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Improving Adherence to Exercise: Do People With Knee Osteoarthritis and Physical Therapists Agree on the Behavioral Approaches Likely to Succeed?

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<<title>>Improving Adherence to Exercise: Do People With Knee Osteoarthritis and Physical Therapists Agree on the Behavioral Approaches Likely to Succeed?

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Objective. To describe which behavior change techniques (BCTs) to promote adherence to exercise have been experienced by people with knee osteoarthritis (OA) or used by physical therapists, and to describe patient- and physical therapist-perceived effectiveness of a range of BCTs derived from behavioral theory.

Methods. Two versions of a custom-designed survey were administered in Australia and New Zealand, one completed by adults with symptomatic knee OA and the second by physical therapists who had treated people with knee OA in the past 6 months. Survey questions ascertained the frequency of receiving/prescribing exercise for knee OA, BCTs received/used targeting adherence to exercise, and perceived effectiveness of 36 BCTs to improve adherence to prescribed exercise.
Results. A total of 230 people with knee OA and 143 physical therapists completed the survey. Education about the benefits of exercise was the most commonly received/used technique by both groups. People with knee OA rated the perceived effectiveness of all BCTs significantly lower than the physical therapists (mean difference 1.9 [95% confidence interval 1.8–2.0]). When ranked by group mean agreement score, 2 BCTs were among the top 5 for both groups: development of specific goals related to knee pain and function; and review, supervision, and correction of exercise technique at subsequent treatment sessions.
Conclusion. Goal-setting techniques related to outcomes were considered to be effective by both respondent groups, and testing of interventions incorporating these strategies should be a research priority.
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<<hd1>>**INTRODUCTION**

Knee osteoarthritis (OA) is a common and disabling problem in older adults, typically resulting in pain, reduced physical function, and decreased quality of life (1). There is no cure for knee OA, and management focuses on minimizing pain and optimizing function (2,3). Exercise is considered the cornerstone of nonsurgical management of knee OA, supported by high-quality evidence of effectiveness for increasing function and decreasing pain (4). Despite exercise providing immediate and short-term clinically worthwhile benefits (4,5), adherence to exercise declines significantly over time (5–7). This decline is problematic, as adherence has been identified as a predictor of the long-term effectiveness of exercise therapy, both during and after a supervised treatment period (4,8). Consequently, recommendations for exercise management of knee OA propose that interventions to improve and maintain adherence to exercise are required (4,9).

<<significance&innovations>>

SIGNIFICANCE & INNOVATIONS

- This study identified a mismatch between the behavior change techniques experienced by people with knee osteoarthritis (OA) and used by physical therapists, and those perceived to be most likely to be effective to increase exercise adherence.
- There was considerable ambivalence among people with knee OA about the potential effectiveness of all behavior change techniques to improve their adherence to exercise.
- People with knee OA and physical therapists considered goal setting related to knee pain and function to be effective at increasing exercise adherence, but these techniques are yet to be specifically evaluated in a randomized trial.

Ongoing adherence to exercise often requires changes in behavior, thus strategies aimed at promoting positive patient behaviors with respect to exercise participation are warranted. For interventions to effectively facilitate behavior change, the use of theoretical rationale is imperative when designing intervention components (10). Behavior change techniques (BCTs) are theory-based methods for changing 1 or more psychological determinants of behavior (11). These include, but are not limited to, techniques such as goal setting, action planning, and use of graded tasks. Given that the barriers and facilitators to exercise participation in people with OA are usually multifactorial (12), interventions aiming to increase adherence to exercise often need to be complex, consisting of multiple components and multiple BCTs.

Various interventions aiming to improve adherence to exercise have been tested for their effectiveness among people with chronic musculoskeletal problems. These have included BCTs such as education, goal setting, supervision of exercises, and the use of self-monitoring techniques such as an exercise diary (13). Our recent systematic review of interventions to increase adherence to therapeutic exercise in older adults with low back pain and/or hip/knee OA included 9 randomized controlled trials (14). Meta-analysis provided moderate quality evidence that booster sessions with a physiotherapist can assist people with hip/knee OA to better adhere to therapeutic exercise, and individual high-quality trials provide emerging evidence to support the use of motivational strategies and behavioral graded exercise to improve adherence to exercise in these populations (6,15,16).

Optimal management of knee OA, including exercise prescription, should be guided by the principles of patient-centered care. Patient-centered care can be defined as "providing care that is respectful of, and responsive to, individual patient preferences, needs, and values, ensuring that patient values guide all clinical decisions" (17). This approach aims to empower patients to take personal responsibility for their treatment through shared decision-making and self-management (18). Physical therapists have an important role in assisting people to manage their knee OA through designing and supervising exercise programs (19). In order for an intervention to be successful in clinical practice, it requires patient participation. To date, no studies have explored which BCTs aimed at increasing adherence to prescribed exercise are thought to be most effective by people with knee OA, or by physical therapists who treat this group. Given the limited research evidence for interventions to promote adherence to exercise, information about which BCTs people with knee OA and physical therapists think will be effective is of value to direct future research and clinical practice.

The objectives of this study were to describe which BCTs are most commonly experienced by people with knee OA when they are prescribed exercise by health professionals, and which are most commonly used by physical therapists, and to describe patient- and physical therapist-perceived effectiveness of a range of BCTs to increase and maintain adherence to prescribed exercise for people with knee OA.

<<hd1>>**MATERIALS AND METHODS**

<<hd3>>**Study design and participants.** A descriptive, cross-sectional survey was undertaken online in Australia and New Zealand. Ethical approval was granted by the School of Health Sciences Human Ethics Advisory Group, University of Melbourne (Ethics Application 1443403). People with a self-reported clinical diagnosis of knee OA, and physical therapists who treat people with knee OA, were recruited between January 2015 and May 2015. Participants were recruited by advertisements on the Centre for Health, Exercise and Sports Medicine website, using Department of Physiotherapy contact lists, and on social media (Facebook). Social media advertisements were shown to users across all of Australia and New Zealand. Participation was voluntary and informed consent was given by completion of the survey. All individual responses were anonymous.

Adults ages ≥50 years who were able to read and understand English and who fulfilled the American College of Rheumatology clinical classification criteria for knee OA (20) were

eligible to complete the patient survey. Specifically, 4 screening questions were used to determine eligibility: Are you 50 years of age or older? Have you had pain in or around one or both knees on most days of the past month? Do you have knee stiffness in the morning that lasts for less than 30 minutes? Do you have crackling, crunching, or grating noises within the knee when you move it? Participants were required to respond positively to all 4 questions to be eligible and progress to the survey. Qualified physical therapists who answered positively to 2 questions were eligible to complete the survey: Are you registered to practice as a physiotherapist in Australia and/or New Zealand? In the past 6 months have you treated one or more patients ages 50 years or older, with knee OA?

To maximize response rate and minimize partial survey completion, participants who completed the survey were entered in a lottery to win an electronic tablet. Previous reviews have found the use of nonmonetary incentives significantly increases the response rate and rate of questionnaire completion (21). All participants were informed of the chance to win prior to taking part in the survey. Participants provided contact details for the lottery by completing a separate online form upon finishing the survey. These contact details were not linked to an individual's survey responses.

<<hd3>>**Survey instrument.** Two versions of the survey were implemented, 1 version for people with knee OA (see Supplementary Appendix A, available on the *Arthritis Care & Research* web site at http://onlinelibrary.wiley.com/doi/10.1002/acr.23297/abstract) and the other for physical therapists (see Supplementary Appendix B, available at http://onlinelibrary.wiley.com/doi/10.1002/acr.23297/abstract). The custom-designed surveys were administered online using SurveyGizmo software (www.SurveyGizmo.com). Each version of the survey comprised 3 sections and took approximately 15 minutes to complete.

Section 1 of the survey ascertained demographic information such as sex and age. The survey for people with knee OA included questions related to duration of knee OA symptoms, previous health professionals consulted for knee OA, and exercise prescription in these consultations. The physical therapist questionnaire included details of clinical experience, frequency of treating people with knee OA, and frequency of prescribing exercise to this population.

The second survey section related to BCTs targeting adherence to exercise. People with knee OA were asked which BCTs targeting adherence to their knee OA exercise program a health care practitioner had used with them. A total of 36 BCTs, based on those in the Coventry, Aberdeen, and London–Refined (CALO-RE) taxonomy (22), were provided. In addition, people with knee OA were able to enter any other techniques they had experienced during health professional consultations about their knee pain.

The CALO-RE taxonomy was developed to identify theory-linked BCTs within physical activity and healthy eating behavioral interventions (22). The taxonomy comprises established standardized definitions of 40 different BCTs. We did not include 8 techniques from the taxonomy in our survey (provide information about others' approval, provide normative information about others' behavior, provide rewards contingent on effort, prompting generalization of behavior, facilitate social comparison, prompt anticipated regret, fear arousal, and stimulate anticipation of future rewards), as there was consensus among the authors that these techniques were not applicable to, or would be inappropriate in, a clinical setting. Each BCT was reworded to be specific to a person with knee OA being prescribed an exercise program. Where appropriate, various modes of delivery of a BCT were included as individual items (e.g., audio instructions of exercises, written instructions of exercises, or video instructions of exercises).

Physical therapists were asked to name strategies they currently use, or have previously used, to promote adherence when prescribing exercise programs to people with knee OA. This question was deliberately broad to allow clinicians to draw on multiple and varied clinical experiences. The list of BCTs was not provided to the physical therapists to avoid bias and over-reporting in responses. Respondents were able to name as many strategies as they wished, in their own words. Responses were grouped according to similar techniques by one author, and reviewed by a second author. We attempted to summarize responses according to the CALO-RE taxonomy; however, significant variation in the level of detail provided in responses precluded this summarization.

The third survey section explored all respondents' perceived effectiveness of the BCTs to improve adherence to exercise. People with knee OA and physical therapists rated each of the 36 BCTs on an 11-point Likert scale (where 0 = strongly disagree and 10 = strongly agree) in

response to the statement “I think this would be an effective way to help me/my patients with knee OA adhere to my/their exercise program.”

The survey was piloted with 4 older adults with knee OA and 4 physical therapists. Pilot participants were given the opportunity to provide written and verbal feedback about the survey format, their comprehension of the questions, and how they arrived at their given answers. Formatting of the questionnaire and wording of a small number of questions was altered as a result of these suggestions.

<<hd3>>**Statistical analysis.** All data were downloaded from SurveyGizmo and processed in Excel. Data analysis was carried out with the Statistical Package for the Social Sciences. Descriptive statistics were calculated. Experience/use of BCTs for each respondent group was expressed as number (percentage). Data pertaining to perceived effectiveness of the BCTs were reported as means and 95% confidence intervals (95% CIs). Independent-sample *t*-tests were conducted to compare BCT agreement rating scores for people with knee OA and physical therapists. The level of significance was set at a *P* value less than or equal to 0.05. Group mean (and 95% CI) agreement scores were calculated for each of the 36 BCTs. The list of techniques was ranked from highest to lowest by group mean scores.

<<hd1>>**RESULTS**

Eligibility screening questions were completed by 387 people with self-reported knee OA and 203 physical therapists. Of these, 308 people with knee OA (79%) and 182 physical therapists (90%) were eligible to take part. All questions in the survey were completed by 230 people with knee OA (75%) and 143 physical therapists (79%). As participants self-enrolled in response to advertising, we were unable to calculate a response rate.

<<hd3>>**Characteristics of the participants.** Demographic characteristics of all respondents are shown in Table 1.<<T1>> Respondents with knee OA had a mean ± SD age of 60.9 ± 6.9 years, were predominantly women, and commonly reported bilateral knee symptoms. The majority of physical therapists were also women. Less than half had postgraduate qualifications, and the majority worked exclusively in private health settings. The majority of both the physiotherapist cohort (62% of responses) and people with knee OA (92% of responses) responded to social media advertising.

<<hd3>>**Knee OA consultations.** Most people with knee OA had consulted 1 or more health professionals about their knee pain (n = 209, 91%), and half of these people reported being prescribed exercises in these consultations (n = 121, 52%). A general medical practitioner was the most commonly consulted health professional (n = 172, 75%) by respondents with knee OA, but exercise was rarely prescribed during these consultations (n = 18, 10%) (Table 1). Exercises were most frequently prescribed when people with knee OA consulted a physical therapist about their knee pain (n = 84, 76%), but less than half of the group had sought this form of treatment (n = 111, 48%).

More than half of physical therapists who completed the survey treated people with knee OA frequently (at least once per week) or very frequently (5 or more per week). Two-thirds (78%) reported that they would always or usually prescribe exercise to people with knee OA; however, 20 respondents (14%) reported that they never prescribe exercise to people consulting for their knee OA.

<<hd3>>**Experience and use of techniques aiming to increase adherence to prescribed exercises.** Table 2 shows the BCTs experienced by respondents with knee OA who had been prescribed exercise by a health professional (n = 121, 52%). Of this group, most (n = 98, 81%) reported having experienced 1 or more of the listed BCTs to help them adhere to their exercise program.<<T2>> The median number of BCTs experienced was 3 (interquartile range 1–7), and the maximum number reported was 20. Techniques used by physical therapists who prescribe exercise programs to people with knee OA (n = 123, 86%) to promote adherence are summarized in Table 3.<<T3>> Education and explanation about the benefits of exercise for knee OA, and the provision of written instructions of the exercises, were commonly reported techniques by both people with knee OA and physical therapists. Approximately one-third of people with knee OA (29%) reported developing specific goals with their health care provider, but few physical therapists (13%) reported setting goals with patients with knee OA to promote adherence to prescribed exercise.

<<hd3>>**Agreement with the effectiveness of BCTs to promote exercise adherence.** Table 4 summarizes mean scores (of a maximum of 10) for agreement with the effectiveness of each BCT at increasing adherence to prescribed exercise, presented according to the area of focus.<<T4>> Overall, people with knee OA rated the effectiveness of BCTs lower than the physical therapists' rating. Agreement rating scores were significantly different between the 2

groups for all 36 techniques (overall mean difference 1.9 [95% CI 1.8–2.0]). Among people with knee OA, no significant differences existed in perceived effectiveness of the BCTs between those who had previously been prescribed exercise and those who had not (all 95% CIs crossed 0; data not shown).

Figures 1 and 2 show ranking of the 5 BCTs rated to be the most effective by each respondent group, with the corresponding rankings of the opposite group.<<F1>><<F2>> Only 2 BCTs were ranked in the top 5 by both groups: development of specific goals related to knee pain and function; and review, supervision, and correction of exercise technique at subsequent treatment sessions. Three of the top 10 ranked techniques by both groups involved goal setting, related to both exercise and outcomes, and review of these goals.

<<hd1>>**DISCUSSION**

To our knowledge, this is the first study to investigate which BCTs have been or are currently used when exercise is prescribed for people with knee OA, as well as perceived effectiveness among people with knee OA and physical therapists of a range of BCTs to improve adherence. Among our sample, education about the benefits of exercise and exercise instructions were the most commonly used techniques by both groups. In evaluating the perceived effectiveness of the BCTs, physical therapists were notably more optimistic than people with knee OA. When ranked by group mean rating scores, the development of specific goals related to knee pain and function and review, supervision, and correction of exercise technique at subsequent treatment sessions were ranked in the top 5 by both groups.

Education and explanation about the benefits of exercise were common techniques received by people with knee OA and delivered by physical therapists. Although previous interventions to increase adherence to a range of therapies across a broad range of conditions have typically focused on education (23), available evidence indicates that information provision alone is not enough to create and maintain good exercise adherence habits (24). Among our cohort, the mode of education delivery appeared to influence the perceived agreement with the effectiveness of educational techniques. Verbal or written explanation of the potential benefits of exercise specific to the person with OA was thought to be effective by both groups, while printed educational materials or referral to a website for information about exercise benefits was not.

Overall people with knee OA were less optimistic than physical therapists about the potential effectiveness of BCTs to increase adherence to exercise. This lack of optimism is perhaps unsurprising given that almost half of respondents (48%) had not been prescribed exercise for their knee OA previously. In addition, among those who had been prescribed exercise, we found that they had experienced few BCTs to help them adhere to exercise recommendations (median = 3). Previous studies have found considerable uncertainty among people with knee OA about the benefits and consequences of exercise, and their capability to perform exercises as prescribed, which may also have influenced these findings (12,25–28).

With respect to the BCTs perceived to be most effective by each group, physical therapists and people with knee OA appeared to agree about the benefit of developing goals related to knee pain and function, and ongoing review of these goals at followup sessions. The positive effects of goal setting in facilitating behavior change have been proposed in behavior change theory for some time. Locke's goal setting theory proposes that setting goals successfully directs attention and action, mobilizes energy expenditure, prolongs maintenance of effort, and motivates people to develop self-regulation strategies for success (29,30). Carver and Scheier's control theory (31) proposes that setting goals, monitoring behavior, receiving feedback, and reviewing relevant goals in the light of feedback are central to self-management and behavioral control. Previous systematic reviews have reported that interventions incorporating goal-setting may improve the frequency and duration of exercise, as well as attendance at exercise sessions, among older adults with OA and other chronic musculoskeletal conditions (13,32). However, our recent systematic review found no studies that specifically evaluated the effectiveness of goal setting and review to increase adherence to exercise (14). Findings from a large randomized trial examining goal setting and review as part of an adherence enhancing toolkit (33) will soon be available. Outcomes of this and other similar studies will be very useful in establishing whether these BCTs do increase adherence to exercise.

The perceived effectiveness of 2 BCTs was notably different between respondent groups. Followup sessions >3 months after the initial session had the 5th highest perceived effectiveness rating score by people with knee OA, and the 19th highest by the physical therapists. This finding is consistent with previous qualitative interviews which have reported that people with knee OA want more time with clinicians, while some health professionals consider regular followup sessions to be inappropriate use of their time (34). Moderate

quality meta-analysis evidence supports the use of booster sessions to increase adherence to exercise (14). The use of booster sessions provides ongoing contact and reinforcement, both of which are recognized as facilitators to exercise adherence in this population (12). Referral or encouragement to join a group exercise class had the highest perceived effectiveness score among physical therapists, yet was rated 25th of the 36 techniques by people with knee OA. This difference may reflect physical therapists' awareness of the constraints of the health care system, and the need to consider cost-effectiveness of interventions. Physical therapists may also be more aware of the additional social and psychological benefits of group exercise. Cochrane review evidence has found positive and statistically similar outcomes in terms of pain and function between individual and class-based exercise programs (4); however, attendance at sessions has been found to be significantly higher with individual rehabilitation when compared to group rehabilitation classes (35). Alternatively, clinicians may feel poorly equipped to implement BCTs themselves and view referral to an exercise class as a method of providing ongoing support. Previous qualitative interviews have highlighted clinicians' perceived difficulty in helping patients make lasting changes to their behavior and identified gaps in clinician knowledge and skills surrounding behavior change (34,36). Concerningly, these studies also identified a strong belief among some physical therapists that adherence to exercise was the patient's own responsibility, not an issue that needed to be addressed together (36).

Given the vast array of factors known to influence exercise adherence in people with OA (12,27,28,37,38), no single BCT is likely to be effective at increasing and maintaining adherence to exercise in all people, all of the time. The World Health Organization acknowledges this fact and advocates the use of an adherence toolkit (23) which includes multiple BCTs that can be selected to suit the individual. Our findings provide insight into the BCTs perceived to be most effective by people with knee OA. These findings should be used in combination with randomized trial and systematic review evidence by clinicians and researchers in compiling and testing a patient-centered adherence toolkit.

Strengths of our study include the use of a theory-based taxonomy of BCTs and the inclusion of large samples of both people with knee OA and physical therapists who treat this patient group. This study also has a number of limitations. The networks of the study team were used for recruitment of both physiotherapists and people with knee OA, potentially introducing social desirability bias; however, we aimed to minimize this bias by anonymous completion

of the survey. Given that most respondents with knee OA and physiotherapists were ultimately recruited via social media, this source of potential bias is further minimized. Response bias may be present as survey completion was voluntary in response to advertisements. As a result we do not know the response rate, and whether nonresponders would have answered differently to those who did complete the survey.

Although we did not record the geographical location of our respondents, it is likely they represented a range of geographical areas in Australia and New Zealand, given that most people were recruited through social media advertising made available across both countries. Although it is not entirely clear how generalizable our sample of people with knee OA is to the wider population, our respondents were of a comparable age, sex, and pain level to those who participated in a UK survey of people with knee OA (25). Findings from our sample of physical therapists may not necessarily be generalizable to those working in Australian public health settings, given that most worked exclusively in private practice. How generalizable our findings are to physical therapy practice elsewhere in the world is also not clear. Compared to responders to a UK survey (19), a higher proportion of physical therapist responders to our survey worked exclusively in private practice (68% versus 23%), and more treated people with knee OA at least once per week (53% versus 33%). Use of therapeutic exercise in managing knee OA was lower (78% said they would usually or always prescribe exercise to people with knee OA) among our cohort than has been reported in other surveys of physical therapist practice (19, 39–41). However, comparing responses is difficult, as none of those studies took place in Australia or New Zealand, so therefore differences in health care settings may exist, and the questions asked had different wording to those questions in our survey.

As the survey was completed online, results may not be generalizable to people who do not have access to the Internet, or are not confident using such technology. However, given that 94% of Australian households owned a computer and 86% had high-speed internet access in 2015 (42), our results are probably generalizable to most people. Completion of the survey sections relating to knee OA consultations, experience, and use of exercise and BCTs was dependent on respondent recall, which can decline with time, leading to inaccurate recollection. People with knee OA were provided with the list of BCTs when asked to recall which BCTs they had experienced. This approach has the potential to facilitate over-reporting. We felt it inappropriate to expect people with knee OA to know what BCTs were,

and recall any/all they had experienced in their own words without prompting. Presentation of the list of 36 BCTs in the survey (once for physiotherapists and twice for the people with knee OA) could introduce respondent fatigue and the potential for order bias. However, this possibility did not appear to be a factor, given that BCTs shown towards the end of the survey revealed similar use and were rated as being as effective as those presented at the beginning of the list. The survey contained a limited number of questions. Questions did not explore specifically what type of exercise was given when prescribed and preferences towards other BCTs targeting adherence to exercise. Our survey data were collected in Australia and New Zealand, and our findings may not necessarily reflect the attitudes of people with knee OA living in other countries, particularly countries where attitudes towards OA management and exercise may differ, or where health professionals classified as primary contact practitioners may vary.

Our study has highlighted a number of areas for clinical practice and future research. Our findings indicate that the most commonly used BCTs are not those that are perceived to be most effective, nor those with evidence to support their effectiveness. Qualitative research has identified common gaps in physical therapist knowledge and skills surrounding behavior change (36). Providing targeted training related to behavior change theory and techniques may improve therapist confidence and skills in using BCTs to help people with knee OA adhere to exercise programs (36). The conduct of further randomized controlled trials incorporating goal setting and regular review of progress towards goals should be a research priority. Similarly, in clinical practice, goal setting should be promoted for incorporation into clinical consultations.

AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Ms Nicolson had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study conception and design. Nicolson, Hinman, French, Lonsdale, Bennell.

Acquisition of data. Nicolson.

Analysis and interpretation of data. Nicolson, Hinman, Bennell.

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Figure 1. The 5 behavior change techniques rated to be the most effective at increasing exercise adherence by people with knee osteoarthritis (OA), with corresponding physical therapist rankings. Each technique was rated on an 11-point Likert scale (where 0 = strongly disagree and 10 = strongly agree) in response to the statement “I think this would be an effective way to help me/my patients with knee OA to adhere to my/their exercise program.” Ranking were based on mean score.

Figure 2. The 5 behavior change techniques rated to be the most effective at increasing exercise adherence by physical therapists, with corresponding rankings by people with knee osteoarthritis (OA). Each technique was rated on an 11-point Likert scale (where 0 = strongly disagree and 10 = strongly agree) in response to the statement "I think this would be an effective way to help me/my patients with knee OA to adhere to my/their exercise program." Ranking were based on mean score.
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Table 1. Demographic and clinical characteristics of respondents*	
Characteristic	**Value**
People with knee OA (n = 230)	
Age, mean ± SD years	60.9 ± 6.9
Women	135 (59)
Symptom duration, mean ± SD years	8.5 ± 6.6
Bilateral symptoms	161 (70)
Average pain in knee over past week (0–10 NRS), mean ± SD	5.8 ± 1.9
Exercise prescription by health professionals consulted for knee OA	
Physical therapist (physiotherapist)	84 (76)
Exercise physiologist/exercise instructor/personal trainer	22 (61)
General practitioner (family physician)	18 (10)
Orthopedic surgeon	18 (15)
Sports physician	7 (23)
Chiropractor	6 (18)
Osteopath	2 (11)
Occupational therapist	2 (18)
Podiatrist	2 (4)
Rheumatologist	1 (5)
Physical therapists (n = 143)	
Age, mean ± SD years	33.8 ± 9.4
Women	95 (66)
Postgraduate qualifications	68 (48)
Current workplace	
Private health setting	98 (68)
Public health setting	28 (20)
Combination of public and private	17 (12)
Frequency treating people with knee OA	
Very infrequently: 1 in the past 6 months	4 (3)
Infrequently: 2–5 in the past 6 months	29 (20)
Somewhat frequently: at least 1 per month	35 (24)
Frequently: at least 1 per week	47 (33)

Very frequently: ≥5 per week	28 (20)
Frequency prescribing exercise in knee OA treatments	
Never	20 (14)
Occasionally	4 (3)
To approximately 50% of patients	7 (5)
Usually	20 (14)
Always	92 (64)

* Values are the number (%) unless indicated otherwise. OA = osteoarthritis; NRS = numeric rating scale.

Table 2. Behavior change techniques experienced by people with knee OA who had been prescribed exercise by a health professional (n = 121)*

Behavior change technique	No. (%)
Explanation of the potential benefits of exercise specific to you	61 (50)
Printed educational materials about the benefits of exercise for knee OA	48 (40)
Use of a plan stating how often to exercise, and specifically what to do	38 (31)
Written instructions of the exercise program	37 (31)
Development of specific goals related to the exercise program	35 (29)
Review of progress in terms of pain and function at followup sessions	32 (27)
Review of exercise goals at followup session	30 (25)
Development of specific goals related to your knee pain and function	28 (23)
A program of exercises that are graded in intensity or difficulty (i.e., getting progressively harder over time)	28 (23)
Review, supervision, and correction of exercise technique at subsequent treatment sessions	24 (20)
Followup sessions >3 months after the initial session, to check on the exercises and progress the program as necessary	15 (12)
Referral to a website for information about the benefits of exercise for knee OA	14 (12)
A written home exercise diary or log book to record exercise practice sessions	14 (12)
Referral or encouragement to join group exercise classes	12 (10)
Followup via phone call from a health professional	11 (9)
Discussion of time management techniques to fit exercise in to each day	11 (9)
Encouragement to reflect on a time when you have been diligent with exercising, and how this positively affected you	11 (9)
Questioning and discussion about what it is that prevents you from adhering to the exercise program	9 (7)
Use of stress management techniques to help reduce anxiety and stress	8 (7)
Referral or encouragement to undertake individual exercise under the supervision of another health professional	7 (6)
Involvement of partner or family to join in with exercising and work together	6 (5)
A written plan of action if you are struggling to continue with the exercises as prescribed	6 (5)

Encouragement to use self-rewards for progress towards goals	4 (3)
Encouragement to enlist other people to help keep doing the exercise program	4 (3)
Use of a daily pain and function diary to monitor effect of exercise on pain and daily tasks	3 (2)
Audio-only instructions/demonstrations of the exercise program	3 (2)
Encouragement to use cues to prompt exercises (i.e., certain times of day)	3 (2)
Encouragement to imagine yourself doing the exercises with ease	3 (2)
Video instructions/demonstrations of the exercise program in the form of a DVD/link to website	2 (2)
Reminders to do the exercises via text message from the therapist	2 (2)
An app (for mobile or tablet) with video demos of the exercise program and an exercise diary	2 (2)
Encouragement to think about the example they are setting for others by exercising (e.g., family)	2 (2)
Encouragement to use self talk during exercise	2 (2)
Video demonstrations of you performing the exercises recorded by the therapist (e.g., on mobile phone)	1 (1)
Reminders to do the exercises via a website or app for mobile or tablet	1 (1)
An exercise contract signed by you stating how often you will exercise, and specifically what to do	1 (1)

* Behavior change techniques based on the Coventry, Aberdeen, and London–Refined taxonomy (22). OA = osteoarthritis.

Table 3. Techniques currently or previously used by physical therapists to promote adherence to exercise programs prescribed to people with knee osteoarthritis (n = 123)*

Technique	No. (%)
Education about the benefits of exercise for knee osteoarthritis	48 (39)
Written instructions of the exercises	48 (39)
Involving patient in exercise program design	41 (33)
Followup appointments to review exercises and adherence	34 (28)
Referral to a group exercise class	27 (22)
Use of an exercise diary to be completed at home	25 (20)
Setting goals with the individual	19 (15)
Education about osteoarthritis	16 (13)
Non-specific education	14 (11)
Advice about use of cues/reminders to prompt exercise completion	13 (11)
Keeping the number of exercises to a minimum	10 (8)
Encouragement to keep going with the exercises	5 (4)
Video demonstrations of patient performing the exercises	5 (4)
Pacing strategies	5 (4)
Positive reinforcement	3 (2)
Use of an exercise contract completed by patient and clinician	2 (2)
Encourage patient to use a rewards chart	2 (2)
Use of an app that includes exercise instructions and a diary	2 (2)

Table 4. Agreement with effectiveness of behavior change techniques at increasing and maintaining exercise adherence*

Behavior change technique	Knee OA patients (n = 230)	Physical therapists (n = 143)
Review/followup		
Review of progress in terms of pain and function at followup sessions	6.6 (6.3–6.9)	8.2 (7.9–8.6)
Review, supervision, and correction of exercise technique at subsequent treatment sessions	6.4 (6.1–6.8)	8.5 (8.1–8.8)
Followup booster sessions >3 months after the initial session with the health professional	6.4 (6.1–6.8)	7.4 (7.0–7.9)
Review of exercise goals at followup session	6.4 (6.0–6.7)	8.3 (8.0–8.5)
Followup via phone call from a health professional	5.2 (4.8–5.6)	7.5 (7.2–7.9)
Goal setting		
Use of a plan stating how often to exercise, and specifically what to do	6.5 (6.2–6.9)	8.2 (7.9–8.6)
Development of specific goals related to your/the patient's knee pain and function	6.4 (6.1–6.8)	8.3 (7.9–8.7)
Development of specific goals related to the exercise program	6.3 (6.0–6.7)	8.2 (7.9–8.5)
An exercise contract provided by the therapist/you and signed by you/the patient stating how often you/they will exercise, and specifically what to do	3.9 (3.5–4.2)	4.8 (4.4–5.2)
Education about benefits		
Explanation of the potential benefits of exercise specific to you/the patient	6.1 (5.8–6.5)	8.3 (7.9–8.6)
Printed educational materials about the benefits of exercise for knee OA	5.3 (5.0–5.7)	7.6 (7.2–8.0)
Referral to a website for information about the benefits of exercise for knee OA	4.9 (4.5–5.3)	5.9 (5.5–6.3)
Exercise instruction		

Video instructions/demonstrations of the exercise program in the form of a DVD/link to website	5.9 (5.6–6.3)	7.5 (7.2–7.9)
A program of exercises that are graded in intensity or difficulty (i.e., getting progressively harder over time)	5.7 (5.3–6.0)	8.0 (7.7–8.4)
Audio-only instructions/demonstrations of the exercise program	5.6 (5.3–6.0)	4.6 (4.2–5.0)
Written instructions of the exercise program	5.6 (5.2–6.0)	7.4 (7.1–7.7)
Referral or encouragement to undertake individual exercise under the supervision of another health professional, e.g., gym instructor	5.2 (4.8–5.6)	7.2 (6.8–7.6)
Referral or encouragement to join group exercise classes	4.8 (4.5–5.2)	8.6 (8.3–8.9)
Video demonstrations of you/the patient performing the exercises recorded by the therapist (e.g., on mobile phone)	4.4 (4.0–4.8)	7.7 (7.3–8.0)
Involvement of partner or family to join in with exercising and work together	4.3 (3.9–4.7)	7.5 (7.1–7.8)
Barrier identification/planning		
Questioning and discussion with you/the patient about what it is that prevents you/them from adhering to the exercise program	5.7 (5.4–6.0)	8.0 (7.7–8.4)
A written plan of action if you are/the patient is struggling to continue with the exercises as prescribed	5.5 (5.1–5.8)	7.0 (6.7–7.4)
Self-monitoring		
An app (for mobile or tablet) with video demonstrations of the exercise program and an exercise diary	5.5 (5.1–5.9)	7.5 (7.2–7.9)
A written home exercise diary or log book to record exercise sessions	5.3 (4.9–5.6)	7.2 (6.8–7.6)
Use of a daily pain and function diary to monitor effect of exercise on pain and daily tasks	5.2 (4.8–5.6)	6.5 (6.2–6.9)

Encouragement to use self-rewards for progress towards goals	5.0 (4.6–5.3)	7.2 (6.8–7.5)
Self-management education		
Encouragement to reflect on a time when you/the patient have been diligent with exercising, and how this positively affected you/them	5.2 (4.8–5.6)	6.5 (6.1–7.0)
Use of stress management techniques (e.g., progressive relaxation) to help reduce anxiety and stress	5.0 (4.6–5.4)	6.4 (6.0–6.8)
Discussion of time management techniques to fit exercise in to each day	4.7 (4.3–5.1)	7.2 (6.8–7.6)
Encouragement to imagine doing the exercises with ease	4.1 (3.8–4.4)	5.6 (5.2–6.0)
Encouragement to enlist other people to help keep doing the exercise program	4.1 (3.7–4.4)	6.8 (6.4–7.2)
Encouragement to use self-talk during exercise	3.9 (3.5–4.2)	5.3 (4.9–5.7)
Encouragement to think about the example you/they are setting for others by exercising	3.6 (3.3–3.9)	5.5 (5.0–5.9)
Prompts		
Encouragement to use cues to prompt exercises (i.e., certain times of day)	4.5 (4.1–4.9)	7.5 (7.2–7.8)
Reminders to do the exercises via text message from the physiotherapist	4.3 (3.9–4.7)	5.9 (5.5–6.3)
Reminders to do the exercises via a website or app for mobile or tablet	4.0 (3.7–4.5)	7.0 (6.6–7.3)

* Values are the mean (95% confidence interval). Each technique was rated on an 11-point Likert scale (where 0 = strongly disagree and 10 = strongly agree) in response to the statement "I think this would be an effective way to help me/my patients with knee OA to adhere to my/their exercise program."