009;31(20):1652-1665.
- 334 10. Kayes NM, McPherson KM, Taylor D, et al. Facilitators and barriers to engagement in  
335 physical activity for people with multiple sclerosis: a qualitative investigation. *Disabil*  
336 *Rehabil.* 2011;33(8):625-642.



- 337 11. Klaren RE, Motl RW, Dlugonski D, et al. Objectively quantified physical activity in persons  
338 with multiple sclerosis. *Arch Phys Med Rehabil.* 2013;94(12):2342-2348.
- 339 12. Dlugonski D, Joyce RJ, Motl RW. Meanings, motivations, and strategies for engaging in  
340 physical activity among women with multiple sclerosis. *Disabil Rehabil.* 2012;34(25):2148-  
341 2157.
- 342 13. Dodd KJ, Taylor NF, Denisenko S, et al. A qualitative analysis of a progressive resistance  
343 exercise programme for people with multiple sclerosis. *Disabil Rehabil.* 2006;28(18):1127-  
344 1134.
- 345 14. Kasser S. Exercising with multiple sclerosis: insights into meaning and motivation. *Adapt*  
346 *Phys Activ Q.* 2009;26(3):274-289.
- 347 15. Carter A, Daley A, Humphreys L, et al. Pragmatic intervention for increasing self-directed  
348 exercise behaviour and improving important health outcomes in people with multiple  
349 sclerosis: a randomised controlled trial. *Mult Scler.* 2014;20(8):1112-1122.
- 350 16. Tosh J, Dixon S, Carter A, et al. Cost effectiveness of a pragmatic exercise intervention  
351 (EXIMS) for people with multiple sclerosis: economic evaluation of a randomised  
352 controlled trial. *Mult Scler.* 2014;20(8):1123-1130.
- 353 17. Fosnot CT. Constructivism: A psychological theory of learning. In Fosnot CT, (Ed).  
354 *Constructivism: Theory, perspectives, and practice* New York: Teachers College Press  
355 1996:8-83.
- 356 18. Gale NK, Heath G, Cameron E, et al. Using the framework method for the analysis of  
357 qualitative data in multi-disciplinary health research. *BMC Med Res Methodol.*  
358 2013;13:117.
- 359 19. Pope C, Ziebland S, Mays N. Qualitative research in health care. *Analysing qualitative data.*  
360 *BMJ.* 2000;320(7227):114-116.
- 361 20. Clarke R, Coote S. Perceptions of Participants in a Group, Community, Exercise  
362 Programme for People with Multiple Sclerosis. *Rehabil Res Pract.* 2015;2015:123494.

- 363 21. Learmonth YC, Motl RW. Physical activity and exercise training in multiple sclerosis: a  
364 review and content analysis of qualitative research identifying perceived determinants and  
365 consequences. *Disabil Rehabil.* 2016;38(13):1227-1242.
- 366 22. Markwick R, Singleton C, Conduit J. The perceptions of people with multiple sclerosis  
367 about the NHS provision of physiotherapy services. *Disabil Rehabil.* 2014;36(2):131-135.
- 368 23. Horton S, MacDonald DJ, Erickson K, et al. A qualitative investigation of exercising with  
369 MS and the impact on the spousal relationship. *Eur Rev Aging Phys Act.* 2015;12:3.
- 370 24. Chief Medical Officers. Department of Health PA, Health Improvement and Protection.  
371 Start Active, Stay Active: A report on physical activity for health from the four home  
372 countries'. 2011.
- 373 25. Andreassen AK, Stenager E, Dalgas U. The effect of exercise therapy on fatigue in multiple  
374 sclerosis. *Mult Scler.* 2011;17(9):1041-1054.
- 375 26. Learmonth YC, Marshall-McKenna R, Paul L, et al. A qualitative exploration of the impact  
376 of a 12-week group exercise class for those moderately affected with multiple sclerosis.  
377 *Disabil Rehabil.* 2013;35(1):81-88.
- 378 27. Greaves CJ, Sheppard KE, Abraham C, et al. Systematic review of reviews of intervention  
379 components associated with increased effectiveness in dietary and physical activity  
380 interventions. *BMC Public Health.* 2011;11:119.
- 381

**Table 1.** Characteristics of the participants

<b>Characteristics</b>	
<b><i>Focus group participants (N=29)</i></b>	
Females (n)	23 (79%)
Age (y)	48.8 ± 8.2
Years since MS diagnosis	8.8 ± 7.0
EDSS	3.8 (1.0 – 6.0)
<b><i>Interview participants (N=4)</i></b>	
Females (n)	3 (75%)
Age (y)	48.8 ± 7.3
Years since MS diagnosis	9.7 ± 3.5
EDSS	3.0 (1.5 – 6.5)

Age and years since MS diagnosis are presented as mean ± SD. Expanded Disability Status Scale (EDSS) is presented as median (range).

**Table 2.** Semi-structured "a-priori" topic guide used to guide discussions

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**Section 1: Exercise experience before the EXIMS trial**

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*Can you tell us if prior to your diagnosis, whether you took part in exercise?  
How did you find this experience?*

*How has this changed since your diagnosis?*

*Have you been given advice in the past from health professionals regarding exercise?  
Can you tell us who gave you the advice and what the advice was?*

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**Section 2: Exercise experience during the EXIMS trial**

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*Can you tell us about your exercise experiences at the University; was it difficult at the beginning? Did it get any easier? At what point was that?*

*How did you feel during and after the sessions?*

*What kept you coming to the exercise sessions?*

*Did you like the structure of the exercise sessions?*

- *Was it the right amount?*
- *Did you like the mixture of home and supervised exercise?*
- *Did you like the gradual reduction in contact time?*

*Did the intervention, in any way help you to become more active? Can you explain?*

*Have you any suggestions for how the exercise might be improved?*

*Did you notice any improvements/benefits from the exercise? If so what?*

*Did you notice any effects on your symptoms? fatigue, pain, sleep etc.*

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**Section 3: Exercise after the EXIMS trial**

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*Have you remained physically active since completing the study?*

*Did the supervised exercise sessions at SHU provide you with any knowledge/skills that you have been able to put into practice following the trial?*

*Do you feel that you are more physically active now than before the trial and in what way?*

*Has the intervention had any influence on your confidence to exercise?  
Can you give an example?*

*What things stop you from participating in activity/exercise?*

*Is there anything that you feel we could have done during the trial to assist you in remaining more active?*

*What help if any do you feel you need to stay active?*

*Would you recommend exercise to others with MS?*

*Are there any other comments that you would like to make?*