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What should a toolkit to aid the delivery of therapeutic exercise for hip and knee osteoarthritis look like? Qualitative analysis of an international survey of 318 researchers, clinicians, and consumers by the OARSI Rehabilitation Discussion Group

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1 **What should a toolkit to aid the delivery of therapeutic exercise for hip and knee**
2 **osteoarthritis look like? Qualitative analysis of an international survey of 318**
3 **researchers, clinicians, and consumers by the OARSI Rehabilitation Discussion Group**

4

5 **Abstract** (250 words)

6 **Background:** We aimed to identify important components of, and practical resources relevant
7 for inclusion in, a toolkit to aid exercise delivery for people with hip/knee osteoarthritis.

8 **Method:** An online international multi-disciplinary survey was conducted across 43 countries
9 (139 clinicians, 44 people with hip/knee osteoarthritis, and 135 osteoarthritis researchers).

10 Participants were presented with the seeding statement “Practical resources to aid the
11 implementation of exercise for people with hip/knee osteoarthritis should...” and asked to
12 provide up to 10 open text responses. Responses underwent refinement and qualitative content
13 analysis to create domains and categories.

14 **Results:** Refinement of 551 open text responses yielded 72 unique statements relevant for
15 analysis. Statements were organized into nine broad domains, suggesting that resources to aid
16 exercise delivery should: 1) be easily accessible; 2) be of high quality; 3) be developed by, and
17 for, stakeholders; 4) include different ways of delivering information; 5) include different types
18 of resources to support exercise and non-exercise components of self-management; 6) include
19 resources on recommended exercises and how to perform/progress them; 7) include tools to
20 support motivation and track progress; 8) include resources to enable tailoring of the program
21 to the individual, and; 9) facilitate access to professional and peer support.

22 **Conclusion:** Our findings identified important components of, and practical resources to
23 include within, a toolkit to aid delivery of exercise for people with hip/knee osteoarthritis.
24 These findings have implications for exercise providers and lay the foundation for the

- 25 development of a toolkit to help ensure exercise provision aligns with current international
- 26 recommendations.

1 **Introduction**

2 Osteoarthritis (OA) affects more than 500 million adults globally ([Initiative., 2020](#); [Network,](#)
3 [2018](#)), most commonly affecting the hip and knee joints. The condition causes joint pain and
4 impaired function, and is one of the leading causes of physical disability worldwide ([Safiri et](#)
5 [al., 2020](#)). The costs associated with OA are enormous ([Puig-Junoy & Zamora, 2015](#)). In 2013,
6 OA was the second most expensive health condition treated at hospitals in the United States
7 ([Torio & Moore, 2016](#)). Indirect healthcare costs are also significant, including restrictions on
8 participation in the workforce, reduced ability to fulfill social roles, and premature mortality
9 ([David J Hunter, Schofield, & Callander, 2014](#)). With the ageing population and rising obesity rates,
10 the prevalence of hip and knee OA is projected to increase in the coming decades to become
11 one of the most widespread diseases in high-income countries ([David J. Hunter & Bierma-Zeinstra,](#)
12 [2019](#)). As such, developing strategies to help reduce the burden of the condition are urgently
13 needed.

14
15 To date, there is no known cure for OA. All current clinical guidelines recommend education,
16 exercise, and if appropriate, weight loss as first-line management approaches ([Bannuru et al.;](#)
17 [Kolasinski et al.;](#) [National Institute for Health and Care Excellence, 2022](#); [The Royal Australian College](#)
18 [of General Practitioners](#)). A large body of high-quality evidence supports the effectiveness of
19 therapeutic exercise for reducing pain, improving physical function, and increasing quality of
20 life in people with OA ([M. Fransen et al., 2015](#); [Marlene Fransen, McConnell, Hernandez-Molina, &](#)
21 [Reichenbach, 2014](#)). As such, exercise is a key element of management for all people with hip
22 and/or knee OA, regardless of age, comorbidity, pain severity, or disability ([Bannuru et al., 2019](#);
23 [Kolasinski et al.](#)). Despite its evidence-base and being universally recommended by all medical
24 societies, exercise is underutilized by people with hip/knee OA and implementation remains a
25 challenge world-wide, highlighted by the fact that only 1 in 3 receive a referral or

26 recommendation to exercise ([Abbate et al., 2018](#); [K. B. Hagen, G. Smedslund, N. Østerås, & G.](#)
27 [Jamtvedt, 2016](#); [Power, Cott, Badley, & Hawker, 2005](#)). There is also evidence that clinicians report
28 a lack of confidence, skills, and knowledge in how to implement best-practice OA care,
29 including exercise ([Barton et al., 2021](#); [Briggs, Hinman, et al., 2019](#); [Briggs, Houlding, et al., 2019](#);
30 [Christiansen et al., 2020](#)).

31

32 To improve the implementation of exercise care for hip/knee OA, we (the Osteoarthritis
33 Research Society International (OARSI) Rehabilitation Discussion Group) conducted a review
34 ([Holden et al., 2021](#)) and an international multi-disciplinary e-Delphi survey to develop
35 evidence-informed recommendations about the delivery of best practice therapeutic exercise
36 ([Holden MA et al., 2022](#)). In total, 54 recommendations mapping to 11 domains were identified,
37 including using an evidence-based approach, considering exercise in the context of living with
38 OA and pain, completing a comprehensive baseline assessment with follow-up, setting goals,
39 considering the type and dose of exercise, modifying and progressing exercise, individualising
40 and optimising the delivery of exercise, focusing on exercise adherence, and providing
41 education about OA and the role of exercise. If widely adopted, these could potentially better
42 standardise delivery of exercise within clinical practice and bridge the gap between exercise
43 provision and current OA clinical guidelines. However, identifying patient/clinician resources
44 to support the delivery of exercise in line with our recommendations is important. Indeed,
45 common barriers to implementing OA care include low confidence in skills to provide
46 recommended care, lack of resources to deliver non-surgical care, lack of skills in directing
47 patients to resources or appropriately prescribe an exercise program, and lack of access to
48 exercise resources for patients ([Briggs, Houlding, et al., 2019](#)). People with OA themselves face
49 numerous barriers to exercise participation, including not knowing what type or intensity of

50 exercise is helpful and not having access to resources like printed exercise instructions ([Dobson](#)
51 [et al., 2016](#)).

52

53 The development of a widely accessible toolkit can support the delivery of exercise for people
54 with OA in line with our published recommendations ([Holden MA et al., 2022](#)). Toolkits are
55 curated resources that provide relevant information (e.g., instructions and links to external
56 resources) to guide users on how to implement evidence-based practices. In other patient
57 populations (including cancer and diabetes), there is evidence that exercise toolkits can
58 improve clinician’s knowledge, skills, and confidence in providing exercise therapy to patients
59 ([Dennett et al., 2022](#); [Lebret et al., 2010](#); [C. Shields et al., 2009](#); [C. A. Shields et al., 2013](#)). Currently,
60 some online education and self-management toolkits for OA exist for clinicians ([Osteoarthritis](#)
61 [Action Alliance, 2022b](#)), and for people with OA themselves ([Knowledge, 2022](#)), though neither
62 are designed to specifically support the delivery of exercise-based care for hip/knee OA.
63 Furthermore, it is unclear what the most important components and practical resources of such
64 a toolkit should be. Thus, we aimed to identify important components of, and practical
65 resources relevant for inclusion in, a toolkit to aid exercise delivery for people with hip/knee
66 osteoarthritis (OA) according to patients, clinicians, and researchers.

67

68 **Methods**

69 *Study design*

70 An online international survey with open-ended questions were used to capture qualitative data
71 was conducted in August 2020. Ethical approval was obtained from the University of
72 Melbourne [1955859.1]. The study was overseen by an international multidisciplinary
73 taskforce ([Holden MA et al., 2022](#)), including 20 members with expertise in OA and exercise
74 from five different countries (Australia, Belgium, Denmark, United Kingdom, and United

75 States). The Consolidated Criteria for Reporting Qualitative Research checklist ([Tong,](#)
76 [Sainsbury, & Craig, 2007](#)) and Consensus-Based Checklist for Reporting of Survey Studies
77 ([Sharma et al., 2021](#)) was used to ensure complete and transparent reporting.

78

79 *Participants*

80 International multidisciplinary participants (including researchers/academics, healthcare
81 professionals and exercise providers, and people with hip/knee OA) were recruited. Eligibility
82 criteria for researchers/academics were either being first/last author on at least one systematic
83 review or randomized controlled trial of exercise for hip/knee OA or having been invited to
84 give a plenary or keynote presentation on exercise for hip/knee OA at an international
85 conference in the last five years. Eligibility criteria for healthcare professionals and exercise
86 providers were being registered to practice and having prescribed exercise for at least one
87 patient with hip/knee OA per week over the past six months. Eligibility criteria for people with
88 hip/knee OA were having experience participating in exercise for their OA.

89

90 Participants were recruited via advertisements on social media (e.g., Facebook, Twitter) as well
91 as email advertisements to OARSI membership lists, and email invitations from taskforce
92 members to their research and clinical networks. Those who were invited to participate were
93 also encouraged to send the invitation to colleagues or contacts who may be eligible.

94

95 *Overview of procedures*

96 Participants completed the survey online using REDCapTM electronic data capture tools hosted
97 at The University of Melbourne ([P. A. Harris et al., 2019](#); [Paul A Harris et al., 2009](#)). After eligibility
98 screening, participants were asked to watch a 10-minute video created by the taskforce that
99 summarized findings of our narrative review ([Holden et al., 2021](#)) before providing demographic

100 information as relevant (age, gender, discipline, country of residence, years of clinical or
101 research experience and/or years with hip and/or knee OA symptoms). Participants were then
102 presented with the seeding statement “*Practical resources to aid the implementation of*
103 *therapeutic exercise for people with knee and hip osteoarthritis should...*” and were asked to
104 provide up to 10 responses to the statement in an open-text box. Practical resources were
105 defined for participants as “*anything that can be used in real life, to help put into place*
106 *therapeutic exercise for hip and/or knee OA.*” The seeding statement was developed by the
107 taskforce and pilot tested with 10 researchers/academics/clinical academics/healthcare
108 professionals and people with hip/knee OA for feedback on the wording that was used.

109

110 *Data analysis*

111 Data were downloaded from REDCap and organized using Excel (Microsoft Corporation,
112 2020). Descriptive statistics (means, standard deviation [SD], frequency) were used to
113 summarize participant characteristics. Responses to the seeding statement underwent a
114 conventional approach to qualitative content analysis ([Hsieh & Shannon, 2005](#)). First, HM, JBL
115 and HM reviewed all the statements to develop an initial coding framework. Then the data
116 underwent rigorous review. Initially, this involved reviewing all responses for clarity and
117 appropriateness. Those that were grammatically incorrect were rephrased and those that
118 comprised multiple constructs were broken down into separate statements. Ambiguous
119 statements and duplicate statements were removed. This process was undertaken by either BL,
120 CB, PC, EG, CL, or AT. To overcome unintentional personal bias, a second taskforce member
121 cross-checked all decisions made, with disagreements resolved between the two researchers.
122 All remaining statements were then reviewed by HM and JBL (and checked by MH) and those
123 that did not relate to the resource (defined as anything that can be used in real life, to help put
124 into place therapeutic exercise for hip and/or knee OA) were also removed. Next, a coding

125 framework was optimized by re-reading responses and organizing them into categories of
126 similar topics or concepts. Related categories were then grouped into broad domains. This
127 coding framework of domains and categories was iteratively discussed and finalized by MH,
128 HM, JBL, KB and BL before being checked for credibility by the taskforce.

129

130 **Results**

131 *Participant characteristics*

132 Of the 673 people who completed eligibility screening, 318 were eligible (Figure 1).
133 Participants were academics or clinical researchers (n=135, 43%), healthcare professionals or
134 exercise providers (n=139, 44%), and people with hip/knee OA (n=44, 14%) from 43 countries
135 (most commonly Australia and the UK). Demographic characteristics of participants are
136 described in detail elsewhere ([Holden MA et al., 2022](#)). Briefly, participants were from 43
137 different countries (most commonly Australia [22%], the United Kingdom [12%], Canada
138 [11%], and the United States [11%]), most healthcare professionals or exercise providers were
139 physiotherapists (84%), most researchers or clinical academics has been researching OA for
140 10 years or less (54%), and most people with OA had experiences symptoms for more than 10
141 years (70%).

142

143 Most participants (n=202, 64%) provided at least one response to the seeding statement
144 (median responses provided = 1; interquartile range 1). In total, 551 responses to the seeding
145 statement were provided (Figure 1). From this, 395 [72%] were removed (332 [84%] were
146 duplicates and were condensed/combined, 48 [12%] were ambiguous in meaning, and 15 [4%]
147 were unrelated to exercise resources), leaving 156 to be used for further analysis. Finally, 72
148 statements were included as they were of direct relevance to development of a toolbox. Nine
149 overarching domains across 42 categories were developed, with between three to 8 categories

150 within each domain (Figure 2). The relationship between these nine domains and the 10
151 recommendations for the delivery of exercise, established in our prior study ([Holden MA et al.,
152 2022](#)), is shown in Table 1.

153

154 *1. Be easily accessible*

155 Participants believed that resources/components of a toolkit to support delivery of exercise
156 should be easily accessible. This included being user-friendly and easy to use/navigate, using
157 content/language that is easy to understand, and being available free of charge and in different
158 languages. It was also perceived to be important that content/resources accounted for
159 differences in culture, race, age, and gender.

160

161 *2. Be of high quality*

162 Participants believed it was important that resources/components were of a high quality,
163 including having references to sources of information and/or evidence, being regularly
164 updated, and being endorsed by an authoritative body.

165

166 *3. Be developed by, and for, stakeholders*

167 Participants believed resources/components should be developed by, and for consumers. This
168 included being co-created with both those with hip and/or knee OA and healthcare
169 professionals/exercise deliverers who provide care for people with hip and/or knee OA.

170

171 *4. Include different ways of delivering information*

172 Participants believed that resources/components should be delivered via a range of different
173 methods, including online, paper/printed, as images or diagrams, via apps, videos, or virtual
174 reality.

175

176 5. *Include different types of resources to support exercise and non-exercise components*
177 *of self-management*

178 Participants believed a range of different types of information resources should be provided to
179 support self-management of hip and/or knee OA. This included links to other external relevant
180 information/resources, educational material, patient stories, and strategies and tips for other
181 non-exercise management methods (including weight loss, a physically active lifestyle, and
182 high-quality sleep).

183

184 6. *Include resources on recommended exercises and how to perform/progress them*

185 Participants believed that resources/components should include summaries of best available
186 evidence regarding exercise for hip and/or knee OA, as well as current general
187 recommendations for exercise and physical activity. It was also believed to be important to
188 include links to tools for rating exercise intensity (e.g. “grade of difficulty” or “perceived
189 exertion”) and provide access to exercise instructions. In addition, it was believed to be
190 important to include links/access to a repository of exercise types/ideas and how to progress or
191 modify them.

192

193 7. *Include tools to support motivation and track progress*

194 Participants believed it was important that resources/components include tools to help support
195 patient motivation to exercise and to track progress. This included links to downloadable
196 exercise logs/diaries, recommended methods for tracking and monitoring progress, example
197 exercise goals, tools to measure symptoms, and tools to use for feedback/motivation (e.g.
198 reward systems).

199

200 8. *Include a suite of options to support tailoring of the program to the individual*

201 Participants believed that it was important that resources/components include a range of tools
202 to support tailoring of the exercise program to the individual. This included providing different
203 options for remote (e.g. via apps, telehealth) and in-person delivery of an exercise program,
204 and providing resources to support different types of exercise, using different types of exercise
205 equipment, and delivery of exercise within different environments (e.g. home, clinic, gym).

206

207 9. *Facilitate access to professional and peer support*

208 Participants believed it was important that resources/components include information about
209 how to access support if needed, such as providing ways in which to find qualified healthcare
210 professionals to help problem solving, and including clinical indicators regarding when to seek
211 help from a clinician. Providing access to peer interaction/support was also perceived to be
212 important, including social media or other types of online peer support.

213

214 **Discussion**

215 From our international multi-disciplinary survey, important components of, and practical
216 resources relevant for inclusion in, a toolkit to aid exercise delivery for people with hip and/or
217 knee OA should: 1) be easily accessible; 2) be of high quality; 3) be developed by, and for,
218 consumers; 4) include different ways of delivering information; 5) include different types of
219 resources to support exercise and non-exercise components of self-management; 6) include
220 resources on recommended exercises and how to perform/progress them; 7) include tools to
221 support motivation and track progress; 8) include a suite of options to enable tailoring of the
222 program to the individual, and; 9) facilitate access to support.

223

224 These findings complement our previously published evidence-informed recommendations for
225 implementing best-practice therapeutic exercise for people with hip and/or knee OA ([Holden
226 MA et al., 2022](#)) by providing guidance around practical resources to support the delivery of
227 exercise (Table 1). For example, the recommendation from our previous study to ‘set goals’
228 and ‘focus on exercise adherence’ can be broadly matched with our current finding that tools
229 to support motivation and track progress are important practical resources relevant for an online
230 exercise toolkit. The recommendations ‘consider the type and dose of exercise’ and ‘modify
231 and progress exercise’ can be matched to our finding regarding the inclusion of resources on
232 types of exercises and how to perform and progress them. Many of our toolkit
233 recommendations are also reflected in international guidelines on exercise for people with OA
234 ([Osthoff et al., 2018](#)), including that exercise should be individualised and that tools to support
235 adherence should be included. In line with clinical guidelines for OA management, our
236 recommendations also included having links to information and education regarding exercise
237 as well as non-exercise management approaches ([Bannuru et al.](#); [Kolasinski et al.](#); [National
238 Institute for Health and Care Excellence, 2022](#); [The Royal Australian College of General Practitioners](#)).

239

240 Many of our domains and categories for practical resources for delivery of exercise directly
241 relate to barriers to exercise implementation among clinicians, including beliefs that exercise
242 is outside their scope of practice ([Barton et al., 2021](#); [Briggs, Houlding, et al., 2019](#)), lack of
243 exercise knowledge or resources, being unsure about how to appropriately prescribe an
244 exercise program, and not knowing which information resources to provide to patients ([Barton
245 et al., 2021](#); [Briggs, Houlding, et al., 2019](#); [Egerton, Nelligan, Setchell, Atkins, & Bennell, 2018](#)). Many
246 of our domains and categories also relate to identified exercise barriers among those who have
247 hip and/or knee OA, including lack of knowledge about what type or intensity of exercise is
248 recommended, or not having access to printed exercise instructions or other resources ([Chou et](#)

249 [al., 2018](#); [Dobson et al., 2016](#)). As such, using our recommendations has the potential to
250 overcome many of these barriers and help improve standardization of exercise in hip and/or
251 knee OA, ensuring that current exercise provision aligns with recommendations provided in
252 clinical guidelines ([Kåre B Hagen, Geir Smedslund, Nina Østerås, & Gro Jamtvedt, 2016](#)).

253

254 Our findings lay the foundation for the development of an exercise toolkit for hip and/or knee
255 OA. For example, the recommendation that practical resources should be easily accessible
256 suggests that it is important to host such a toolkit both online, as well as in hard-copy for those
257 that prefer paper versions. However, further consideration regarding content and
258 implementation is also required. For example, the identified domain to ‘include different types
259 of resources to support self-management’ would need further consideration to establish exactly
260 what resources should be included. People with OA seek information from a range of different
261 sources ([Chou et al., 2018](#)), and there are numerous unique websites with information about OA,
262 much of which is of poor-average quality ([K. E. Murray, Murray, O'Rourke, Low, & Veale, 2019](#)).
263 Health apps for people with OA are also of a poor quality, and many have low potential for
264 supporting behaviour change ([Bricca et al., 2022](#)). As such, it is important to decide exactly
265 which sources of information to use, as well as how many different resources to include. The
266 toolkit should be easy to use and navigate, and could be housed online by an international,
267 trusted source of OA information – such as the OARSI website. However, the toolkit would
268 likely require designated personnel to regularly review and update content to reflect current
269 evidence and links to the most relevant resources/information, as well as translation into
270 different languages. One of the suggested components for our toolkit was to facilitate access
271 to support from qualified healthcare professionals and social/peer support networks. However,
272 this would be difficult to include within a national or international toolkit. Methods for
273 directing individual consumers to their local support networks will need further consideration.

274 Another potential challenge regarding creation and implementation of the toolkit will be how
275 to best promote its use among healthcare providers and consumers across the world. Effective
276 engagement with key stakeholders (e.g. government health authorities, decision makers, and
277 community organisations) would also be needed to promote its uptake and use. Other studies
278 ([Butler, 2007](#); [Keddem, Agha, Long, Werner, & Shea, 2017](#); [E. Murray, May, & Mair, 2010](#); [Thoele,
279 Ferren, Moffat, Keen, & Newhouse, 2020](#)) have used multi-step processes to develop health
280 toolkits to facilitate implementation of evidence-based interventions, including compiling
281 resources and tools, creating new tools, and reflecting and refining the toolkit with consumers
282 and stakeholders using a combination of quantitative and qualitative methods. This process
283 will be a required next step necessary to build on the findings of this current study.

284

285 *Comparison to other research*

286 Our findings within OA broadly reflect studies of other health conditions that have evaluated
287 the most important components for toolkits to support implementation of exercise. For
288 example, other studies that have evaluated the process of developing exercise toolkits for
289 people with depression ([Glowacki et al., 2019](#)), cancer ([Dennett et al., 2022](#)), and diabetes ([C. A.
290 Shields et al., 2013](#)) also included similar elements, such as being created with, and for,
291 healthcare providers and consumers, including evidence-informed guidelines, individualisation
292 of exercise, information on how to progress/regress exercise, how to monitor progress, links to
293 information about other management methods, and access to support. The similarities between
294 their findings and ours suggests that proposed practical resources to aid the delivery of exercise
295 are broad and applicable across different health conditions, and thus our findings may have
296 implications beyond OA.

297

298 Toolkits for OA management currently exist online ([Alberta Bone & Joint Health Institute, 2022](#);
299 [Arthritis Society Canada, 2022](#); [Knowledge., 2022](#); [Osteoarthritis Action Alliance, 2022a](#); [SOPHE's](#)
300 [Center for Online Resources & Education, 2022](#); [The College of Family Physicians of Canada, 2017](#)).
301 However, none appear to meet all of the recommendations identified by our study. For
302 example, many of these toolkits are only crafted for use by healthcare professionals, rather than
303 also including components/resources for consumers with OA. Many do not include references
304 to sources of information, are not available in different languages, do not always provide
305 resources relating to recommended exercises and how to perform them, and often do not
306 include tools to support motivation and track progress.

307

308 *Research and clinical implications*

309 Nor only do the findings of this study lay the foundation for the design and development of an
310 exercise toolkit for people with hip and/or knee OA (as discussed above), but may also provide
311 useful insights for others developing toolkits for exercise-based interventions in other health
312 conditions. Our findings also have implications beyond the development of a toolkit. Use of
313 our recommendations in clinical practice may help standardise the delivery of exercise, help
314 promote exercise adherence, and increase clinician confidence in exercise prescription. Our
315 findings likely have relevance beyond OA, including other chronic health conditions where
316 exercise is recommended, and implementation or delivery is a challenge. However, further
317 research is required to evaluate the effects of a toolkit that is informed by our recommendations,
318 and to explore the generalisability of our findings to other populations.

319

320 *Strengths and limitations*

321 Our study has strengths and limitations. Strengths include the broad international sample with
322 multiple end-users, including healthcare professionals and exercise providers who provide care

323 for people with OA, researchers in OA, and people with hip and/or knee OA. Our participants
324 were diverse, representing 43 countries, and three stakeholder groups, increasing the
325 generalizability of the toolkit content. We also utilized methods to improve credibility and
326 trustworthiness of our findings, including iteratively developing a coding framework that was
327 subsequently used for analysis, and having a researcher independently check refinement of
328 statements. Our study also has limitations. Most of our healthcare provider participants were
329 physiotherapists from Western countries where physiotherapy is well-accepted and accessible.
330 This may limit the generalizability of our findings to those from countries without established
331 rehabilitation providers and who may have different beliefs about resources for exercise
332 implementation. We had a relatively low proportion of people with hip/knee OA, compared to
333 clinicians and researchers, in our sample. Finally, our survey was in English only and was only
334 available online, and therefore our findings may not be generalisable to non-English speaking
335 regions or those with limited internet access.

336

337 In conclusion, our findings identified important components of, and practical resources to
338 include within, a toolkit to aid delivery of exercise for people with hip/knee OA. These findings
339 have implications for exercise providers and lay the foundation for the development of a toolkit
340 to help ensure exercise provision aligns with current international recommendations.

341

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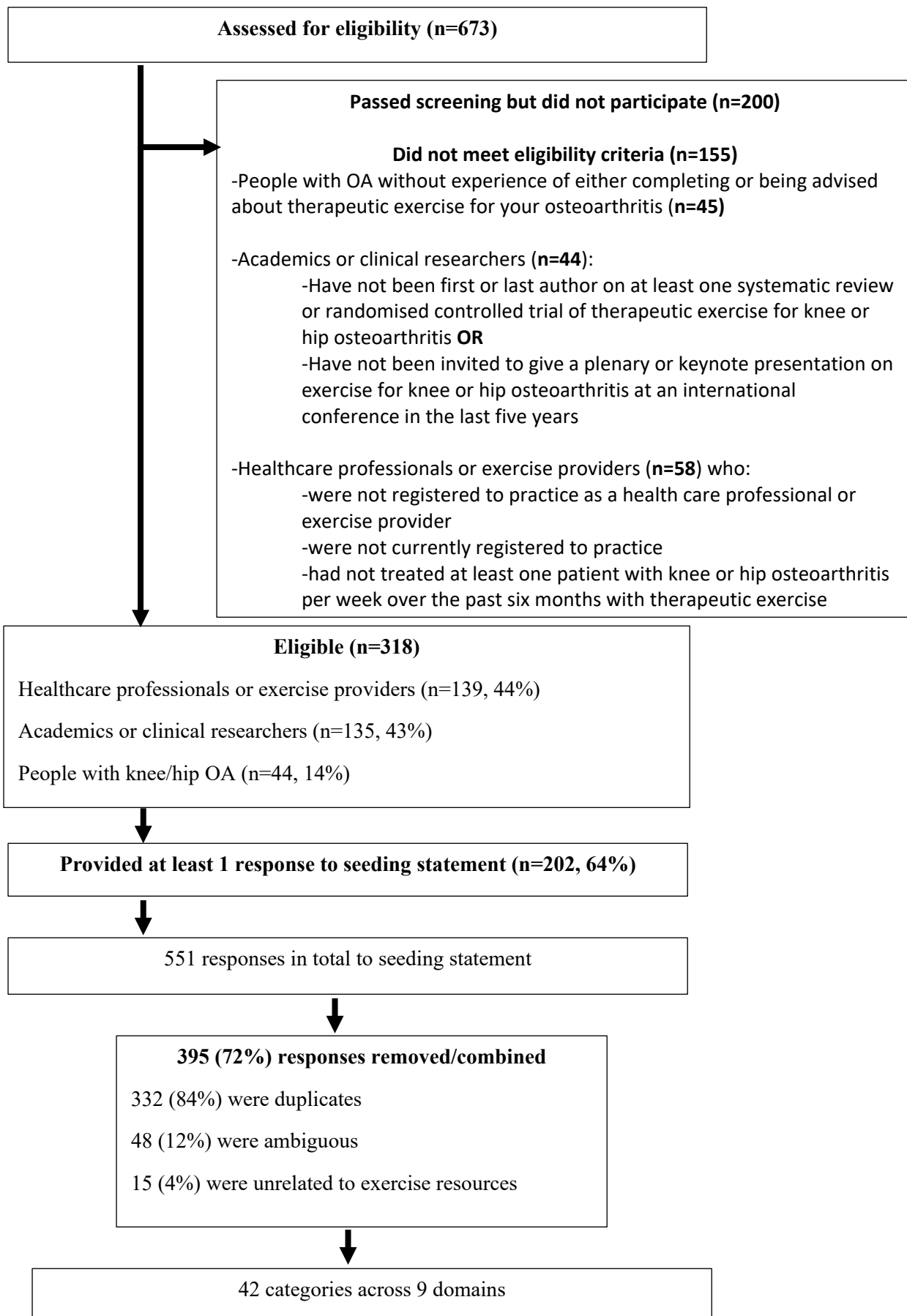
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495



1

2 **Figure 1. Overview of study flow and data analysis**



1. Be easily accessible:

- User-friendly and easy to navigate, irrespective of comfort level with use of technologies
- Available in, or easily translatable to, different languages
- Free of charge
- Easy to understand content/resources (accounting for different levels of health literacy)
- Content/resources that account for cultural, racial, age and gender differences



2. Be of high quality:

- References to sources of information/content (e.g., societies such as OARS, NICE, NHS, or reference specific research studies)
- Regularly updated
- Endorsed by an authoritative body



3. Be developed by, and for, stakeholders:

- Co-created with people with OA and healthcare professionals
- Instructions/advice for healthcare professionals about **how** to implement exercise (eg monitor progress, test fitness, tailor exercise to individuals), as well as resources to use with patients
- Information/resources that healthcare professionals can refer to and people with OA can use themselves



4. Include different ways of delivering information:

- Printable materials
- Digital materials
- Written materials
- Audio commentary
- Phone apps
- Images
- Videos
- Virtual reality



5. Include different types of resources to support self-management:

- Weblinks to other relevant information/resources
- Educational materials
- Patient stories
- Strategies and tips for other management methods (weight loss, a physically active lifestyle, good sleep)



6. Include resources on recommended exercises and how to perform/progress them:

- Summaries of best available evidence and current recommendations (eg ACSM physical activity recommendations)
- Tools for rating "grade of difficulty" or "perceived exertion" of exercise
- Instructions on how to perform exercises
- Demonstrations about how to perform exercises
- Repository of exercise types/ideas, including variations for progression



7. Include tools to support motivation and track progress:

- Online/downloadable exercise logs/diaries
- Methods of tracking progress and monitoring the condition/symptoms
- Example exercise goals to aim for
- Questionnaires/tools to monitor pain and function
- Tools for feedback/award systems (eg stickers or electronic "medals" and words of affirmations)



8. Include a suite of options to enable tailoring of the program to the individual:

- Remote exercise delivery options (eg app-based, telehealth technologies)
- In-person exercise delivery options
- Different types of exercise
- Varying availability of exercise equipment
- Different exercise/training environments (eg gym, outdoors, home)



9. Facilitate access to professional and peer support:

- Access to a qualified healthcare professional to help with problem solving/overcoming barriers
- Clinical indicators about when to seek help from healthcare professionals
- Information about who people can contact should they have trouble
- Access to social interaction/peer support (eg social media, online support)

4 **Figure 2. Domains and categories related to practical resources to aid implementation of exercise for**
5 **people with osteoarthritis applicable to the development of an online toolbox**

6 OARSI = Osteoarthritis Research Society International; NICE = National Institute for Health Care
7 Excellence; NHS = National Health Service; ACSM = The American College of Sports Medicine

Table 1. Practical resources that support the recommendations for implementing exercise in people with hip/knee osteoarthritis

	Recommendations for delivery of exercise for people with OA (Holden MA et al., 2022)									
Categories of practical resources	Consider exercise in the context of living with osteoarthritis and pain	Undertake a comprehensive baseline assessment with follow-up	Set goals	Consider the type of exercise	Consider the dose of exercise	Modify and progress exercise	Individualise exercise	Optimise the delivery of exercise	Focus on exercise adherence	Provide education about osteoarthritis and the role of exercise
1. Be easily accessible	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2. Be of high quality	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3. Be developed by, and for, consumers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4. Include different ways of delivering information	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5. Include different types of resources to support exercise and non-exercise components of self-management	✓									✓
6. Include resources on recommended exercises and how to perform/progress them				✓	✓	✓	✓	✓		
7. Include tools to support motivation and track progress			✓						✓	
8. Include a suite of options to enable tailoring of the program to the individual				✓	✓	✓				
9. Facilitate access to support	✓									✓