The effect of action and coping plans on exercise adherence in people with lower limb osteoarthritis: a feasibility study

Daniel O'Brien, *MHSc*
Clinical Educator (Physiotherapy), AUT University.

Dr Sandra Bassett, *PhD*
Senior Lecturer, AUT University

Professor Peter McNair, *PhD*
Professor of Rehabilitation, AUT University

ABSTRACT

The known benefits of exercise for lower limb osteoarthritis are limited by poor patient adherence to them. Action and coping plans do enhance treatment adherence. This feasibility study investigated the effects of action and coping plans on adherence, self-efficacy and functional performance in people with lower limb osteoarthritis; and tested the study protocol for a larger study. Twenty seven people with hip or knee osteoarthritis were randomly allocated to the exercise plus action and coping plans (intervention) group (n=17) or exercise only (control) group (n=10). Participants undertook a 12 week gym based exercise programme along with a home exercise programme. Exercise self-efficacy and physical function were measured pre- and post-study, and exercise adherence throughout. Data were analysed statistically. There were no significant differences between the two groups' adherence rates, and one significant difference between the two groups' self-efficacy scores. The intervention group improved significantly in four of the five physical measures, whereas the control group significantly improved on only one measure. Action and coping plans appear to have had a beneficial effect on physical function, limited effect on self-efficacy and no effect on exercise adherence. A larger study is required to ascertain the true merit of action and coping plans.

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Key Words: Osteoarthritis, exercise, adherence, action and coping plans, self-efficacy

INTRODUCTION

Osteoarthritis (OA) is a joint disease characterised by pain, decreased function (Goldring and Goldring 2010) and reduced quality of life (Cook et al 2007). Management has predominantly been pharmaceutical and/or surgical (Hunter and Lo 2008), despite international guidelines advocating the use of exercise-therapy (Mazieres et al 2008, Roddy et al 2005, Zhang et al 2007). Exercise-therapy is known to improve function and quality of life in people with OA (Fransen and McConnell 2009, Mikesky et al 2006), leading to less reliance on health services (Fransen and McConnell 2009). Nonetheless, the effectiveness of these programmes is governed to some extent by people's adherence to them, and if higher levels of adherence could be achieved then it could be expected that their effectiveness would improve (Fransen and McConnell 2009, Pisters et al 2010a).

Behaviour change strategies, such as implementation intentions in the form of action and coping plans have been found to improve adherence to the exercise component of cardiac rehabilitation programmes (Sniehotta et al 2005). Implementation intentions are planning strategies which outline how the behaviour will be performed (Gollwitzer, 1999). Action plans require people to state how, when, where and with whom they are going to undertake the behaviour such as exercise, whereas coping plans assist individuals to overcome the barriers to successful completion of the exercise (Sniehotta et al 2005). Nonetheless, it is not known whether these plans are effective adherence enhancing adjuncts to exercise programmes for people with OA (Pisters et al 2010b). Therefore, this feasibility study tested specific protocols in preparation for a larger investigation of the effect of action and coping plans on adherence to exercise programmes for people with OA of the lower limb. It was hypothesised that participants who received the action and coping plans would have higher levels of self-efficacy and adherence, and better function following the exercise programme, than those who did not. It was also hypothesised that there would be significant relations between adherence, post-study self-efficacy and post-study functional performance.

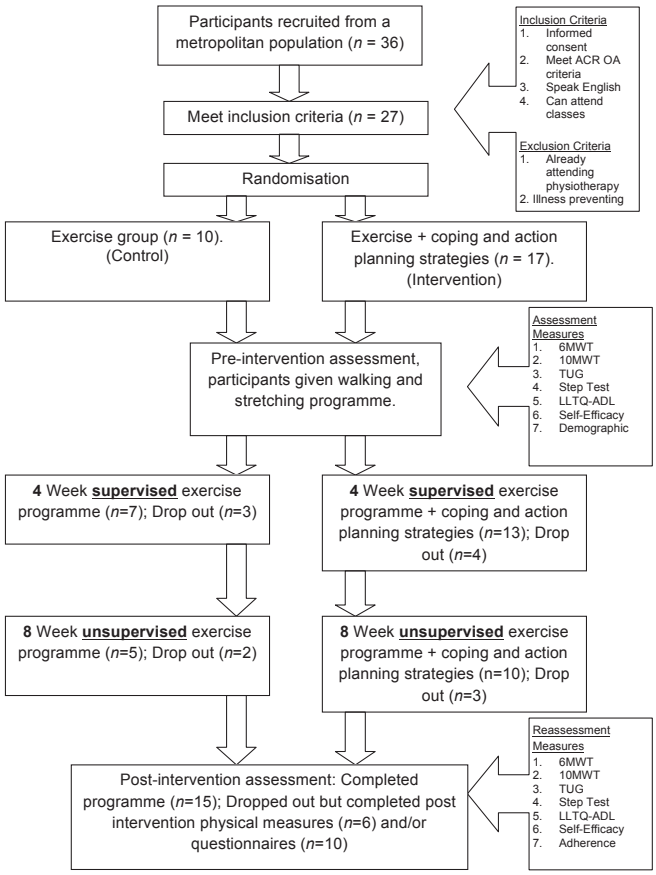
METHODS

Study Design

This feasibility study was a two group, randomised controlled design with testing at the beginning, during and at the end of the exercise programme. The sample size was based on the recommendations of Thabane et al (2010) for pilot studies. Participants were randomly assigned to either the intervention (exercise plus action coping plans) or control (exercise only) group with the use of a computer-generated random number table. The sample size was defined and the computer programme allocated participant numbers to one of the two groups. Participant numbers were generated by the order in which people enrolled in the study. The intervention group received an exercise programme plus action and coping plans and the control group received only the exercise programme. The dependent variables were adherence, self-efficacy, and functional performance. Research assistants collected the

data, supervised the exercise classes and were blinded to the participants' group allocation. The researcher, who assisted the participants to develop the action and coping plans was blinded to the baseline and post-intervention scores of the participants as well as their adherence scores until the completion of the study. See Figure 1 for the study design, and the participants' progression through the study.

Figure 1: Study design showing the flow of participants through the study



Abbreviations: ACR: American College of Rheumatology, OA: Osteoarthritis, 6MWT: 6 minute walk test, 10MWT: 10 metre walk test, TUG: timed up and go, LLTQ-ADL: lower limb task questionnaire – activities of daily living

Participants

Twenty seven people with hip and/or knee joint OA who met the inclusion criteria were recruited. Participants needed to meet the classification criteria defined by the American College of Rheumatology (radiographic evidence of OA changes, joint pain on most days of the last month, as well as three of the following; aged 50 years or older, morning joint stiffness longer than 30 minutes, crepitus, bony tenderness, bony enlargement and no palpable warmth; Altman et al 1986), have good command of the English language and be able to undertake exercise. People were excluded if they were already undergoing physiotherapy or had a disorder/illness that prevented them from exercising. Thirty six people initially expressed an interest in the study, with 27 enrolling, and 15 completing the programme.

Measures

Demographic and Osteoarthritis Characteristics

The Physical Activity Readiness Questionnaire (PAR-Q: Chen et al 2009) was modified for this study for collection of demographic and OA characteristics information. In addition to the standard PAR-Q form, the modified questionnaire also included OA characteristics, such as duration and location of symptoms.

Adherence

As adherence to exercise programmes requires a diverse range of behaviours, its measurement was multifaceted (Brewer 1999).

(i) Attendance and Programme Completion: Participants were encouraged to attend three classes per week, and their attendance was recorded at the beginning of each class. Class attendance was measured by the number of classes each participant attended over the 12 week programme. Programme completion was defined as attending a minimum of one class per week for the 12 weeks; allowances were made if participants were sick or had a planned absence during the study (i.e. holiday).

(ii) Class-Based Adherence: Participation during the class-based sessions was measured with the Sport Injury Rehabilitation Adherence Scale (SIRAS), which has three items, scored on a five point incremental scale. The supervisor scored the participants' exercise intensity, their ability to follow instructions and their receptiveness to changes to the programme during the session. The SIRAS has acceptable test-retest reliability (ICC = 0.77, Brewer et al 2000b), and good internal consistency (alpha = 0.82, Shaw et al 2005).

(iii) Home-based adherence was measured by a participant self-report scale. It consisted of two items measured by a five increment scale (1 = *not at all* to 5 = *as advised*), that required the participants to rate the extent to which they followed each of the walking and the stretching programmes (Bassett and Prapavessis 2007). This measure has acceptable internal consistency (α = 0.78, Bassett and Prapavessis 2007).

Self-Efficacy

Self-efficacy beliefs are known to differ from starting a new behaviour to maintaining it (Scholz et al 2005), therefore the use of phase specific self-efficacy measures were deemed appropriate.

(i) Exercise phase specific self-efficacy was measured by self-report scales of task, maintenance, and recovery self-efficacy. Participants responded to items adapted from previous research using a four-point Likert response scale (1 = *strongly disagree* to 4 = *strongly agree*) (Sniehotta et al 2005). Each item in each scale commenced with either *'I am confident that'* or *'I am able to'* or *'I can'*. Task self-efficacy was a four-item scale that measured the participants' perceived ability to undertake the prescribed exercise programme, maintain their general fitness and follow the advice given about exercising. Maintenance self-efficacy was a four-item scale that measured the participants' perceived ability to maintain the prescribed exercises. Recovery self-efficacy was a three-item scale that measured the possibility that the participants could have lapses in their exercise programme. Previous research (Scholz et al 2005) reported that these scales have acceptable internal reliability. The Cronbach

alpha scores for each of these scales was 0.75, 0.73 and 0.85 respectively.

Functional Performance

Functional performance was measured by four objective measures and one participant self-report scale.

(i) The Timed Up and Go (TUG) test measures peoples' functional mobility (Podsaidlo and Richardson 1991). Participants sat in a chair, when instructed they rose from the chair with the use of their arms, walked around a three metre mark and returned to the seat. The TUG has high test-retest reliability (ICC = 0.80, Kennedy et al 2005).

(ii) The Ten-Metre Walk Test (10MWT) measures maximal walking speed (Freter and Fruchter 2000). Participants were required to walk as quickly as possible for a length of 10 metres with the time taken to cover the distance measured. It has high test-retest reliability (ICC = 0.91, Kennedy et al 2005).

(iii) The Step Test measures the number of times stepped up and down a single 20 cm step in 15 seconds, with the more steps completed being an indication of greater lower limb strength and dynamic balance. This test is reliable in patients with OA (r = 0.90, Kennedy et al 2005).

(iv) The Six-Minute Walk Test (6MWT) measures people's functional physical capacity (Kennedy et al 2005). Participants walked as quickly as possible along a flat 20-metre track turning around a marker placed at each end for six minutes. Any rests the participants had were included in the six minutes and the distance covered during this time was recorded. The 6MWT has high test-retest reliability (r = 0.94, Kennedy et al 2005) and correlates with perceived functional measures (r = 0.83, Stratford et al 2006).

(v) The Lower Limb Task Questionnaire (LLTQ, McNair et al 2007) is a self-report measure of physical function and consists of two scales, recreational activities and activities of daily living (ADL). Only the ADL subscale was used because an initial validation study testing people with OA found it was more appropriate than the recreational sub-scale (LLTQ, McNair et al 2007). The LLTQ-ADL subscale has ten activities each of which the participant rated on a five increment scale with 0 = *unable to complete* and 4 = *no difficulty to complete*. The LLTQ-ADL subscale possesses good factor structure and composition, and shows high levels of internal consistency (Cronbach alpha = 0.91, McNair et al 2007).

Exercise Programme

All participants were encouraged to attend three exercise sessions per week in the University's exercise laboratory for 12 weeks for the class-based sessions, and were given a home-based walking and stretching programme. During the first four weeks they were closely supervised during these class-based sessions and supervision was minimal over the last eight weeks. Participants were taught initially to perform the exercises correctly and encouraged to apply maximal effort to each exercise. The exercise sessions were based on previous recommendations (Mazieres et al 2008, Roddy et al 2005, Zhang et al 2007), and consisted of a resistance-based circuit with eight stations. Participants spent 60 seconds at each station and had 30 seconds to move from one station to the next. They completed three circuits that took 36 minutes to complete with each circuit including use of an exercycle, cross trainer, leg press and calf press, and performance of knee extensions in sitting, sit to stand, a 20 centimetre step-up, and resisted hip abduction in standing. The resistance (load) was progressed on a station if the participant could comfortably complete more than 15 repetitions of the exercise in the allotted 60 seconds. The home-based activity programme was undertaken twice weekly and was based on the recommendations of Roddy et al (2005) and Zhang et al (2007). It consisted of a 20 minute walk and a stretching programme that included one 30 second stretch bilaterally for the quadriceps, gastrocnemius and hamstring muscles.

Action and Coping Planning Strategies (Intervention Group)

The development and implementation of the action and coping plans were based on those outlined by Sniehotta et al (2005). Intervention group participants completed the action and coping plans under the guidance of the researcher. They developed a realistic functional goal that they wanted to achieve by the end of the 12 week exercise programme, for example, to walk for 30 minutes without stopping. The participants and researcher then discussed how completion of the exercise programme would aid the achievement of this goal. The researcher assisted the participants individually with the completion of their planning forms. Participants completed an action plan that stated specifically when, where, how and with whom they were going to undertake the home-based walking, the home-based stretching, and class-based exercise programmes. Coping plans were based on the obstacles participants thought were likely to prevent them from attending the classes, and completing the stretching and walking programmes, for example *'I don't like walking in the rain'*. They then listed how they would overcome these anticipated obstacles by completing the sentence, *'I will overcome these obstacles by....'*. Participants who completed the action and coping plans, signed and dated the documents and were provided with a photocopy of their plan.

Procedure

Ethical approval for the study was obtained from the Northern Region 'Y' Ministry of Health Ethics Committee (NTY/09/01/001). Participants were recruited via advertising in a local paper and medical centres. Those who met the inclusion criteria and volunteered to participate were provided with verbal and written information about the study and signed a consent form. The components of the class-based exercise programme and home-based walking and stretching programmes were explained to all participants, and they were encouraged to attend three classes per week for 12 weeks. They then completed the questionnaires (PAR-Q, task, maintenance and recovery self-efficacy subscales) with the assistance of a trained research assistant and the functional measures (TUG, 6MWT, 10MWT, the Step Test and the LLTQ-ADL subscale) under the guidance of a second research assistant. Next the researcher instructed the intervention group participants about the development and use of the action and coping plans, and they were given a copy of these.

During the exercise programme, participants' class attendance was recorded at the beginning of each exercise class session, and participants completed the self-report scales for adherence to the home-based stretching and walking. At the end of each class one of the research assistants completed the SIRAS. At the

end of the 12 week programme participants repeated all the pre-exercise programme measures except for the PAR-Q. Those who withdrew from the programme (*n*=12) were contacted and in total, 25 participants completed the final set of questionnaires while 21 completed the physical measurements.

Data Analysis

Data were analysed using the Statistical Package for Social Sciences Version 16 (SPSS Inc., Chicago, IL, USA), with an alpha level set at 0.05. Data were screened for normal distribution, and mean scores, standard deviation and confidence intervals were calculated. Group equivalence on the demographic and OA characteristics and the pre-intervention measures were checked using independent *t*-tests and Chi-square tests. Cronbach alpha scores were calculated for each of the self-efficacy scales, the SIRAS, and the LLTQ-ADL subscale. When a significant difference occurred at baseline, a one-way analysis of covariance (ANCOVA) was used to determine the difference. The hypothesis that participants who received the action and coping plans would have higher levels of adherence and self-efficacy and better function following the exercise programme than those who did not, was tested using two group repeated measures analysis of variance (ANOVA) for the self-efficacy and function data, and one-way ANOVA and Chi-square tests for the adherence data. When significant differences occurred in the repeated measures ANOVAs then respective post-hoc independent and paired samples *t*-tests determined where these occurred. To test the hypothesised relationships between adherence and self-efficacy, adherence and post-study functional performance, and self-efficacy and post-study functional performance Pearson correlations were undertaken.

RESULTS

Demographic and Osteoarthritis Characteristics

The descriptive statistics and group comparisons for the demographic and OA characteristics are presented in Table 1. Thirty-six people expressed interest in taking part in the study; however, nine did not enter the study because they either did not meet the inclusion criteria (*n*=3) or choose not to enrol in the study (*n*=6). Twenty seven people took part in the study, with 17 in the intervention group and ten in the control group; the difference in group sizing was due to the computer-generated group randomisation. Fifteen of the participants who started the study completed the exercise programme (Figure 1) and where possible those who withdrew were followed up and asked to complete the final outcome measures. Six of the participants who dropped out of the study cited an increase in pain as the reason, with five of these specifically indicating that they felt the leg press machine was aggravating their symptoms. All of these participants had hip joint OA. The other participants who withdrew cited a lack of time (*n*=3), transport problems (*n*=1), work commitments (*n*=1) and other health concerns (*n*=1). Of note, there were no significant baseline measurement or group allocation differences between those who completed and those that did not complete the study. The only significant difference in the OA characteristics between the intervention group and the control group was the use of analgesics; however there was a trend (*p*= 0.059) towards a difference in duration since diagnosis of OA, with both scores being higher in the control group.

Adherence

There were no significant differences between the two groups in any of the adherence measures and their completion rate (Table 2). The attendance and programme completion rates were low for both groups, with approximately 50% of scheduled exercise sessions not being attended or programmes completed. The

Table 1: Descriptive and statistical comparison of the two groups' demographic and osteoarthritis characteristics

Variable	Intervention Group (*n*=17) mean (SD)	Control Group (*n*=10) mean (SD)	Statistic	Significance (*p* value)
Sex				
male	9	2	$\chi^2(1) = 2.83$	.09
female	8	8		
Age (years)	63.3 (SD 10.4)	63.7 (SD 11.3)	$t(25) = -.95$	.93
Currently employed	9	4	$\chi^2(3) = 1.27$	.53
Undertaken previous regular exercise	15	8	$\chi^2(1) = .34$	.56
Current exercise level (sessions per week)	3.5 (SD 1.5)	3.0 (SD 1.8)	$t(24) = .87$	.39
Joint affected				
hip	5	1	$\chi^2(2) = 2.84$	.24
knee	12	8		
both	0	1		
Duration since diagnosis of OA (months)	41.0 (SD 48.5)	76.7 (SD 47.7)	$t(25) = -1.98$	.06
Currently using analgesics	1	5	$\chi^2(1) = 7.09$	.01

Note. OA = Osteoarthritis, Gp = Group, SD=Standard Deviation.

Table 2: Descriptive and statistical comparisons of the two groups' adherence data

Adherence variable	Intervention Group (*n*=16) Mean (SD)	Control Group (*n*=9) Mean (SD)	Statistic	Significance (*p* value)
Classes attended (number out of 31 scheduled sessions)	17 (SD 11)	16 (SD 10)	*t*(24) = .24	.81
Class-based (SIRAS)	4.5 (SD 0.4)	4.6 (SD 0.9)	*t*(23) = -.65	.52
Home-based stretching	3.7 (SD 1.3)	3.9 (SD 0.2)	*t*(23) =-1.29	.21
Home-based walking	3.6 (SD 1.3) (*n*=17)	3.5 (SD 1.0) (*n*=10)	*t*(23) = .93	.93
Programme completion	10	5	c^2(1) = .20	.66

Note. SD=Standard Deviation, SIRAS = Sports Injury Rehabilitation Adherence Scale, the SIRAS / home-based stretching / home-based walking adherence scales were all rated on a 5 point likert scale where 1 equalled *'not at all'* and 5 equalled *'as advised'*, the variations seen in group sizes (i.e. *n*=16 changing to *n*=17) is due to some participants being lost to follow up measures.

Cronbach alpha for the SIRAS was acceptable (0.72). Their mean scores for the class- and home-based adherence were high, ranging from 3.5 to 4.6 out of a possible score of 5.

Self-Efficacy

Exercise Phase Specific Self-Efficacy

The exercise phase specific self-efficacy pre- and post-study mean scores were moderate to high at both time points (Table 3). The pre- and post-study Cronbach alpha scores for the three self-efficacy scales were high (task, 0.86; maintenance 0.88 and 0.91; recovery 0.90 and 0.92), except for post-study task self-efficacy which was 0.67. There was a significant difference between the groups for recovery self-efficacy, with an independent sample t-test revealing that it occurred between the groups' pre-study scores ($t(25) = 2.28$, $p < 0.033$, CI(95%) = 0.42-0.91), but not with the post-study scores $t(25) = 1.79$, $p = 0.089$, CI(95%) = -0.10-1.27). As the significant difference occurred at pre-study, a one-way ANCOVA was undertaken with no significant difference being found between the groups at the end of intervention ($F(1,18) = 0.31$, $p = 0.583$). There was a significant within-group difference for maintenance self-efficacy, and post-hoc paired sample t-test analyses comparing each groups' pre- and post-study maintenance self-efficacy showed a significant difference for the intervention group ($t(12) = 2.56$, $p < 0.025$, CI(95%) = 0.08 - 1.03), but not the control group ($t(7) = 1.06$, $p < 0.323$, CI(95%) = -0.38 - 1.00).

Functional Performance

The groups' mean scores for each functional test were similar at each of the measurement points with no significant differences occurring in the between-group analyses (Table 4). However, the within-groups analyses revealed significant differences in the 10MWT, step test, TUG and the LLTQ-ADL, but not in the 6MWT scores. Post-hoc paired sample *t*-test analyses revealed that significant differences occurred in the intervention group on the 10MWT, step-test, the TUG, and LLTQ-ADL, but only on the 10MWT for the control group (see Table 5). The pre-and post-study Cronbach alpha scores for the LLTQ-ADL subscale were acceptable (0.92 and 0.90).

Adherence, Self-Efficacy, Functional Performance Relationships

Amongst the three sets of relationships analysed, one significant correlation was identified that made conceptual and theoretical sense. This occurred between the SIRAS (adherence to the class-based exercise programme) and post-study LLTQ-ADL scores ($r = 0.51$, $p < 0.05$).

DISCUSSION

Our findings provided limited support for both hypotheses. For the first hypothesis the only notable significant difference between the two groups on the self-efficacy measures occurred for maintenance self-efficacy with a significant decrease in

Table 3: Descriptive statistics of the group comparison pre- and post-study and statistical comparison of the main mixed between- and within-group effect for phase specific self-efficacy subscales

	Pre-study		Post-study		Between-groups		Within-groups	
SE subscale	Intervention Group Mean (SD) (*n*=17)	Control Group Mean (SD) (*n*=10)	Intervention Group Mean (SD) (*n*=13)	Control Group Mean (SD) (*n*=8)	*F*(*df*=1,19)	Significance (*p* value)	*F*(*df*=1,19)	Significance (*p* value)
Task	3.39 (SD .55)	3.16 (SD .65)	3.60 (SD .34)	3.27 (SD .59)	1.70	.21	.05	.83
Maintenance	3.44 (SD .50)	3.00 (SD .66)	2.96 (SD .73)	3.81 (SD 1.03)	1.04	.32	5.82	.03
Recovery	3.51 (SD .59)	3.03 (SD .48)	3.46 (SD .59)	2.88 (SD .92)	6.66	.02	1.44	.24

Note. SE=Self-efficacy, Gp=Group, SD=Standard Deviation, df=Degrees of Freedom, Task / Maintenance / Recovery scales were all rated on a 4 point likert scale where 1 equalled *'strongly disagree'* and 4 equalled *'strongly agree'*, the variations seen in group sizes (i.e. *n*=17 changing to *n*=13) is due to some participants being lost to follow up.

Table 4: Descriptive statistics of the group comparison pre- and post-study and statistical comparison of the main mixed between- and within-group effect for functional performance scores

	Pre-study		Post-study		Between-groups			Within-in groups	
Functional performance	Intervention group mean (SD) (*n*=17)	Control group mean (SD) (*n*=10)	Intervention group mean (SD) (*n*=13)	Control group mean (SD) (*n*=6)		*F*(*df*=1,19)	Significance (*p* value)	*F*(*df*=1,19)	Significance (*p* value)
10MWT (Sec)	7.0 (SD 2.6)	6.8 (SD 2.2)	6.2 (SD 2.1)	5.5 (SD 1.4)	.88	.88	.36	10.21	.01
Step test (Reps)	7.4 (SD 2.4)	7.5 (SD 2.1)	9.4 (SD 1.6)	9.5 (SD 2.1)	.67	.67	.42	17.22	.00
6MWT (Meters)	475 (SD 130)	459 (SD 171)	465 (SD 171)	499 (SD 91)	.53	.53	.48	.12	.73
TUG (Sec)	9.0 (SD 3.6)	7.9 (SD 2.8)	7.4 (SD 2.8)	6.6 (SD 1.6)	1.37	1.37	.26	6.33	.02
LLTQ-ADL	28.2 (SD 8.4)	29.0 (SD 8.1)	32.2 (SD 6.0)	27.8 (SD 8.4)	.30	.30	.59	1.83	.94

Note. 10MWT = 10 meter walk test, 6MWT = 6 minute walk test, TUG = timed up and go test, LLTQ-ADL = Lower limb task questionnaire activities of daily living subscale, SD=Standard Deviation, *df*=Degrees of Freedom, the variations seen in group sizes (i.e. *n*=17 changing to *n*=13) is due to some participants being lost to follow up

Table 5: Within group post-hoc t-test statistical comparison of function

Functional Measures	Statistic	CI (95%)	Significance
10MWT (Sec)			
Intervention (*n*=13)	*t*(12) = 3.27	.36 - 1.83	*p* < .01
Control (*n*=6)	*t*(5) = 3.02	.08 - 1.02	*p* < .03
Step test (Reps)			
Intervention (*n*=13)	*t*(12) = -4.76	-3.25 - -1.21	*p* < .00
Control (*n*=6)	*t*(5) =-1.94	-2.33 - 0.33	*p* =.11
TUG (Sec)			
Intervention (*n*=13)	*t*(12) = 3.48	.73 - 3.17	*p* < .01
Control (*n*=6)	*t*(5) =.77	-.47 - 0.87	*p* = .48
6MWT (Meters)			
Intervention (*n*=13)	*t*(12) = .03	-86.50 - 89.27	*p* =.97
Control (*n*=6)	*t*(5) = .96	-33.41 - 73.41	*p* =.38
LLTQ-ADL			
Intervention (*n* =13)	*t*(12) = -3.27	-6.54 - -1.31	*p* < .01
Control (*n* =13)	*t*(7) =.786	-2.54 - 5.04	*p* = .46

Note: 10MWT = 10 meter walk test, 6MWT = 6 minute walk test, TUG = timed up and go test, LLTQ-ADL = Lower limb task questionnaire activities of daily living subscale, Sec = Seconds, Reps = Repetitions.

these scores for the intervention group over the duration of the study. Despite there being no significant differences between the groups on their pre- and post-intervention functional activity scores, there were significant within group differences. The intervention group showed significant differences on the 10MWT, step test, TUG and the LLTQ-ADL, whereas the only significant difference for the control group was on the 10MWT. The limited support for the second hypothesis came from the moderate strength significant correlation in the expected direction between the class-based adherence and post-study functional outcomes. Over and above these general observations there are a number of factors related to the study, its findings and the feasibility of the protocols that merit discussion.

Contrary to previous research showing that action and coping plans have a positive effect on adherence to exercise programmes (Luszczynska 2006, Scholz et al 2005), the findings of our study were not completely in favour of this notion. This may have been due to the characteristics of the programme, the measures used and the sample size. The 12 week duration of the exercise programme and the need to attend the class for up to three times per week may have been a deterrent to the participants. Prior to the commencement of the programme potential participants were informed about the commitments of the programme, leading to six people declining to participate because they could not commit to the programme requirements. By the end of the programme the attendance

rates of both groups was less than desirable, at approximately 50%. Given that adherence to long-term exercise programmes is known to diminish over time (Lombard et al 1995), the 12 week duration of the programme may have contributed to the poor level of attendance (Rejeski et al 1997). In addition, six participants withdrew because the exercises increased their pain; exercise-related pain has previously been shown to reduce exercise adherence (Rejeski et al 1997).

The non-significant result between the two groups' class- and home-based adherence may have been due to a ceiling effect in the scores. The groups' mean scores for adherence to the class-based (SIRAS) and home-based activities were moderate to high, ranging from 3.4 to 4.6 out of a possible 5. These high scores may be due to the SIRAS only consisting of three items, meaning it is not able to capture all of the class-based adherence related patient behaviours. In a recent study, the SIRAS was reported to have limited sensitivity (Granquist et al 2010). One reason for the high home adherence self-report measure scores may have been due to participants over-estimating their level of adherence, which has been reported in other research (Pisters et al 2010a). Nonetheless, participants may have high levels of home-based exercise adherence because of the easy accessibility to the activities, which has been shown in previous research (Bassett and Prapavessis 2007).

The only noteworthy self-efficacy finding was a significant decrease in the intervention group's maintenance self-efficacy over the duration of the study, which is contradictory to other research (Luszczynska 2006, Scholz et al 2005). A possible reason could be that the self-efficacy measures were completed at the beginning of the study when the participants had a limited awareness of the demands of the exercise programme, which may have led to them underestimating the influence of the barriers to exercise over the duration of the programme. This decrease could therefore be regarded as an adjustment to the "accuracy" of the participants' beliefs regarding their ability to exercise regularly. This unexpected decrease in self-efficacy scores over the duration of the exercise programme is not new and has been described in other health-related exercise programmes (Morgan et al 2010).

The significant differences in the two groups' functional performance findings could be due to three possible reasons. First, improvements could be attributed to the effect of the prescribed exercises, as found in similar exercise programmes (Jan et al 2009, Mikesky et al 2006). Second, the action and coping plans may have to some extent been responsible for the intervention group's functional improvements over the duration of the study by focussing this group's attention on the exercises and overcoming the barriers to exercise and attending the exercise classes (Sniehotta et al 2005). Similarly, Ziegelmann et al (2007) found providing a plan for participation in exercise (implementation intentions) resulted in better engagement in the exercise programme than simple goal setting. Third, the lack of the control group's change in function over the duration of the programme may have been due to significantly more participants in the control group being on analgesic medication and the trend towards this group having a longer duration of symptoms before starting the study. Longer symptom duration has been linked to poor response to exercise in people with OA (Wright et al 2009), which in turn may explain their reduced functional improvement.

The significant correlation between adherence (SIRAS) and post-study perceived function (LLTQ-ADL) adds to existing knowledge, by further strengthening the notion that high levels of treatment adherence are associated with optimal functional recovery. Previous research has documented associations between high levels of rehabilitation adherence and functional recovery (Bassett and Prapavessis 2011, Brewer et al 2000a).

There are a number of recommendations for future research into exercise programmes and the use of adherence enhancing strategies that have come to light as a consequence of conducting this feasibility study. Five recommendations involve improvements to the design and implementation of future similar studies. Three of these recommendations relate to procedural aspects of study: the timing of the measurement of participants' self-efficacy beliefs, the balance of the home- and class-based exercises, and the removal of exercises that produce joint pain. Firstly, the measurement of the participants' self-efficacy beliefs would have been better done at the end of the participants first week of exercises, instead of before commencing the exercises. This would have allowed the participants to have a more accurate understanding of the prescribed exercises, and may have limited the possibility of over-estimating self-efficacy beliefs. Secondly, the balance of the class- and home-based components of the exercise programme could be adjusted, as the results indicated that the participants, irrespective of their grouping, found it easier to adhere to home-based exercises than the class-based exercises. Similar results have been found by other researchers (Bassett and Prapavessis 2011, Johansson et al 2009); therefore, it would be appropriate for a greater emphasis on home-based exercises in future studies. Finally, in light of the number of the participants (n = 5) with OA who dropped out of the study because of the pain experienced with the leg press exercise, future studies could look to excluding this exercise for participants who experience similar problems. This recommendation is in keeping with that of Allegrante and Marks (2003).

The two measurement tool factors that could be changed to improve the design of future studies include the use of home-based adherence measures with a larger range of Likert scale responses, and the use of a more reliable measure of class-based adherence. Using a rating scale of one to seven, versus one to five, may reduce the likelihood of a ceiling effect with the measurement scale (Hessing et al, 2004). A ceiling effect occurs when a measure possesses a distinct upper limit for potential responses and a large concentration of participants score at or near this limit. The scale is therefore unable to differentiate between changes in the recorded phenomenon. Since the design and implementation of this study, a new measure of class-based adherence has been developed which has been shown to be a more reliable and valid measure of class-based adherence than the SIRAS (Granquist et al 2010). Future studies may find class-based adherence would be better assessed by the recently developed 16 item Rehabilitation Adherence Measure for Athletic Training (Granquist et al 2010).

In spite of its limitations, this feasibility study did provide a preliminary insight into the use of action and coping plans as adjuncts to exercise programmes for future research and clinical practice. Given the findings of previous research that has shown action and coping plans are effective in encouraging exercise

behaviours (Luszczynska 2006, Scholz et al 2005, Sniehotta et al 2005), physiotherapists should consider using these with patients who are having problems incorporating exercises into their daily routines.

CONCLUSION

Contrary to our expectations, exercise adherence was not significantly improved by the use of action and coping plans, which may in part be due to limitations with the adherence measures used. Nonetheless, the group that implemented the action and coping plans did have a significant improvement in four of the five functional outcomes which may have been due to them focussing on the exercises and overcoming the barriers. Further the moderate to strong adherence – post-treatment relationship adds further weight to the notion that high levels of adherence are important for optimal treatment outcomes. Finally, the true value of incorporating action and coping plans into exercise programmes for people with lower limb OA will only be ascertained by a larger investigation that includes the methodological recommendations we have identified.

KEY POINTS

- Action and coping plans as an adjunct to exercise programmes may improve functional performance
- Action and coping plans did not influence adherence or self-efficacy
- Future research should be mindful of the procedural recommendations made in this feasibility study
- Relationships exist between exercise adherence and post-treatment functional outcomes

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ADDRESS FOR CORRESPONDENCE

Daniel O'Brien, Physiotherapy Clinic , Akoranga Integrated Health Clinic, AUT University, Private Bag 92006, Auckland 1142. Email: dobrien@aut.ac.nz

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