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Osteoarthritis and Cartilage



Recommendations for the delivery of therapeutic exercise for people with knee and/or hip osteoarthritis. An international consensus study from the OARSI Rehabilitation Discussion Group



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SUMMARY

Objective: To develop evidence-informed recommendations to support the delivery of best practice therapeutic exercise for people with knee and/or hip osteoarthritis (OA).

Design: A multi-stage, evidence-informed, international multi-disciplinary consensus process that included:

- 1) a narrative literature review to synthesise existing evidence;
- 2) generation of evidence-informed proposition statements about delivery of exercise for people with knee and/or hip OA by an international multi-disciplinary expert panel, with statements refined and analysed thematically;
- 3) an e-Delphi survey with the expert panel to gain consensus on the most important statements;
- 4) a final round of statement refinement and thematic analysis to group remaining statements into domains.

Results: The expert panel included 318 members (academics, health care professionals and exercise providers, patient representatives) from 43 countries. Final recommendations comprised 54 specific proposition statements across 11 broad domains: 1) use an evidence-based approach; 2) consider exercise in the context of living with OA and pain; 3) undertake a comprehensive baseline assessment with follow-up; 4) set goals; 5) consider the type of exercise; 6) consider the dose of exercise; 7) modify and progress exercise; 8) individualise exercise; 9) optimise the delivery of exercise; 10) focus on exercise adherence; and 11) provide education about OA and the role of exercise.

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Conclusion: The breadth of issues identified as important by the international diverse expert panel highlights that delivering therapeutic exercise for OA is multi-dimensional and complex.

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Introduction

Osteoarthritis (OA), particularly of the knee and hip, is a leading cause of pain and disability, with estimates suggesting that 528 million people are currently affected globally¹. The prevalence of OA increased by 9.3% between 1990 and 2017¹, and its burden is expected to continue growing due to the ageing, increasingly obese population². In addition to high personal burden, the cost implications associated with knee and hip OA are considerable, both in terms of health care costs (including a high number of primary healthcare visits and total knee/hip replacements) and non-healthcare-related costs (e.g., productivity losses and formal/informal care)³. The overall societal cost of OA could be between 0.25% and 0.50% of a country's Gross Domestic Product (GDP)³. As there is no cure for OA, treatments that reduce symptoms and slow functional decline should be the focus of care and future research⁴.

Multiple international clinical guidelines recommend therapeutic exercise as a first line treatment for knee and hip OA^{5–7}. These are supported by an extensive evidence base of randomised controlled trials (RCTs) and systematic reviews that highlight varied clinical benefits from therapeutic exercise (e.g., pain reduction, improved physical function, increased quality of life^{8,9}), in addition to demonstrating it to be a cost-effective treatment¹⁰.

Despite this, health care professionals often deliver therapeutic exercise in a non-standardised and sub-optimal manner^{11–13}. This may be, in part, due to their beliefs. Among some health care professionals, OA is perceived as a low priority disease with expected progression to inevitable joint replacement surgery. Some also lack interest in therapeutic exercise for OA and are uncertain about its effectiveness and safety¹⁴. Others report a lack of knowledge and training about how to provide physical activity advice, and how to prescribe therapeutic exercise for people with musculoskeletal pain more generally¹⁵.

There is very little guidance for health care professionals and exercise providers about how to effectively deliver best practice therapeutic exercise for people with knee and/or hip OA. Existing recommendations are either outdated or offer limited specific information or practical resources relevant to the delivery of exercise in clinical practice (e.g., 16,17). For example, there is limited or no guidance on how to best prescribe exercise, the optimal 'dose' of therapeutic exercise, how to optimise potential outcomes from exercise, or how to maintain any improvements with exercise over time. As the second in a series of projects designed to address this gap by the Osteoarthritis Research Society International (OARSI) Rehabilitation Discussion Group, we aimed to develop evidence-informed recommendations to support the delivery of best practice therapeutic exercise by health care professionals and exercise providers, for people with knee and/or hip OA.

Method

A multi-stage, evidence-informed, international multi-disciplinary consensus process was used to develop the recommendations, overseen by an international, multi-disciplinary taskforce. The taskforce included 17 members with expertise in OA and therapeutic exercise, representing different disciplines (including

medicine, physical therapy, health science, and patient experience), and five different countries (Australia, Belgium, Denmark, United Kingdom and United States of America). It comprised of members of the OARSI Rehabilitation Group Steering Committee, two patient representatives from Australia, and members of the OARSI Rehabilitation Discussion group invited to sit on the taskforce following an open call (recruited purposively to ensure maximum diversity in country of work, discipline, and level of research experience). Ethical approval was gained from the University of Melbourne [1955859.1]. Four stages were included in the consensus process, including: 1) evidence synthesis; 2) statement generation; 3) consensus via e-Delphi survey; and 4) development of the final set of recommendations (Fig. 1).

Stage 1: Evidence synthesis

A literature search was initially completed to identify recent systematic reviews, meta-analyses and guideline recommendations relating to therapeutic exercise for knee and/or hip OA, and current key general physical activity recommendations for activity frequency. The existing literature was narratively summarised and is published elsewhere¹⁸.

Stage 2: Statement generation

Informed by the evidence synthesis, proposition statements about delivery of best practice therapeutic exercise for knee and/or hip OA were developed by an international, multi-disciplinary panel of experts that included researchers (academics and clinical academics), healthcare professionals and exercise providers, and people with knee and/or hip OA who met the inclusion criteria outlined in Table I.

Sampling for the panel of experts

A broad range of potential panel members with different backgrounds from different countries were targeted by electronic snowball sampling. Sampling techniques consisted of: taskforce members emailing invitations to their academic, research, clinical and patient representative networks; email advertisements being sent to the membership lists of OARSI and the OARSI Rehabilitation Discussion Group; advertisements placed on social media (e.g., Facebook, Twitter); and potential panel members being encouraged to send the invitation to colleagues who they thought might be eligible and interested in participating. There was no maximum number of panel members, however we aimed for a panel consisting of at least 160 members for sufficient responses to the e-Delphi consensus process outlined in Stage 3 below.

Data collection

Potential panel members were instructed to access an electronic survey using REDCap software between 1st August 2020 and 30th September 2020. The first questions screened for eligibility, and those who were eligible and provided informed consent became expert panel members. Panel members were asked to watch a short (10 min) video embedded in the electronic survey that summarised the key findings of the narrative review completed in Stage 1

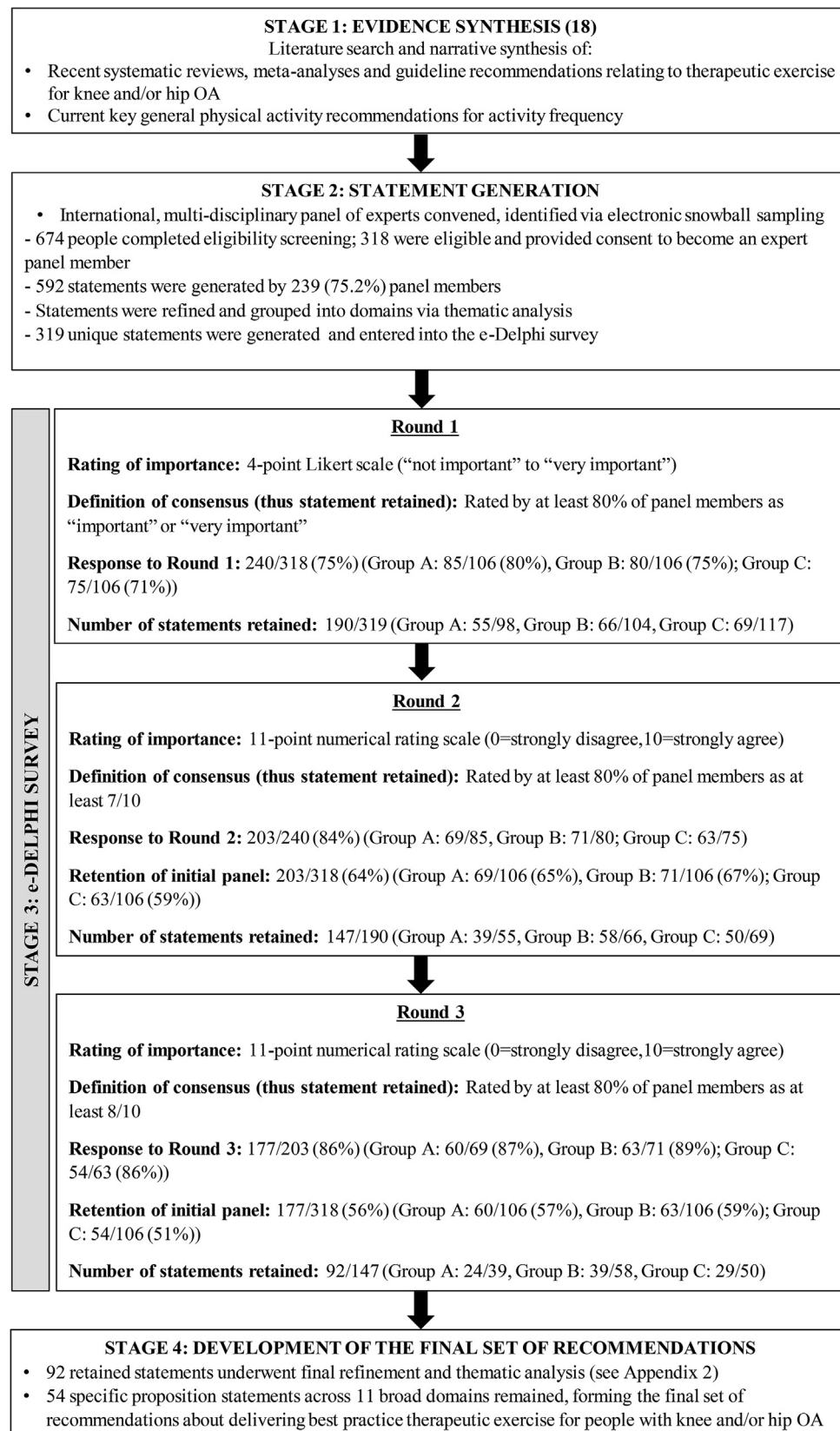


Fig. 1

	Inclusion criteria
Researchers/academics	First or last author on at least one systematic review or randomised controlled trial of therapeutic exercise for knee or hip or Invited to give a plenary or keynote presentation on exercise for knee or hip OA at an international conference in the last 5 years
Health care professionals and exercise providers (e.g., exercise physiologist)	Currently registered to practice as a health professional or exercise provider and Have treated, on average, at least one patient with knee or hip OA per week over the past 6 months with therapeutic exercise.
People with knee and/or hip OA	Experience of therapeutic exercise for their OA

Table 1

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Inclusion criteria to become an international multi-disciplinary panel member

(<https://www.youtube.com/watch?v=dDlCkGUrziI>). Considering the existing evidence-base, each panellist was asked to generate up to 10 statements about delivering best practice therapeutic exercise for people with knee and/or hip OA by completing the following seeding statement (the wording of which was finalised following piloting with 10 researchers (academics/clinical academics), health care professionals and exercise providers, and people with knee and/or hip OA):

“When implementing therapeutic exercise for people with hip and/or knee osteoarthritis, health professionals and exercise providers should ...”

Survey questions also gathered demographic information (age, gender, discipline, country of residence, years of experience) to allow us to describe the panel of experts.

Data analysis

Data were collated and analysed in Microsoft Excel (version 2018). Descriptive statistics were used to summarise the expert panel members' demographic characteristics. The content of proposition statements was analysed qualitatively via thematic analysis¹⁹. Firstly, all statements were reviewed by one researcher (either MH, BM, BL) for clarity. Ambiguous statements were removed, statements not written in English were translated via Google Translate, those that were grammatically incorrect were re-structured, and those that contained multiple constructs were split into individual statements. Secondly, a preliminary coding framework was developed. Statements were read and re-read to identify and code those that represented particular concepts. Using principles of constant comparison, statements were closely examined for similarities and differences. Duplicate statements were removed, and those that represented similar concepts were grouped into domains¹⁹. Emerging codes and domains were discussed and agreed between MH, BM, and BL until the preliminary coding framework was developed. This was checked for credibility with the taskforce and then applied to all statements by either MH, BM, and BL with ongoing refinement as needed.

Once all statements had been appropriately coded, they were sorted according to domains. A second round of statement refinement then commenced (including removal of duplicate and ambiguous statements, and re-structuring of statements where

necessary for utmost clarity and consistency in language). One taskforce member (one of MH, BM, BL, EC, LT, EW, NC, HM, KB) refined all statements within a specific domain. A second taskforce member then checked their decision making to protect against unintentional personal bias²⁰ and to ensure that any re-wording for clarity did not change the initial meaning of a statement. Disagreements were resolved between the two taskforce members, with input from MH if needed.

All remaining statements were read, re-read and constantly compared by MH to remove statements duplicated in different domains (checked by BM). The remaining statements and the domains applied were checked for credibility by the taskforce before being taken into Stage 3.

Stage 3: Consensus via e-Delphi survey

To reach consensus on the most important proposition statements, an e-Delphi survey was conducted using REDCap software between February and May 2021, with the established international, multi-disciplinary panel of experts. Based on the methods previously used by Hinman *et al.*²¹, the e-Delphi survey was completed iteratively over three rounds, approximately 2 weeks apart. Each round was open for 2 weeks, with three reminder emails sent over that time to non-responders to encourage completion. For subsequent e-Delphi rounds, only panel members who had completed the preceding e-Delphi round were emailed the survey.

Due to the large number of statements brought forward from Stage 2, to minimise burden and maximise response, the panel of experts was randomly divided into three groups (Group A, Group B or Group C), stratified according to panel member discipline. Each group of panel members reviewed approximately 100 statements, and then re-rated the same statements in subsequent rounds.

Round 1

In Round 1, panel members were asked to rate each statement as being either: 'not important'; 'somewhat important'; 'important'; or 'very important' for ALL individuals with knee and/or hip OA. Statements that reached consensus (defined by at least 80% of the panel rating the statement as important or very important) were retained for further consideration in Round 2.

Round 2

In Round 2, the panel were asked to reconsider and rate the statements retained from Round 1, for importance for ALL individuals with knee and/or hip OA on an 11-point numerical rating scale (ranging from 0 = strongly disagree to 10 = strongly agree). Summary panel data from Round 1 (presented as *n* (%) across response categories) were provided against each statement to assist

in this process. Only statements that achieved a consensus (at least 80% of Panel) rating of seven or more were retained for Round 3.

Round 3

In round 3, the panel were presented with statements retained from round 2 with their corresponding summary panel data (presented as: *n* (%) across response categories). Panel members were

	Total panel members	Health care professionals and exercise providers	Researchers/clinical academics*	People with knee and/or hip OA
Expertise of expert panel member, <i>n</i> (%)	318	139 (43.7%)	135 (42.5%)	44 (13.8%)
Gender, <i>n</i> (%)				
Male	161 (50.6%)	73 (52.5%)	72 (53.3%)	16 (36.4%)
Female	156 (49.1%)	65 (46.8%)	63 (46.7%)	28 (63.6%)
Chose not to say	1 (0.3%)	1 (0.7%)	0 (0%)	0 (0%)
Age, <i>n</i> (%)				
≤30 years	40 (12.6%)	30 (21.6%)	10 (7.4%)	0 (0%)
31–50 years	178 (56%)	88 (63.3%)	88 (65.2%)	2 (4.5%)
51–70 years	84 (26.4%)	20 (14.4%)	36 (26.7%)	28 (63.6%)
>70 years	16 (5%)	1 (0.7%)	1 (0.7%)	14 (31.8%)
Country of residence, <i>n</i> (%)				
Australia	69 (21.7%)	35 (25.2%)	16 (11.9%)	18 (40.9%)
United Kingdom	39 (12.3%)	18 (12.9%)	14 (10.4%)	7 (15.9%)
Canada	36 (11.3%)	16 (11.5%)	7 (5.2%)	13 (29.5%)
United States of America	35 (11%)	12 (8.6%)	22 (16.3%)	1 (2.3%)
Denmark	15 (4.7%)	3 (2.2%)	10 (7.4%)	2 (4.5%)
India	13 (4.1%)	3 (2.2%)	10 (7.4%)	0 (0%)
Ireland	8 (2.5%)	6 (4.3%)	1 (0.7%)	1 (2.3%)
Brazil	7 (2.2%)	6 (4.3%)	1 (0.7%)	0 (0%)
South Africa	7 (2.2%)	5 (3.6%)	1 (0.7%)	1 (2.3%)
Portugal	6 (1.9%)	3 (2.2%)	3 (2.2%)	0 (0%)
China	6 (1.9%)	1 (0.7%)	5 (3.7%)	0 (0%)
Other (32 countries†)	77 (24.2%)	31 (22.3%)	45 (33.3%)	1 (2.3%)
Type of health professional/exercise provider, <i>n</i> (%)				
Physiotherapist/physical therapist		117 (84.2%)	58 (43%)	
Orthopaedic surgeon		4 (2.9%)	9 (6.7%)	
Exercise physiologist		5 (3.6%)	0 (0%)	
Chiropractor		2 (1.4%)	2 (1.5%)	
General practitioner/family physician		2 (1.4%)	2 (1.5%)	
Rehabilitation Physician/physiatrist		2 (1.4%)	1 (0.7%)	
Rheumatologist		1 (0.7%)	1 (0.7%)	
Sport and Exercise Medicine Physician		2 (1.4%)	0 (0%)	
Occupational therapist		1 (0.7%)	0 (0%)	
Exercise scientist		0 (0%)	1 (0.7%)	
Other		3 (2.2%)	2 (1.5%)	
Years researching OA, <i>n</i> (%)				
≤10 years			73 (54.1%)	
11–20 years			40 (29.6%)	
21–30 years			19 (14.1%)	
>30 years			3 (2.2%)	
Years clinical practice, <i>n</i> (%)				
≤10 years		58 (41.7%)	27 (20%)	
11–20 years		53 (38.1%)	25 (18.5%)	
21–30 years		18 (12.9%)	19 (14.1%)	
>30 years		10 (7.2%)	5 (3.7%)	
Years OA symptoms, <i>n</i> (%)				
≤10 years				13 (29.5%)
11–20 years				14 (31.8%)
21–30 years				10 (22.7%)
>30 years				7 (15.9%)

* Clinical academics = academics/researchers who also work within a clinical role (*n* = 76).

† Including Austria, Belgium, Brunei, Chile, Colombia, Ecuador, Egypt, Finland, France, Germany, Ghana, Greece, Hungary, Indonesia, Israel, Japan, Kenya, Malaysia, Netherlands, New Zealand, Norway, Philippines, Romania, Saudi Arabia, Singapore, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, United Arab Emirates.

Table II

Demographic characteristics of responders to the survey who were eligible and provided content to become an expert panel member

asked to rate each statement using the same numerical rating scale as round 2. Only statements that achieved a consensus (at least 80% of Panel) rating of eight or more were retained for inclusion in the final set of recommendations²¹.

Stage 4: Development of the final set of recommendations

The remaining statements underwent final refinement and thematic analysis¹⁹. With continuous input from Taskforce members, MH closely scrutinised all remaining statements, removed ambiguous statements and merged closely related statements (checked by BM), and refined and reapplied the coding framework. Domains that represented concepts within the remaining statements formed the broad recommendations about how to deliver best practice therapeutic exercise for people with knee and/or hip OA. Statements grouped within each domain were retained to provide more detailed information related to each recommendation.

Results

Response

In total, 674 people completed the eligibility screening. Of those 318 were eligible and provided consent to become an expert panel member. One hundred and thirty-nine (43.7%) panel members were healthcare professionals or exercise providers spanning at least 10 disciplines, although the majority were physical therapists ($n = 117$, 84.2%). One hundred and thirty-five panel members (42.5%) were academic or clinical academic researchers, and 44 (13.8%) panel members were patient representatives. The majority of patient representatives had experienced OA symptoms for 11 years or longer ($n = 31$, 70.4%). Panel members resided in 43 different countries, most commonly Australia ($n = 69$, 21.7%) and the United Kingdom ($n = 39$, 12.3%) (see [Table II](#)).

In total, 261 (82.1%) expert panel members watched the video summarising the existing evidence base for therapeutic exercise for knee and/or hip OA, and 239 (75.2%) provided at least one proposition statement. All 318 panel members were invited to participate in Round 1 of the e-Delphi, irrespective of whether they had generated a proposition statement or not. We retained 240 panel members for Round 2 and 203 panel members for Round 3. This represented 75% and 64% of the initial panel, respectively. In Round 3, a response was obtained from 177 out of the 203 remaining panel members. This represented 56% of the original panel (see [Fig. 1](#)). Demographic characteristics were broadly similar between panel members that did ($n = 280$) and did not ($n = 38$) participate in the study (i.e., provided at least 1 proposition statement and/or responded to at least one round of the e-delphi survey), and panel members who were randomised to Group A, B and C ($n = 106$, respectively) (see [Appendix 1](#)). Demographic characteristics of panel members were also broadly similar at each stage of the e-Delphi survey (see [Appendix 1](#)).

Generation of proposition statements and recommendations

In total, 592 statements were generated. Following the removal of duplicate or ambiguous statements, 319 statements were entered into the first round of the e-Delphi survey. Of the 319 statements that were entered into the e-Delphi, 190 were retained after Round 1, 147 were retained after Round 2 and 92 were retained after Round 3. [Fig. 1](#) summarises the outcomes of each e-Delphi Round.

Following a final stage of statement refinement and thematic analysis ([Appendix 2](#)), 54 specific proposition statements across 11

broad domains remained, forming the final set of recommendations. Domains covered in the recommendations include: 1) use an evidence-based approach ($n = 1$ statement); 2) consider exercise in the context of living with OA and pain ($n = 5$); 3) undertake a comprehensive baseline assessment with follow-up ($n = 5$); 4) set goals ($n = 5$); 5) consider the type of exercise ($n = 4$); 6) consider the dose of exercise ($n = 4$); 7) modify and progress exercise ($n = 5$); 8) individualise exercise ($n = 3$); 9) optimise the delivery of exercise ($n = 5$); 10) focus on exercise adherence ($n = 6$); and 11) provide education about OA and the role of exercise ($n = 11$). Specific statements within each domain are shown in [Table III](#) (and in [Appendix 3](#) as an infographic).

Discussion

This multi-stage, international multi-disciplinary consensus process has resulted in the most detailed and comprehensive recommendations to date to support health care professionals and exercise providers to deliver best practice therapeutic exercise for people with knee and/or hip OA. Informed by the existing evidence base¹⁸, a diverse group of international experts, including patient representatives, agreed that 54 proposition statements mapping to 11 different domains were important to consider. The breadth of domains deemed important by the panel highlights that the prescription of therapeutic exercise for OA is multi-dimensional and complex. This may help to explain why its current delivery in clinical practice can be suboptimal^{11–13}, and why outcomes from therapeutic exercise can be variable. Whilst some of the domains identified are included within existing recommendations (the need to consider the type and dose of exercise, individualise exercise based on assessment and follow-up, and assess and address exercise adherence)¹⁷, some have not been previously considered (the importance of optimising the delivery of exercise, the need to consider exercise prescription in the context of OA symptoms and pain), and not to the same level of detail as the methods of the current study have allowed. If adopted, these recommendations may therefore have the potential to better standardise the delivery of therapeutic exercise and bridge the gap between exercise provision and current clinical guidelines for OA¹¹.

The panel of experts agreed that a baseline assessment with follow-up was an important component of delivering best practice therapeutic exercise for knee and/or hip OA. The recommended content of the baseline assessment reflected the bio-psychosocial model²² and included identification of the individual's reported difficulties, physical limitations, functional restrictions and impact on participation, relevant psychosocial factors, the individual's overall health (including comorbidities), any underlying serious pathology and any contraindications or precautions to therapeutic exercise. Findings from the baseline assessment, along with follow-up, could then be used to inform the specific type, dose, individualisation, and progression and modification of therapeutic exercise.

In line with existing evidence that suggests benefits can be gained from many types of therapeutic exercise (e.g., [8,9,23](#)), no single type of exercise was recommended over another. Rather, experts agreed it is important that the type of exercise should be selected to directly address the impairments or functional limitations of the individual. To aid exercise participation, it was also recommended that exercise should be easy to reproduce at home and not rely on expensive equipment. Factors deemed important to consider when individualising exercise included the presence of comorbidities, pain severity, physical and cognitive ability to participate in the exercise, and ability to perform the exercise independently without supervision. These recommendations may, in part, reflect the current evidence base (that has identified comorbidity, pain and physical function as important considerations

-
- 1. Use an evidence-based approach**1.1. Take into consideration best available evidence.
-
- 2. Consider exercise in the context of living with osteoarthritis and pain**2.1. Ensure that the program promotes active self-management, and work with the individual to develop an osteoarthritis self-management plan that is sustainable in the long-term.
2.2. Empower the individual to have the skills and knowledge to self-manage their osteoarthritis now and in the future.
2.3. Be confident that a well-designed exercise program will not worsen the condition or prognosis of the individual.
2.4. Provide the individual with strategies for managing short-term increases in pain during and after exercise, including after exercise has been progressed or performed at a higher intensity.
2.5. Include a plan about how to modify the exercise program in response to an osteoarthritis flare up, so the individual is able to continue with the program.
-
- 3. Undertake a comprehensive baseline assessment with follow-up**3.1. Undertake a comprehensive baseline assessment to fully understand the individual's reported difficulties, physical limitations, functional restrictions and impact on participation, as well as any relevant psychosocial factors.
3.2. Check for red flags (indicating serious underlying pathology) and ensure that there are no contraindications to exercise.
3.3. Evaluate the individual's overall health (including comorbidities) and use this information to identify exercise precautions.
3.4. Establish baseline measurements and set targets to determine progress.
3.5. Monitor the individual's response to the exercise program over time.
-
- 4. Set goals**4.1. Collaborate with the individual to establish meaningful and mutually agreeable goals.
4.2. Set functional goals that promote participation in daily activities.
4.3. Create an exercise program that aligns with the individual's goals.
4.4. Communicate exercise goals clearly to the individual in terms of the type, frequency, intensity, time/duration of exercise.
4.5. Set realistic expectations about the outcomes of exercise, including timeframes.
-
- 5. Consider the type of exercise**5.1. Consider various kinds of exercise including aerobic, strengthening, neuromuscular training, flexibility training and balance training.
5.2. Select exercises that will directly address the impairments or functional limitations of the individual.
5.3. Provide a simple exercise program that relies on inexpensive and readily obtainable equipment, and can be easily reproduced at home.
5.4. Incorporate strategies to increase general physical activity levels for the individual if they are insufficiently physically active.
-
- 6. Consider the dose of exercise**6.1. Provide a sufficient dose of exercise (in terms of frequency, intensity, time/duration) to provide physiological benefits and clinically meaningful changes in line with the individual's goals.
6.2. Encourage the individual to exercise two or more times per week.
6.3. Determine an appropriate starting exercise dose for the individual.
6.4. Encourage a "long-term" rather than "episodic" approach to exercise participation.
-
- 7. Modify and progress exercise**7.1. Progress exercise appropriately for the individual, providing ways to incrementally increase or decrease the difficulty of the exercise.
7.2. Modify or progress exercises according to the individual's response (e.g., in response to an increase in muscle strength, or when the exercise has become too easy).
7.3. Progress the exercise program gradually, as long as the individual does not experience significant increases in pain or discomfort.
7.4. Modify exercise in response to any problem that the individual encounters (e.g., provide alternative exercises).
7.5. Provide clear guidance on when and how to modify and progress exercises.
-
- 8. Individualise exercise**8.1. Ensure that the exercise program is tailored to the individual, taking into consideration any co-existing medical conditions, their level of pain, their physical and cognitive ability to participate in exercise, and their ability to perform the exercise on their own without supervision.
8.2. Tailor the exercise program to the individual based on assessment findings.
8.3. Focus on "the whole person" and not just the affected joint(s).
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- 9. Optimise the delivery of exercise**9.1. Provide instructions that are easy to follow.
9.2. Ensure that the exercise program is well understood by the individual (e.g., ask them to give you a demonstration and provide feedback as necessary).
9.3. Ensure that the individual is confident in their ability to complete the exercise program.
9.4. Create a strong therapeutic alliance. Build trust with the individual.
9.5. Listen to the individual and encourage open dialogue. Allow the individual to ask questions at any time.
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- 10. Focus on exercise adherence**10.1. Motivate the individual to perform and adhere to the exercise program.
10.2. Address barriers and facilitators to exercise early, and work with the individual to develop personalised strategies to promote long-term adherence to their exercise program.
10.3. Ensure that the exercise program is achievable to enhance long-term adherence.
10.4. Provide the individual with feedback on performance and outcomes of exercise.
10.5. Be prepared with alternative options for the individual if adherence to the exercise program is challenging.
10.6. Look at ways that the individual can maintain the exercise program within the community when their treatment has been completed.
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- 11. Provide education about osteoarthritis and the role of exercise**11.1. Provide advice and education to every individual with osteoarthritis.
11.2. Educate the individual about osteoarthritis, helping them make sense of osteoarthritis and the symptoms they are experiencing from a patient-centred perspective.
11.3. Use a positive approach when educating the individual about osteoarthritis, with lay terminology that is not perceived as harmful, and that reduces fear of exercise.
11.4. Explain the importance of daily physical activity for long-term health.
11.5. Explain the purpose of exercise in the treatment of osteoarthritis.
11.6. Explain the benefits of exercise for improving pain and function, and that exercise is an effective way to cope with osteoarthritis.
11.7. Emphasise that the benefits of exercise for osteoarthritis come with consistent exercise participation over time, like taking a medication to manage other diseases.
11.8. Explain that participating in exercise is not associated with higher risk of joint damage or joint replacement, and that short-term pain with exercise does not indicate damage.
11.9. Ensure that the individual understands the difference between osteoarthritis pain flare ups and expected pain with exercise (e.g., muscle soreness).
11.10. Address any fears that the individual has that are related to exercise.
11.11. Address any misconceptions about the effectiveness of exercise, the safety of exercise and about pain with exercise.
-

for therapeutic exercise prescription^{17,24,25}), but also the personal experiences and views of the expert panel.

The panel also highlighted the importance of focussing on exercise adherence. This is in line with current literature, which suggests that adherence is crucial to achieve desired outcomes from therapeutic exercise²⁶. Although the existing evidence-base highlights many barriers and facilitators to therapeutic exercise in people with knee and/or hip OA²⁷, evidence supporting strategies to enhance adherence is inconsistent²⁶. Recommendations from our findings are to address barriers and facilitators to exercise early and use strategies to enhance adherence that are personalised. Linked to adherence, it was also recommended to set goals, a recognised technique for facilitating exercise behaviour change²⁸ that is considered effective by patients²⁹. There was consensus that goals should be mutually agreed, functional, and clearly communicated in terms of the type, frequency, intensity, time/duration or exercise. It was also agreed that goals should be set with realistic expectations about the anticipated outcomes from exercise, including time frames.

Specific to this population, experts agreed it was important that exercise should be considered in the context of living with OA and pain. This included empowering individuals with OA to have the knowledge and skills to self-manage their OA, providing strategies for managing short-term increases in pain during and after exercise, and including a plan about how to modify the exercise program in response to an OA flare-up. There is increasing recognition that 'acute-on-chronic' episodes and 'flare-ups' of more severe pain are a common part of the natural history of OA^{30,31} which, when present, can disrupt healthy behaviours, including undertaking therapeutic exercise³². Co-developing a plan about how to continue with a modified exercise program when a flare is present may therefore contribute to maintaining exercise adherence over the long term. However, this is currently untested and represents the expert opinion based on the panel's experience rather than existing evidence.

In line with international clinical guidelines (e.g., 5,6,7) and previous research²⁹, consensus was also reached on the importance of accompanying therapeutic exercise with education, and that the overall approach to delivering therapeutic exercise should be evidence-based. Going beyond the simple recommendation of education, the experts wished to highlight specific aspects of education that they considered particularly important. These included the need to help individuals make sense of OA and the symptoms they are experiencing from a patient-centered perspective, the role, and benefits of exercise and physical activity for OA and general health, the safety of exercise, the difference between OA pain flare-ups and expected pain with exercise (e.g., muscle soreness), and the need to address any misconceptions or fears about the role of exercise for OA. These are consistent with behaviour change theory^{33,34} and directly address known barriers to therapeutic exercise in OA²⁶. It was also agreed as important to adopt a positive approach when educating individuals about OA, using lay terminology that is not perceived as harmful and reduces fear of exercise.

Finally, the importance of optimising the delivery of therapeutic exercise was highlighted. This included providing easy-to-follow instructions, ensuring that the exercise programme is well understood, actively listening, and building a strong therapeutic alliance. Although the importance of the therapeutic alliance is recognised

within existing literature^{35,36}, how to deliver exercise is often poorly reported^{37,38}. These specific recommendations are therefore likely to be based on the personal views and experiences of panel members.

Strengths and limitations

This study has several strengths. Utilising both qualitative and quantitative components has enabled the development of rich, detailed recommendations³⁹, all of which are agreed as important by a multi-disciplinary international panel of experts. The size and diversity of our expert panel is also a strength, comprising 318 members, covering 43 different countries, and including academics, health care professionals and exercise providers (of at least 10 disciplines), and patient representatives. This helps to ensure that the recommendations are likely to apply to a broad range of countries and disciplines and are relevant to patients. Over 50% of our panel were retained throughout all three rounds of the e-Delphi survey; this is a comparable response to other surveys including health care professionals^{13,40}. With 177 responses to the final round, this can still be considered large for a Delphi study⁴¹. When thematically analysing the content of proposition statements, efforts were made to ensure credibility and trustworthiness of findings, including the initial coding framework being iteratively developed by three researchers, refinement of statements being independently checked by a second researcher, and the taskforce (that included 2 patient representatives) overseeing all stages of the analyses, including agreeing to the final statements and their encompassing domains that formed the final set of recommendations²⁰.

Due to the large number of proposition statements generated, we split the panel of experts into three separate groups to each review a sub-sample of statements. Whilst this was done randomly (stratified by discipline), and there were no apparent differences in demographic characteristics or response rates between groups, the final consensus on the most important proposition statements might have been different if the whole expert panel had been able to review all statements. In addition, although the panel was diverse, it predominantly comprised physical therapists from Western, high-income countries. Finally, we conducted our Delphi study electronically. Although this enabled us to capture data from a diverse international sample, potential panel members who do not access computers might have expressed different views.

Clinical and research implications

These recommendations will be used to directly inform the development of an online toolbox and associated implementation strategy to support health care professionals and exercise providers to deliver best practice therapeutic exercise for patients with knee and/or hip OA. This might have the potential to better standardise delivery of therapeutic exercise within clinical practice and bridge the gap between exercise provision and current OA clinical guidelines. This could increase confidence in therapeutic exercise provision among health care professionals and exercise providers, facilitate uptake of and adherence to exercise programmes, and ultimately optimise outcomes from therapeutic exercise for patients, although this is yet to be tested.

Table III

Several core domains within these recommendations might also be of wider relevance beyond therapeutic exercise for people with knee and/or hip OA. This is likely to include people with OA at different sites, or those with other musculoskeletal pain conditions or chronic conditions for which therapeutic exercise is currently recommended, but where there is limited information on how best to deliver it within clinical practice. Future research could explore the transferability of these recommendations to other patient populations.

Conclusion

Informed by the existing evidence base, a diverse panel of international experts, including patient representatives, agreed that 54 proposition statements mapping to 11 different domains are important considerations for delivering best practice therapeutic exercise for people with knee and/or hip OA. Attention should not only be given to the specific type, dose, and progression/modification of exercise (based on a comprehensive baseline assessment and follow-up), but also aspects relating to adherence and how exercise is delivered, including in the context of living with OA and pain based on person-centered goals. In line with international clinical guidelines, therapeutic exercise should also be accompanied by education about OA and the role of exercise. The breadth of issues deemed important by our panel of experts highlights that therapeutic exercise prescription for OA is multi-dimensional and complex. The recommendations developed in this study will be used to directly inform the development of an online toolbox and associated implementation strategy to support health care professionals deliver best practice therapeutic exercise for patients with knee and/or hip OA.

Contributions

Melanie Holden contributed to: (1) the conception and design of the study, acquisition of data, analysis and interpretation of data; (2) drafting and revising the article; (3) final approval of the submitted version.

Ben Metcalf contributed to: (1) the conception and design of the study, acquisition of data, analysis and interpretation of data; (2) drafting and revising the article; (3) final approval of the submitted version.

Belinda J Lawford contributed to: (1) the acquisition of data, analysis and interpretation of data; (2) drafting and revising the article; (3) final approval of the submitted version.

Rana S Hinman contributed to: (1) the conception and design of the study, acquisition of data, analysis and interpretation of data; (2) drafting and revising the article; (3) final approval of the submitted version.

Matthew Boyd contributed to: (1) the acquisition of data and interpretation of data; (2) drafting and revising the article; (3) final approval of the submitted version.

Kate Button contributed to: (1) the conception and design of the study, acquisition of data, analysis and interpretation of data; (2) drafting and revising the article; (3) final approval of the submitted version.

Natalie J Collins contributed to: (1) the conception and design of the study, acquisition of data, analysis and interpretation of data; (2) drafting and revising the article; (3) final approval of the submitted version.

Elizabeth Cottrell contributed to: (1) the conception and design of the study, acquisition of data, analysis and interpretation of data; (2) drafting and revising the article; (3) final approval of the submitted version.

Yves Henrotin contributed to: (1) the conception and design of the study, acquisition of data and interpretation of data; (2) drafting and revising the article; (3) final approval of the submitted version.

Jesper B Larsen contributed to: (1) the conception and design of the study, acquisition of data and interpretation of data; (2) drafting and revising the article; (3) final approval of the submitted version.

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Conflict of interest

STS is associate editor of the *Journal of Orthopaedic & Sports Physical Therapy*, has received grants from The Lundbeck Foundation, personal fees from Munksgaard and TrustMe-Ed, all of which are outside the submitted work. He is co-founder of Good Life with Osteoarthritis in Denmark (GLA:D®), a not-for-profit initiative hosted at University of Southern Denmark aimed at implementing clinical guidelines for osteoarthritis in clinical practice.

YH is associate editor of *Therapeutic Advance in Musculoskeletal Diseases*, has received grants from the Fond National de la Recherche Scientific in Belgium and from Walloon government. He is also the founder and President of The Osteoarthritis Foundation a not-profit association of patient and supporting research initiative. He also received personal fees from industry all of which are out of the scope of this research work.

KB received personal fees from Wolters Kluwer for production of UpToDate knee OA guidelines.

RSH and KLB developed an online educational course for physiotherapists about evidence-based exercise management of osteoarthritis, some fees from which are paid to The University of Melbourne.

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Supplementary data

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