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Why Won't They Exercise More?

Development of a Tool to Assess Motivators and Barriers to Exercise in Older Adults

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Abstract

Objectives

The aim was to develop a quantitative tool to measure perceived motivators and barriers to exercise amongst older adults in order to facilitate the development of bespoke interventions.

Methods

Focus groups conducted with participants over the age of 65 informed the initial development of a 56-item Motivators and Barriers Questionnaire (MBQ). This was administered to a second sample of 72 sedentary and active older adults (65 to 90 years).

Results

Principle components analysis resulted in five factors defined as motivators to exercise and six factors representing barriers to exercise. A subsequent confirmatory factor analysis provided support for the model as assessed by RMSEA criteria.

Discussion

These findings suggest that the MBQ may help to identify an individual's 'profile' of motivators and barriers to exercise, and so inform personalized interventions that might successfully increase activity levels in adults over 65 years of age when compared to standardised approaches.

Keywords: Aging, Exercise, Barriers, Motivators

1. Introduction

As our ageing population continues to grow (Office for National Statistics, 2017), we are faced with the unique challenge of addressing the health problems associated with old age in a cost effective way whilst also striving to maintain a good quality of life in this cohort. Physical activity has been shown to have numerous health benefits for older adults (WHO, 2017). Engaging in physical activity is a good preventative technique to successfully delay the onset of disease (Miller, Rejeski, Reboussin, Ten-Have & Ettinger, 2000; Vogel et al. 2009) and disability (Mobily, 2013; Song et al. 2017); and also to improve mental health (Rejeski & Mihalko, 2001) and quality of life in older adults (Windle et al. 2010). Despite this knowledge, older adults are known to be mainly inactive, with the vast majority leading completely sedentary lives (British Heart Foundation, 2015; The Health Survey for England, 2008).

In order to realise the associated benefits of exercise, the WHO (2017) and the UK government recommend older adults should undertake 30 minutes of moderate intensity exercise, at least five times per week (Department of Health, 2011). Recent figures suggest that adults aged 65 to 75 fall far short of these recommendations, with only 20% of men and 17% of women reaching these targets. Above the age of 75 years this figures drop to 9% and 6% respectively (The Health Survey for England, 2008). If exercise is so beneficial why are the compliance rates so low, and what can be done to increase activity levels in this population?

Much research has focused upon the factors that both prevent and promote physical activity in older adults, with the vast majority using qualitative techniques to glean this information. It has been argued that the barriers and motivators to exercise for older adults consistently fall into three broad categories; environmental, interpersonal and intrapersonal (Associated Retirement Community Operators, 2015; Stathi et al. 2012; Bethancourt, Rosenberg, Beatty & Arterburn, 2014). Environmental factors have been identified as the suitability and availability of facilities; cost; accessibility; safety, and weather (Schutzer & Graves, 2004; Hardy & Grogan, 2009; Franco et al. 2015). Interpersonal factors include social support and the views of other people (Hardy & Grogan, 2009; Stathi et al. 2012; Franco et al. 2015), and intrapersonal factors include health, inertia, enjoyment and past experience (Lees, Clark, Nigg & Newman, 2005; Buman, Yasova & Giacobbi, 2010).

However, incorporating these 'motivators' and 'barriers' to exercise into theoretically driven interventions to increase activity has proven a challenge. For example, interventions based upon self-determination theory (Deci & Ryan, 2002) strive to shift the individual's motivation to exercise from extrinsically motivated reasons (environmental and intrapersonal) to more intrinsically motivated reasons (interpersonal), as this has been demonstrated to predict long term engagement with exercise, but it has been shown to be less successful with exercise initiation (Wilson, Mack & Grattan, 2008). Self-determination theory however, is primarily concerned with motivation and fails to address the importance of barriers to exercise, something which is especially important in the initial phases of exercise engagement (Teixeria, Carraca, Markland, Silva & Ryan, 2012). By comparison, interventions aimed at increasing self-efficacy for exercise, are very much focused on overcoming the psychological barriers to exercise. Findings suggest that self-efficacy is also a good predictor of exercise behaviour in both adults and older adults (Bozoian, Rejeski, & McAuley, 1994; Ashford, Edmunds & French, 2010), particularly in the initial adoption and early maintenance phases (McAuley, Duncan, & Russell, 1992). However, its impact on the long-term maintenance of exercise is less clear (McAuley, Courneya, Rudolf & Lox, 1994), perhaps due to its relative neglect of the importance of motivation in exercise maintenance. Somewhat surprisingly, the majority of studies in this area have failed to incorporate both motivators and barriers together in their conceptual framework, an observation that provided the initial impetus for the current work.

To date, interventions to increase activity levels in older adults have demonstrated some success, particularly in the short-term. However, a 'gold standard' approach has not been found, and one consistent recommendation across research studies is the need for a personalised approach, tailored to the individuals' needs (Hutchison, Johnston & Breckon, 2013). Indeed, Hardy and Grogan (2009) point out that older adults are likely to experience different motivators and barriers based upon their age, gender, socio economic status, ethnicity and current activity levels. A systematic review of motivators and barriers for physical activity among older adults by Baert, Gorus, Mets, Geerts and Bautmans (2011) suggested that "further research. . . is warranted in order to identify specific targets in the development of efficient strategies to increase" physical activity (p. 473). Therefore, being able to identify the appropriate motivators and barriers for each individual, and their relative importance, is essential in order to successfully develop an intervention to increase activity levels. The most cost effective and time efficient approach to gather this information would be through a quantitative tool that could provide an individual profile of motivators and barriers to exercise.

Newson and Kemps (2007) developed two questionnaires to look at the motivators and barriers to exercise specifically in a sample of Australian older adults. Through the adaptation of an existing youth motivation questionnaire (Participation Motivation Questionnaire; Gill, Gross & Huddleston, 1983), and the development of barrier questions based upon an American focus group study (Larkin, 2005), they produced the Motivation and Barriers to Exercise Scales. Analysis of the factor structure of both questionnaires resulted in four motivating factors (fitness, engagement, challenge and health) and four barrier factors (medical, concern, situational and facilities/knowledge). A flaw in Newson and Kemps (2007) research however is the failure to develop questionnaires based on information obtained from their target population. Barriers to exercise for older adults living in America may be quite different to ones experienced by older adults in Australia, and the correspondence between motivating factors for the young and elderly might be tenuous at best and potentially implausible. Furthermore, use of a quantitative tool such as a questionnaire that was not based upon qualitative data from the target population makes it nearly impossible to identify any major themes that might be missing in terms of item content, yet still important for the target population.

The aim of the current study was therefore to develop and examine the psychometric properties of a quantitative self-report measure: the 'Motivators and Barriers Questionnaire' (MBQ) for adults over the age of 65. This questionnaire was based upon qualitative data gathered from focus groups with older adults in the UK, conducted by the authors, and thus addressing the flaws identified above in previous research. Exploratory factor analysis was applied to an initial data set to identify a potential factor structure and the extent to which it might

underpin the qualitative factors arising from the focus groups. A confirmatory factor analysis was then employed to assess the fit of this potential latent factor structure with a second sample of data. If successful, future analysis of respondent's answers to the MBQ will aid the identification of an individual's profile of motivators and barriers to exercise. This will then enable a personalised approach to dealing with barriers and motivators to be developed, and potentially lead to increased exercise activity that can be sustained.

2. Method

2.1 Definitions

The term exercise in this questionnaire was defined as a planned physical activity e.g. brisk walking, heavy gardening, swimming, exercise classes, the gym, dancing and bowls etc.

2.2 Design

A non-experimental survey design was employed to gather data from two samples in order to develop the questionnaire and assess its reliability and fit to a theoretical structure.

2.3 Scale Development

The MBQ was developed from a series of eight focus groups conducted by the authors. Four of the focus groups consisted of 24 regular exercisers (defined as exercising three or more times per week, for a minimum of 30 minutes in each session), aged between 65 and 87 (M = 73.9, sd = 7.09), and the other four focus groups consisted of 21 non-exercisers aged 65 to 87 (M = 74, sd = 7.1). The focus groups explored issues relating to why the participants did/did not exercise, what motivated them to be active and how they could be encouraged to start/do more exercise. Following thematic analysis (Braun & Clark, 2006) of the focus group transcripts, seven themes were identified as barriers to exercise. These were: ***Constraints*** (the many reasons given for not exercising regularly, including physical, mental and social barriers to exercise); ***Worries*** (any feelings which acted as barriers to exercise participation, such as being cautious about risk of harm, lacking confidence, feeling frustrated about not being able to do as much as they used to and social physique anxiety); ***Knowledge*** (a deficit in knowledge regarding suitable exercise facilities and feeling nervous about attending a gym as they were viewed as a young person's domain); ***Mindset*** (the overall negative attitude towards exercise: lack of motivation to participate; the unimportance of exercise and inactivity as an inevitable part of the ageing process); ***Perception of Exercise*** (a difficult and intentional pursuit, un-enjoyable, boring, where people would be forced to follow a regime with a lack of control. Gyms were perceived to be for young, attractive, fit people. Often older adults feel they are doing enough exercise as a by-product of everyday things, such as using stairs, housework, etc, when in fact this is insufficient to realise the associated benefits); ***Physical Barriers*** (actual physical constraints and the anticipated physical constraints that prohibit exercise participation); and ***Practicalities*** (actual practical difficulties and perceptions of practical difficulties, including: lack of facilities, lack of knowledge about facilities, the financial cost, not being able to fit things into their routine, not wanting to have a routine, time of day and weather).

Five themes were identified as motivators to exercise: ***Intrinsic Rewards*** (the physical and mental benefits experienced through exercise participation including keeping bones strong and preventing joints/muscles from seizing up, weight management and health maintenance, the feel good factor (particularly afterwards), having personal performance goals and working to improve performance and a sense of achievement and accomplishment); ***Practicalities*** (the practical elements associated with exercise such as being motivated by having reasonably priced facilities, prioritised exercise over other activities and having or making time to exercise now that they are retired); ***Safeguarding*** (exercising in a safe environment with a trusted qualified professional in a way that promotes feeling secure in their exercise. Safeguarding refers to the need for the cautious and sometimes anxious feelings of the exercisers to be acknowledged and addressed); ***Social Gains*** (the sense of camaraderie and support gained from exercising with peers, knowing that they would be missed if they did not attend and being able to chat and socialise during or after the exercise); ***Trigger*** (the reason that causes the individual to exercise in later life. Often a health scare, followed by medical advice or referral triggered them to take up exercise). These themes (and their corresponding codes) were then used to develop the 56 questions (31 relating to barriers and 25 relating to motivators) that constituted the initial version of the MBQ.

The MBQ was scored on a 5 point Likert scale with 1 corresponding to 'disagree', 2 corresponding to 'disagree somewhat', 3 corresponding to 'don't know', 4 corresponding to 'agree somewhat' and 5 corresponding to 'agree'. Participants were asked to circle the response to indicate how much they either agree or disagree with each statement.

2.4 Participants

Stage 1: Exploring the factor structure

The MBQ was posted to an initial sample of 108 adults over the age of 65. The participants were primarily recruited via a participant database held at a University in the North East of England. 70 completed questionnaires were returned (64% response rate). The participants consisted of twenty males (aged 67 to 89, M = 71.86, sd = 5.53) and fifty females (age 65 to 90, M = 72.70, sd = 6.11).

Stage 2: Confirmatory factor analysis

The revised MBQ was posted to a second sample of 310 adults over the age of 65. These participants were recruited through the North East Age Research database held at a University in the North East of England, and from local older adult social groups in the North East of England. 144 questionnaires were returned (46% response rate). Participants were 33 males (aged 65 to 90 years, M = 77.76, sd = 10.65) and 111 females (aged 65 to 94 years, M = 78.95, sd = 9.05).

2.5 Statistical Analysis

Reliability

The internal consistency of the MBQ was measured by calculating Cronbach's alpha.

Validity

Construct validity of the MBQ was assessed using exploratory principles component analysis. The final structure of the questionnaire's underpinning factors was assessed through confirmatory factor analysis.

3. Results

3.1 Construct Validity

Exploratory Factor Analysis

The use of factor analysis on the 56-item MBQ was supported by both the Kaiser-Myer-Olkin Measures (barriers KMO = .72; motivators KMO = .70) and Bartlett's test of sphericity (barriers χ^2 (465) = 1185.35, $p < .001$; motivators χ^2 (300) = 822.63, $p < .001$). Principal components analysis with varimax rotation was applied to the barrier questions and revealed seven components with eigen values greater than 1.0 accounting for 66.7% of the variance in the data. The scree plot was examined and was in congruence with the seven-factor component solution. Each item loaded onto one of the seven derived factors at 0.44 or greater. However, inspection of the items in each factor revealed that the two items contributing to factor seven, questions 11 (On days when I exercise I find it difficult to sleep) and question 40 (I dislike feeling hot and sweaty) did not fit conceptually together based upon the themes which were previously drawn from the qualitative data. These two questions were therefore removed from the questionnaire to improve its theoretical coherence. In addition, the questions created from the qualitative theme 'worries' were not found to relate statistically to one another when grouped into factors through this analysis. It was therefore decided to remove a further two questions, item number 3 (I set myself unrealistic exercise goals and become frustrated when I cannot meet them) and item number 45 (sometimes I feel too unhappy to exercise). Finally, an error in the questionnaire was discovered where question 8 and 43 were the same (my appearance stops me from exercising), so question 8 was also removed.

Principal components analysis with varimax rotation was also applied to the motivator questions and revealed six components with eigen values greater than 1.0 accounting for 64.1% of the variance in the data. The scree plot was examined and was in congruence with the six component solution. Each item loaded onto one of the six derived factors at 0.40 or greater. Further inspection of the items comprising each factor revealed that the items comprising factor six, item 29 (I understand my physical limitations and exercise within my limits) and item 41 (when the sun shines I feel more inclined to exercise) did not fit conceptually together and were therefore removed from the questionnaire. See Table 1 for initial factor loadings.

Table 1. Motivators and Barriers Questionnaire: Factor Analysis Loadings for 56-item questionnaire

Barrier Factors	**Item**	**Question**	**Loading**
Factor 1	3	I set myself unrealistic exercise goals and become frustrated when I cannot meet them.	.475
	6	I find that I am too tired to exercise in the evening.	.566
	10	I worry that I might injure myself when exercising.	.494
	34	My lifestyle has become more sedentary than it used to be.	.523
	42	My ill health makes it difficult for me to exercise.	.810
	48	I have too many aches and pains to exercise.	.700
	53	I feel too unsteady to exercise.	.808
	55	My physical ailments prevent me from exercising.	.869
Factor 2	18	I find exercise boring.	.842
	22	Bad weather puts me off exercising.	.539
	30	I lack the motivation and will power needed to exercise.	.750
	33	I am too busy to find the time to exercise.	.507
	36	I do not enjoy exercising.	.756
	39	It would take too much effort to exercise.	.668
	51	I feel too tired to exercise.	.495
Factor 3	8	My appearance stops me from exercising.	.728
	20	I worry that people will be better than me in exercise classes.	.586
	43	My appearance stops me from exercising.	.799
	46	I don’t exercise because I worry that everyone will be younger than I am	.736
Factor 4	14	I find it too expensive to exercise regularly.	.599
	16	Exercise facilities tend to be too crowded.	.761
	49	I don’t know what suitable exercise facilities are available in my area.	.740
	56	There are a limited variety of exercise options available to me.	.742
Factor 5	5	My spouse and/or friends do not do exercise.	.569
	13	Nobody encourages me to exercise.	.761
	25	I have nobody to exercise with.	.443
	45	Sometimes I feel too unhappy to exercise.	.480
Factor 6	23	I am too old to exercise.	.632
	27	Friends and family believe I am too old to exercise.	.786
Factor 7	11	On days when I exercise I find it difficult to sleep.	.844
	40	I dislike feeling hot and sweaty after exercise.	.453
Motivator factors	**Item**	**Question**	**Loading**
Factor 1	2	Exercising makes me happy.	.767
	9	I enjoy exercising.	.799
	17	Exercising helps to keep my brain active and alert.	.805
	19	I exercise to improve my health.	.801
	28	Exercising helps me maintain my independence.	.611

	44	I feel fitter when I exercise.	.807
	47	Exercising gives me a sense of achievement.	.742
	50	I have always taken part in exercise throughout my life.	.529
	52	I make exercising a priority.	.573
Factor 2	1	There are lots of suitable exercise classes which I could join.	.896
	4	There are a wide range of different exercise classes and facilities for me to attend.	.909
	7	I know what exercise facilities are available in my area.	.503
	38	Exercise facilities are available at times that suit me.	.539
Factor 3	12	The cost of exercising is low for people over 65.	.446
	32	My friends and family encourage me to exercise.	.479
	35	I enjoy exercising because I enjoy the social aspect of it.	.644
	37	I have more time now to exercise.	.800
Factor 4	15	I exercise to lose weight.	.653
	21	I have been advised to exercise by a health professional.	.828
	24	A health scare prompted me to exercise.	.863
Factor 5	26	I push myself to exercise.	.798
	31	I like to set myself exercise targets.	.436
	54	I try to build exercise into my everyday routine.	.526
Factor 6	29	I understand my physical limitations and exercise within my limitations.	.491
	41	When the sun shines I feel more inclined to exercise.	.814

Exploratory factor analysis was then re-run on the 49-item revised scale, as the removal of items can change the relationship between the remaining items and the factors that might be extracted. Therefore, the initial analysis cannot be relied upon to be an accurate portrayal of the final factor structure. Using the revised version of the MBQ, both the Kaiser-Myer-Olkin Measures (barriers KMO = .78; motivators KMO = .75) and Bartlett's test of sphericity (barriers χ^2 (325) = 988.21, $p < .001$; motivators χ^2 (253) = 768.71, $p < .001$) supported the use of a factor analytical approach. Principal components analysis on the barrier questions revealed six components with eigen values greater than 1.0 accounting for 67% of the variance. The scree plot was examined and was in congruence with the six component structure. Each item loaded onto one of the six derived factors at 0.42 or greater. Only one item (no. 49 "I feel too tired to exercise") changed in terms of the factor that it most strongly loaded onto; moving from 'Negative mindset' (factor 2) to 'Health constraints' (Factor 1).

Principal components analysis with varimax rotation was performed on the revised motivator questions and revealed six components with eigen values greater than 1.0. However, one factor was only loaded on by one item, and a second item did not meet the recommended loading criterion of 0.4 as proposed by Gable and Wolf, (1993). As a consequence, the analysis was repeated with these items removed and the added constraint of extracting just five components. This five component solution accounted for 63.2% of the variance in the motivator measures. The scree plot was examined and was in congruence with the five component solution, and each item loaded onto one of the five derived factors at 0.45 or greater. See Table 2 for factor loadings.

Table 2. Motivators and Barriers Questionnaire: Factor Analysis Loadings for 49-item questionnaire

Barrier Factors	**Item**	**Question**	**Loading**
Health constraints	5	I find that I am too tired to exercise in the evening.	.615
	8	I worry that I might injure myself when exercising.	.492
	30	My lifestyle has become more sedentary than it used to be.	.543
	36	My ill health makes it difficult for me to exercise.	.811
	41	I have too many aches and pains to exercise.	.724
	45	I feel too unsteady to exercise.	.807
	47	My physical ailments prevent me from exercising.	.864
	49	I feel too tired to exercise.	.495
Negative mindset	15	I find exercise boring.	.800
	19	Bad weather puts me off exercising.	.422
	26	I lack the motivation and will power needed to exercise.	.781
	29	I am too busy to find the time to exercise.	.649
	32	I do not enjoy exercising.	.758
	35	It would take too much effort to exercise.	.765
Perception of exercise	17	I worry that people will be better than me in exercise classes.	.729
	37	My appearance stops me from exercising.	.740
	39	I don't exercise because I worry that everyone will be younger than I am.	.805
Knowledge regarding facilities	11	I find it too expensive to exercise regularly.	.657
	13	Exercise facilities tend to be too crowded.	.484
	42	I don't know what suitable exercise facilities are available in my area.	.715
	48	There are a limited variety of exercise options available to me.	.728
Social constraints	4	My spouse and/or friends do not do exercise.	.550
	10	Nobody encourages me to exercise.	.674
	22	I have nobody to exercise with.	.429
Age appropriateness	20	I am too old to exercise.	.545
	24	Friends and family believe I am too old to exercise.	.692
Motivator factors	**Item**	**Question**	**Loading**
Intrinsic factors	2	Exercising makes me happy.	.764
	7	I enjoy exercising.	.820
	14	Exercising helps to keep my brain active and alert.	.810
	16	I exercise to improve my health.	.788
	25	Exercising helps me maintain my independence.	.565
	38	I feel fitter when I exercise.	.784
	40	Exercising gives me a sense of achievement.	.820
	43	I have always taken part in exercise throughout my life.	.598
	44	I make exercising a priority.	.545

Practicalities	1	There are lots of suitable exercise classes which I could join.	.892
	3	There are a wide range of different exercise classes and facilities for me to attend.	.903
	6	I know what exercise facilities are available in my area.	.461
	34	Exercise facilities are available at times that suit me.	.514
Extrinsic factors	9	The cost of exercising is low for people over 65.	.535
	28	My friends and family encourage me to exercise.	.454
	31	I enjoy exercising because I enjoy the social aspect of it.	.684
	33	I have more time now to exercise.	.794
Triggers	12	I exercise to lose weight.	.652
	18	I have been advised to exercise by a health professional.	.827
	21	A health scare prompted me to exercise.	.867
Personal goals	23	I push myself to exercise.	.766
	27	I like to set myself exercise targets.	.482
	46	I try to build exercise into my everyday routine.	.512

3.2 Final Scale Reliability Analysis

Cronbach's alpha coefficient was calculated to measure the internal consistency of the 49-item motivator and barrier subscales of the MBQ. The 23 item Motivator subscale had an $\alpha = .868$, and the 26 item barrier subscale had an $\alpha = .908$. All items contributed to the internal consistency of the subscales. Total item correlations for barriers ranged from .27 to .77; and .27 to .70 on the motivators subscale, indicating a moderate to strong relationship between the individual items and the two overarching subscales. One item, Q23 did fall outside of this range with a correlation value of .12. However, given the strength of its factor loading of .766 there was no reason to consider removing this item based on the item-total correlation value. Table 3 contains the scale item analysis and reliability data.

Table 3a. MBQ 'motivator' item analysis and reliability data for 49-item questionnaire

Motivators α = 0.87	**Ratings**					**M**	**SD**	**Correlation with dimension**	**Dimension alpha reliability if item deleted**
	1	**2**	**3**	**4**	**5**				
Q1. There are lots of suitable exercise classes which I could join.	6	7	12	16	31	3.94	1.17	0.37	0.87
Q2. Exercising makes me feel happy	6	4	8	24	30	4.11	1.09	0.68	0.86
Q3. There are a wide variety of different exercise classes and facilities for me to attend.	6	4	16	19	24	3.73	1.23	0.32	0.87
Q6. I know what exercise facilities are available in my area.	5	3	17	22	25	3.92	1.13	0.53	0.86
Q7. I enjoy exercising.	10	6	2	24	30	3.91	1.33	0.74	0.85
Q9. The cost of exercising is low for people over 65.	10	8	30	8	15	3.14	1.30	0.32	0.87
Q12. I exercise to lose weight.	24	8	3	19	16	2.97	1.62	0.36	0.87
Q14. Exercising helps keep my brain active and alert.	6	2	7	16	40	4.23	1.15	0.55	0.86
Q16. I exercise to improve my health.	3	3	1	17	47	4.47	0.98	0.70	0.86
Q18. I have been advised to exercise by a health professional.	33	4	3	8	23	2.78	1.80	0.31	0.87
Q21. A health scare prompted me to exercise.	35	6	4	10	14	2.27	1.60	0.27	0.87
Q23. I push myself to exercise.	25	8	2	23	14	3.08	1.60	0.12	0.88
Q25. Exercising helps me maintain my independence.	5	1	7	24	34	4.06	1.15	0.62	0.86
Q27. I like to set myself exercise targets.	20	9	8	19	13	2.81	1.51	0.37	0.87
Q28. My friends and family encourage me to exercise.	14	8	7	24	19	3.39	1.44	0.45	0.86
Q31. I enjoy exercising because I like the social aspect of it.	8	9	19	9	25	3.50	1.39	0.55	0.86
Q33. I have more time now to exercise.	10	5	2	17	37	4.11	1.30	0.28	0.87
Q34. Exercise facilities are available at times that suit me.	4	3	26	14	21	3.69	1.11	0.55	0.86
Q38. I feel fitter when I exercise.	5	1	5	16	44	4.44	0.94	0.61	0.86
Q40. Exercising gives me a sense of achievement.	4	1	5	20	40	4.27	1.10	0.64	0.86
Q43. I have always taken part in exercise throughout my life.	18	13	0	16	22	3.20	1.65	0.28	0.87
Q44. I make exercising a priority.	34	12	5	15	5	2.84	1.54	0.62	0.86
Q46. I try to build exercise into my everyday routine.	46	10	1	10	5	3.56	1.42	0.48	0.86

Table 3b. MBQ 'barrier' item analysis and reliability data for 49-item questionnaire

Barriers α = 0.91	**Ratings**					**M**	**SD**	**Correlation with dimension**	**Dimension Alpha Reliability if item deleted**
	1	**2**	**3**	**4**	**5**				
Q4. My spouse and/or friends do not do exercise.	23	10	4	16	16	2.91	1.64	0.27	0.91
Q5. I find that I am too tired to do exercise in the evening.	22	8	2	17	23	3.06	1.68	0.60	0.90
Q8. I worry that I might injure myself when exercising.	34	11	3	16	7	2.14	1.40	0.39	0.91
Q10. Nobody encourages me to exercise.	22	14	0	10	23	2.88	1.71	0.28	0.91
Q11. I find it too expensive to exercise regularly.	32	8	14	7	10	2.24	1.43	0.52	0.90
	15	9	26	14	7	2.89	1.27	0.40	0.91
Q13. Exercise facilities tend to be too crowded.	34	12	2	13	10	2.30	1.53	0.42	0.91
Q15. I find exercising boring.	44	10	8	6	3	1.71	1.16	0.32	0.91
Q17. I worry that people will be better than me in exercise classes.	30	12	3	17	7	2.41	1.51	0.43	0.91
Q19. Bad weather puts me off exercising.	48	11	2	5	6	1.61	1.15	0.57	0.90
Q20. I am too old to exercise.	31	10	5	8	15	2.53	1.68	0.60	0.90
Q22. I have nobody to exercise with.	48	4	9	8	3	1.74	1.22	0.49	0.90
Q24. Friends and family believe I am too old to exercise.	30	14	1	16	8	2.41	1.52	0.77	0.90
Q26. I lack the motivation and will power needed to exercise.	40	15	0	12	5	1.86	1.26	0.70	0.90
Q29. I am too busy to find the time to exercise.	18	4	2	21	23	3.39	1.65	0.40	0.91
Q30. My lifestyle has become more sedentary than it used to be.	31	17	4	9	10	2.14	1.38	0.60	0.90
Q32. I do not enjoy exercising.	33	15	4	9	10	2.12	1.42	0.73	0.90
Q35. I have more time now to exercise.	34	11	2	11	13	2.27	1.57	0.53	0.90
Q36. My ill health makes it difficult for me to exercise.	56	7	1	2	5	1.32	0.90	0.35	0.91
Q37. My appearance stops me from exercising.	52	10	1	4	4	1.41	0.91	0.41	0.91
Q39. I don't exercise because I worry that everybody will be younger than I am.	36	13	1	15	6	2.06	1.38	0.76	0.90
Q41. I have too many aches and pains to exercise.	24	11	11	11	13	2.67	1.54	0.31	0.91
Q42. I don't know what suitable exercise classes are available in my area.	20	16	2	19	15	1.76	1.27	0.54	0.90
Q45. I feel too unsteady to exercise.	10	7	3	32	20	1.97	1.46	0.67	0.90
Q47. My physical ailments prevent me from exercising.	42	9	2	9	10	2.68	1.38	0.36	0.91
Q48. There are a limited variety of exercise options available to me.	21	7	24	8	9	2.12	1.35	0.73	0.90
Q49. I feel too tired to exercise.									

Note. Ratings 1= Disagree; 2 = Disagree somewhat; 3 = Don't know; 4 = Agree somewhat; 5 = Agree

3.3 Confirmatory Factor Analysis

Confirmatory factor analysis was performed on data from the second sample of participants (n=144) to test both the six-factor-solution for the barrier questions, and the five-factor-solution for the motivator questions developed using the exploratory factor analysis. The confirmatory factor analysis was performed using AMOS software and employed the maximum likelihood discrepancy procedure as this is considered the most appropriate for complete datasets, where regression weights and covariance's can be accurately estimated from the data. Two first order factorial models were estimated: one for barriers (figure 1) and one for motivators (figure 2). Initial inspection of the regression coefficients for each item from their respective latent constructs revealed that two items were not significantly predicted by the constructs (No. 34 (Motivator) 'exercise facilities are available at times that suit me' and No. 35 (Barrier) 'It would take too much effort to exercise'). These items were consequently deleted from the questionnaire (and models) as recommended by Byrne (2010) in order to improve the conceptual structure of the scale. Following this, the analysis was repeated and all items were now significantly predicted by their latent constructs. Modification indices were also calculated as part of the analysis procedure. These were then employed to adjust the models in the light of shared error variance between items related to the same underlying constructs, given that these covariances derive from the characteristics and overlap of item content (Aish & Joreskog 1990). This respecification of the models to incorporate correlated errors resulting in a significant reduction in the CMin statistic falls under the framework of post hoc analyses in CFA and such parameters should be included in the model where they make substantive sense (Joreskog & Sorbom, 1993).

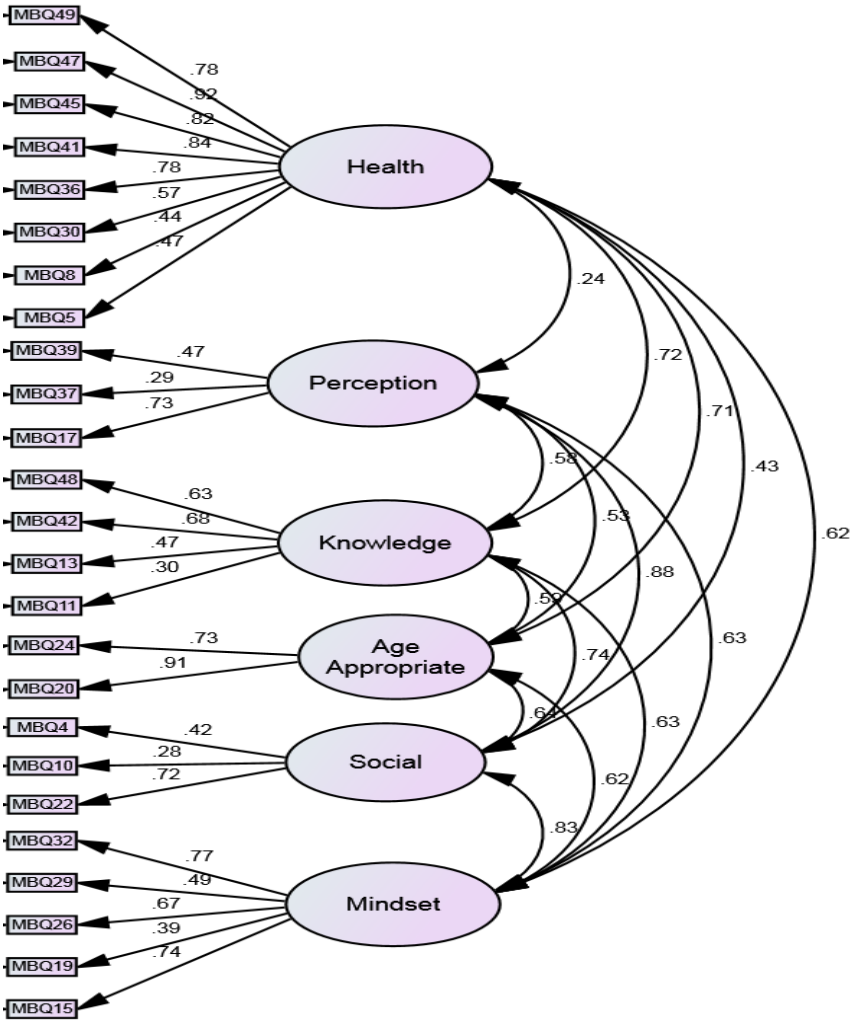

Figure 1. Confirmatory Factor Analysis diagram for Barriers for the MBQ.

Note. Underlying factors are represented by the named circles linked, and the questionnaire items they predict are represented by the square boxes_

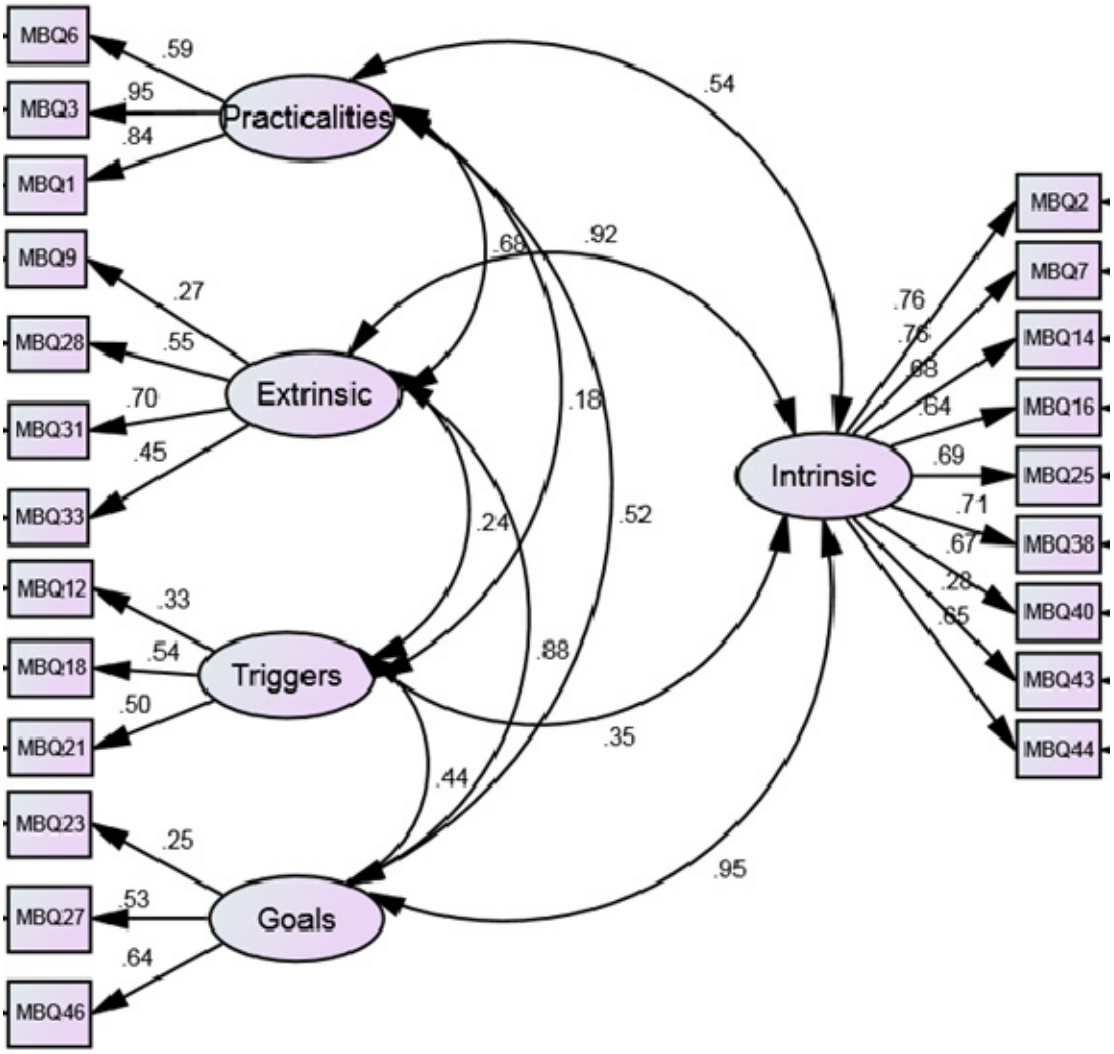

Figure 2. Confirmatory Factor Analysis diagram for Motivators for the MBQ.

Note. Underlying factors are represented by the named circles linked, and the questionnaire items they predict are represented by the square boxes

The model fit was assessed using the Root Mean Square Error of Approximation criterion (RMSEA). This is considered to be the most informative of the criteria presented by AMOS as it takes into account the error of approximation in the population. For the Motivators an RMSEA value of 0.77 was obtained and for Barriers 0.75. Values below 0.8 are accepted as indicating reasonable fit (Browne & Cudeck, 1993). This indicates that the factorial structure suggested by the exploratory factor analysis is confirmed as accurate, i.e. the items load onto the specified structure in such a way as to support the presence of the underlying components identified in the initial exploratory factor analysis, and based upon the analysis of the initial qualitative data. As a consequence, the questionnaire can be usefully employed to assess these concepts via the items that constitute the MBQ. Tables 4 (Motivators) and 5 (Barriers) show the model's parameter estimates along with their standard errors and significance.

Table 4. Five-factor Confirmatory Factor Analysis Regression Weights for Motivators

Regression Weights	Maximum likelihood estimates		
	Estimate	**Standard error**	**Critical ratio**
Q2 ← Intrinsic	1.000		
Q7 ← Intrinsic	1.077	.074	14.608
Q14 ← Intrinsic	.966	.105	9.165
Q16 ← Intrinsic	1.015	.136	7.476
Q25 ← Intrinsic	1.183	.147	8.072
Q38 ← Intrinsic	.967	.116	8.341
Q40 ← Intrinsic	.984	.126	7.838
Q43 ← Intrinsic	.501	.162	3.096
Q44 ← Intrinsic	1.132	.150	7.554
Q33 ← Extrinsic	1.000		
Q31 ← Extrinsic	1.715	.314	5.458
Q28 ← Extrinsic	1.371	.315	4.348
Q9 ← Extrinsic	.540	.199	2.716
Q46 ← Goals	1.000		
Q27 ← Goals	.795	.147	5.420
Q23 ← Goals	.366	.136	2.697
Q21 ← Triggers	1.000		
Q18 ← Triggers	1.442	.604	2.386
Q12 ← Triggers	.874	.399	2.193
Q6 ← Practicalities	.568	.094	6.034
Q3 ← Practicalities	1.215	.127	9.594
Q1 ← Practicalities	1.000		

Note. All critical ratios were statistically significant at the 0.05 level.

Table 5. Six-factor Confirmatory Factor Analysis Regression Weights for Barriers

	Maximum likelihood estimates		
Regression Weights	**Estimate**	**Standard error**	**Critical ratio**
Q5 ← Health	1.000		
Q8 ← Health	.906	.200	4.523
Q30 ← Health	1.360	.257	5.292
Q36 ← Health	1.638	.300	5.458
Q41 ← Health	1.670	.298	5.609
Q45 ← Health	1.652	.297	5.563
Q47 ← Health	1.864	.335	5.566
Q49 ← Health	1.420	.240	5.916
Q15 ← Mindset	1.000		
Q19 ← Mindset	.639	.153	4.168
Q26 ← Mindset	.917	.133	6.914
Q29 ← Mindset	.506	.089	5.707
Q32 ← Mindset	1.057	.120	8.773
Q17 ← Perception	1.000		
Q37 ← Perception	.147	.050	2.955
Q39 ← Perception	.535	.119	4.482
Q11 ← Knowledge	1.000		
Q13 ← Knowledge	1.457	.437	3.334
Q42 ← Knowledge	2.830	.921	3.073
Q48 ← Knowledge	2.626	.866	3.032
Q22 ← Social	1.000		
Q10 ← Social	.381	.127	2.991
Q4 ← Social	.555	.122	4.545
Q20 ← Age	1.000		
Q24 ← Age	.827	.094	8.843

Note. All critical values were statistically significant at the 0.05 level.

4. Discussion

Data analysis permitted the refining of the MBQ from its initial 56-item structure based on the theoretical concepts that had been identified in a focus groups study. Principle components analysis of the data led to the removal of items from both the Barriers and the Motivators categories based upon conceptual or statistical poor fit to the extracted components. Successive principle components analysis on the reduced 47-item scale was then used to extract the factors pertaining to motivators and barriers to exercise experienced by older adults. Within the 22-item motivator subscale, five derived factors were identified. These were named as: Intrinsic Factors, Practicalities, Extrinsic Factors, Triggers and Personal Goals and reflected well the concepts and items drawn from the qualitative study. The most notable change from the qualitative research was the theme 'Social Gains', which was as a factor in the questionnaire renamed as Extrinsic Factors. This change in name reflected the statistical grouping of other questions (from the previously named themes 'social gains' and 'practicalities'), which were considered to be better defined as extrinsic motivators (e.g. 'I enjoy exercising because I like the social aspect of it' and 'The cost of exercising is low for people over 65'). Within the 26-item barrier subscale, six derived factors were identified. These were named as: Health Constraints, Negative Mindset, Perception of Exercise, Knowledge Regarding Facilities, Social Constraints and Age Appropriateness, and again reflect the outcome of the qualitative study, although some changes were evident. One of the biggest themes drawn from the qualitative research was named 'mindset', and it represented the participants overall negative attitude towards exercise. Following data analysis of the questionnaire this large theme was broken down further into

three specific factors, subsequently named negative mindset, age appropriateness and social constraints. The qualitative themes 'constraints' and 'physical barriers' were combined following data analysis of the questionnaire to comprise the factor Health Constraints. Overall, these 11 derived factors strongly supported the construct validity of the scale, demonstrated through the high correlations of items within each of the derived factors.

Initial findings also suggest that the MBQ for older adults is a reliable scale. The alpha coefficient measures of internal consistency for the two overarching subscales, motivators and barriers, were high suggesting that the questions consistently measured the intended constructs (Reynaldo & Santos, 1999).

The factorial structure of the MBQ was supported by the confirmatory factor analysis (CFA), although this process also led to the removal of two further items from the scale. Recommendations indicate that care should be taken when changing the structure of a model during CFA, as the process can become exploratory in nature and undermine the concept of confirmation (Byrne 2010). However, given that the adjustment made was a simplification in terms of item number, and the detection of misfitting parameters, as opposed to changing the underlying factor structure, confidence can be maintained (MacCallum, 1986). The value of RMSEA obtained represents adequate fit of the data to the model. However, the overall sample sizes employed here suggest that replication with a larger sample is required to fully confirm the models arrived at here, although empirical studies into the role of sample size in CFA do suggest that the numbers employed here would be adequate to produce accurate solutions (Arrindell & van der Ende 1985; Barrett & Kline 1981).

It could be argued that the issue of recruiting a suitably large and representative sample is particularly important for the area in which this research is focused. One of the main problems of research into countering the sedentary lifestyle of older adults is that the majority of volunteer participants might represent a minority of the aged population. Specifically, only those who *are* active or *recognise* the importance of increasing activity and *desire* to address this volunteer to take part, and as such the greater majority (for whom the process of designing interventions is primarily aimed) actually do not provide data (Golomb et al., 2012). Further work is required in this area to attempt to improve the data base foundation that underpins the model presented here, for there is a risk that a disparity will exist between what is recommended based on the 'evidence' and what is actually best for the recipients of future interventions.

As it stands, the MBQ provides a unique tool with which barriers and motivators to exercise, specific to older individuals can be identified. Such information may be crucial in the development of personalised interventions aimed at increasing activity levels in this population. As previous research has focused upon simply collecting information on the motivators and barriers to exercise for older adults without going on to translate this information into an assessment tool. One such tool that was developed by Newsom and Kemps (2007) identified many of the factors identified in the current study. However, factors identified via the MBQ, but which are not covered in Newsom and Kemps questionnaire include Negative Mindset, Perception of Exercise and Age Appropriateness in barriers, and Practicalities in motivators. Negative mindset relates to an individual's overall negative attitude towards exercise. This factor was the most prominent theme discussed by non-exercisers in focus groups conducted by the author. Both lack of will power and negative affect (both central to the factor negative mindset), are routinely reported in the qualitative literature (Newsom, Kaplan, Huguet & McFarland, 2004; Lees et al. 2005). The omission of a measure of participants' attitude towards exercise in Newsom and Kemps (2007) questionnaire could result in one of the key components to change being overlooked. Similarly, omission of the factors 'perception of exercise' and 'age appropriateness' may limit the success of any interventions based upon the collected data. Lee, Arthur and Avis (2008) highlight the importance of understanding the psychological components of the barriers to exercise in order to develop successful interventions for this age group.

Due to incomplete data sets the total number of participants included in the initial Factor Analysis are lower than those suggested for this statistical technique (Comrey & Lee, 1992), however Bartlett's test of sampling adequacy indicated that from a statistical standpoint this was not problematic. We argue that the MBQ can be used to develop intervention strategies for each of the 11 motivator and barrier factors. Once these have been established, the MBQ may be then used as an assessment tool to identify which barriers and motivators are particularly salient to an individual, and therefore should be targeted in order to increase activity levels. It is still recommended however that further testing with the MBQ is completed with a new sample, and a subsequent Confirmatory Factor Analysis performed. This would assess the test-retest reliability of the latent factor structure identified in this study, and the mapping of the questionnaire items on to that structure.

In conclusion, the MBQ is a reliable and valid measure of the motivators and barriers to exercise for older adults. It incorporates the three broad categories of motivators and barriers; environmental, interpersonal and intrapersonal (Stathi et al. 2012), and because a unique profile can be identified through the MBQ, it affords the opportunity to develop personalised interventions based upon the scores obtained.

Conflict of Interest

The Authors declare that there is no conflict of interest.

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