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Patient Education for Patellofemoral Pain: A Systematic Review

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Patellofemoral pain (PFP), characterized by diffuse anterior knee pain,[15] is one of the most common knee conditions. The prevalence of PFP ranges from 7% to 35%, with the highest prevalence in sporting populations.[18,46] Exercise therapy, with or without additional interventions (manual therapy, taping, or foot orthoses), is supported by level 1 evidence for managing PFP.[2,12,30]

One in 3 people continue to experience symptoms 12 months following treatment,[13] and 1 in 4 people report persistent symptoms 20 years after diagnosis.[37] Persistent PFP is associated with higher body mass index,[24] pain-related fear,[40] impaired quality of life,[9] reduced physical activity levels,[23] increased risk of ceasing sports participation,[42] and manifestations of pain sensitization.[17] The high prevalence of poor long-term outcomes highlights the need to identify additional treatment targets and resources for improved self-management.

One potential solution to improve long-term outcomes (longer than 12 months) is to provide high-quality patient education (eg, patient-specific advice and information on the condition, empowering patients to manage their expectations), which is considered essential by clinicians and researchers.[1,2,12] Patient education is frequently included in PFP trials as part of a combined treatment approach or used as a comparator. However, the efficacy of patient education for PFP is not known.

We aimed to evaluate the effect of education interventions (combined with other treatments or in isolation) in people with PFP compared to any other comparator.

OBJECTIVE: To evaluate the effect of education interventions compared with any type of comparator on managing patellofemoral pain (PFP).

DESIGN: Intervention systematic review. PROSPERO identifier: CRD42018088671.

LITERATURE SEARCH: MEDLINE, Embase, CINAHL, and Web of Science were searched for studies evaluating the effect of education on clinical and functional outcomes in people with PFP.

STUDY SELECTION CRITERIA: Two reviewers independently assessed studies for inclusion and quality. We included randomized controlled trials on PFP where at least 1 group received an education intervention (in isolation or in combination with other interventions).

DATA SYNTHESIS: Available data were synthesized via meta-analysis where possible; data that were not appropriate for pooling were synthesized qualitatively. Interpretation was guided by the Grading of Recommendations Assessment, Development and Evaluation approach.

RESULTS: Nine trials were identified. Low-credibility evidence indicated that health education material alone was inferior to exercise therapy for pain and function outcomes. Low- and very low–credibility evidence indicated that health professional–delivered education alone produced outcomes similar to those of exercise therapy combined with health professional–delivered education for pain and function, respectively.

CONCLUSION: Health professional–delivered education may produce similar outcomes in pain and function compared to exercise therapy plus health professional–delivered education in people with PFP. *J Orthop Sports Phys Ther 2020;50(7):388-396. Epub 29 Apr 2020. doi:10.2519/jospt.2020.9400*

KEY WORDS: *anterior knee pain, health, knee, rehabilitation*

METHODS

Reporting followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines.[31] The protocol was registered in the PROSPERO database in February 2018 (registration number CRD42018088671).[38] Patients or public partners were not involved in the design, conduct, or interpretation of this systematic review.

Deviations From Study Registration and the Study Protocol

In our preregistered protocol, we planned a mixed-methods study, including a cross-sectional analysis of general web content. Following suggestions from the peer-review process, we decided to separate the cross-sectional analysis from this systematic review. We preplanned to determine the quality of evidence by using a modified

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version of van Tulder's criteria. However, following suggestions from the peer-review process, we decided to use the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach.

Search Strategy and Screening Process

We searched the MEDLINE, Embase, CINAHL, and Web of Science databases from inception to February 2019. The electronic search was complemented by searching the reference lists of the retrieved articles. The full search strategy is available in **APPENDIX A** (available at www.jospt.org). A review author (D.O.S.) exported all studies identified by the search to EndNote Version X7.5 (Clarivate Analytics, Philadelphia, PA), then cross-referenced the results and deleted duplicates. Two review authors (D.O.S. and M.P.) independently screened all titles and abstracts. Full-text articles were obtained for those eligible for full-text screening, based on the inclusion and exclusion criteria (outlined below). All full-text articles were screened in duplicate, any discrepancies were resolved during a consensus meeting, and a third reviewer was available (C.B.) if needed.

Inclusion and Exclusion Criteria

We included randomized controlled trials on PFP in which at least 1 group received an education intervention (in isolation or in combination with other interventions). We defined education as providing information, advice, and/or behavior modification techniques, aimed at influencing a person's knowledge, health behavior, and/or coping strategies.[20,39] The comparison group could be any other intervention, "wait and see," or a combined intervention (eg, education and exercise compared to exercise alone, or education and exercise compared to education alone). Abstracts, posters, unpublished trials, nonrandomized controlled trials, articles unrelated to PFP, and trials without at least 1 education intervention group were excluded.

Participants must have been diagnosed with PFP in line with current recommendations for PFP diagnosis.[15] There were no restrictions for sex, age, year, or language of publication. In the event of unreported data, missing data, or data that could not be extracted, the study's authors were contacted via e-mail. If the authors could not provide the missing data or did not reply to the request after 3 attempts, the study was excluded from further statistical analysis.

Outcomes

The primary outcome was self-reported pain. Secondary outcomes were self-reported function, objective function, quality of life, lower-limb strength, and psychological factors (ie, depression, anxiety).

Quality Assessment

Two review authors (M.P. and E.B.) used the Physiotherapy Evidence Database scale to independently evaluate the quality of the trials.[34] This is a validated and reliable appraisal tool designed to assess methodological quality in clinical trials and consists of 11 items.[34] We rated trials as high quality (7/10 or greater), moderate quality (4-6/10), and low quality (3/10 or less). When available, the score was cross-checked with the Physiotherapy Evidence Database. Any discrepancies were resolved during a consensus meeting, and a third reviewer was available (D.O.S.) when disagreements could not be resolved.

Assessment of Risk of Bias

Two review authors (D.O.S. and M.P.) independently assessed the risk of bias using the Cochrane risk-of-bias tool. Any discrepancies were resolved in a consensus meeting, and a third reviewer was available (C.B.). We assessed random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias. Other sources of bias were lack of comparability in clinicians' experience with the interventions under testing and compliance with the intervention. As these potential sources of bias were not covered by those previously mentioned items, we included them. The domains were classified as low risk of bias, high risk of bias, or unclear risk of bias ("unclear" referring to a lack of information or uncertainty over the potential for bias).

Data Extraction

Two review authors (D.O.S. and M.P.) independently extracted data using a standardized data-extraction sheet and compared the extracted data. Inconsistencies were discussed between the reviewers. The following data were extracted: trial characteristics (publication details, author, and year), participant characteristics (population, age, sex, body mass index, and number of participants in each group), education resource development process (description, expert and/or end-user consultation), intervention description (extracted using the Template for Intervention Description and Replication [TIDieR] checklist as a guide), and education delivery method (website, advice, leaflet with no time dedicated to education, leaflet with time dedicated to education).

Data Synthesis and Statistical Analysis

We pooled data (using Review Manager Version 5.3; The Nordic Cochrane Centre, Copenhagen, Denmark) if trials investigated similar interventions (eg, health education material or education delivered by a health professional) using comparable outcome measures (eg, self-reported pain using a visual analog scale) at comparable time points. We considered short term to be less than 12 weeks, medium term to be 6 months to less than 12 months, and long term to be 12 months or longer from treatment commencement.

Data that were not appropriate for pooling were summarized in a table. We calculated the standardized mean differences (SMDs) with 95% confidence intervals (CIs) for both pooled and unpooled continuous data from the end of treatment and subsequent follow-ups. The end-of-treatment time point was based on the intervention duration of each trial.

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For quantitative synthesis, we used random-effects models and calculated pooled point estimates and 95% CIs. We quantified heterogeneity with the I^2 statistic. Individual or pooled SMDs were categorized as small (0.59 or less), medium (0.60-1.19), or large (1.20 or greater).[7,27]

Quality of evidence for each outcome was assessed according to the Grading of Recommendations Assessment, Development and Evaluation approach, per section 12.2 of the *Cochrane Handbook for Systematic Reviews of Interventions*.[25] We assessed the quality of the evidence for the following comparisons: health education material compared to supervised exercise therapy plus education material, and health professional–delivered education compared to exercise therapy plus health professional–delivered education. We presented knee pain, knee self-reported function, and knee extensor isometric strength at the end of treatment (short term) and in the medium and/or long term (3 months or longer). We did not assess quality of evidence for outcomes present in 1 study (see **APPENDIX B**, available at www.jospt.org, for a detailed description).

For trials with 2 or more comparator groups,[36,47] we combined groups to prevent a unit-of-analysis error due to the unaddressed correlation between the estimated intervention effects from multiple comparisons.[25] To perform the combination of 2 or more comparator groups, we used the formulae described in section 7.7.3.8 of the *Cochrane Handbook*.[25]

RESULTS

Six thousand nine hundred eighty-two records were identified for screening, prior to removal of duplicates (**FIGURE 1**). Nine trials were eligible based on full-text screening; we excluded 1 trial due to inability to retrieve data (after 3 attempts to contact the authors).[28] Three trials delivered education via leaflets or booklets[36,47,48] and 5 trials delivered education via a health professional.[8,21,35,43,44] Comparators were exercise therapy (stretching, strengthening),[21,35,36,43,44,48] taping,[8,35] and gait retraining.[21] The content of all interventions is described in **APPENDIX C** (available at www.jospt.org).

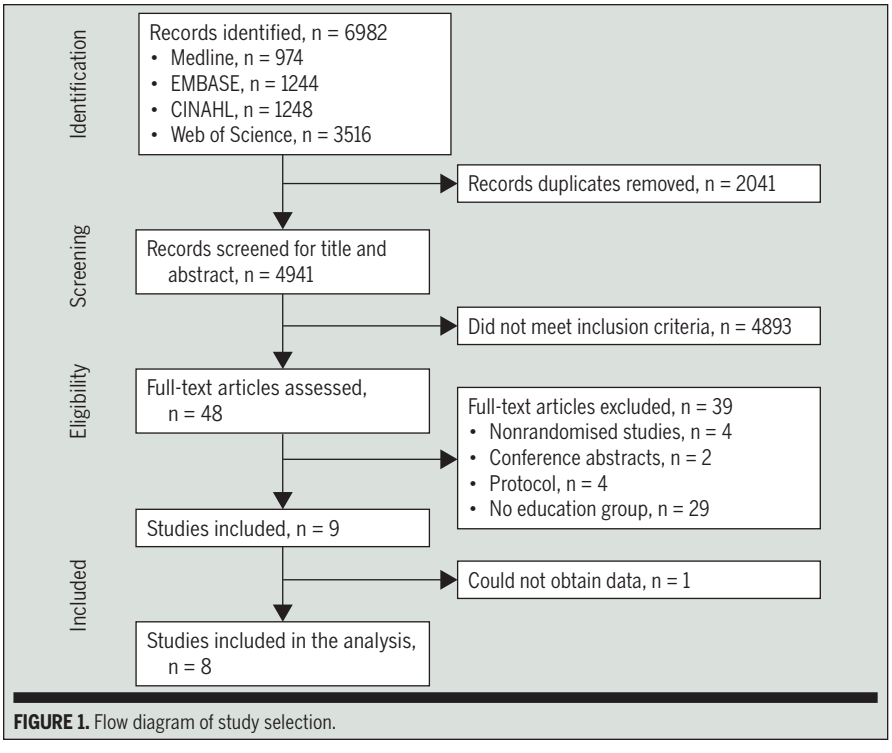


FIGURE 1. Flow diagram of study selection.

Participant Characteristics of Included Studies

Trial characteristics are outlined in **APPENDIX D** (available at www.jospt.org). There were 731 participants with PFP (467 women, 63.8%). The mean age ranged from 13 to 82 years and the mean body mass index ranged from 21 to 25.2 kg/m^2. Of the 731 participants, 279 (38%) were included in the education intervention group and 452 (62%) were included in the comparator groups. The trial populations included adolescents,[43,44] young adults,[8,47,48] older adults,[35,36] and runners[21] with PFP.

Methodological Quality Assessment and Risk of Bias

Three trials were rated as high quality[8,21,47] and 6 trials were rated as moderate quality[28,35,36,43,44,48] (**APPENDIX E**, available at www.jospt.org). Domains with the highest risk of bias were blinding of participants (89%) and allocation concealment (44%) (**FIGURE 2**). Descriptions of educational interventions lacked many of the specific items from the TIDieR checklist, particularly details such as location of the intervention (50%), adherence to the intervention (100%), and the content of the intervention (85%). No included manuscripts fulfilled all criteria proposed by the TIDieR checklist.

Number of Sessions of Each Intervention

Trials offered an average of 2 education sessions to participants with PFP. When education was offered as health education material, an average of 1 session was reported. When education was delivered via a health professional, there was an average of 3 sessions. An average of 20.5 exercise therapy sessions were offered for participants with PFP in exercise groups. For taping and gait retraining interventions, an average of 3.5 and 5 sessions were offered, respectively (**APPENDIX C**).

Effect of Education Intervention Versus Exercise Therapy on Knee Pain

Data were available for pooling to compare (1) education material versus exer-

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cise therapy for pain (visual analog scale and/or numeric rating scale of worst pain), and (2) education delivered verbally by a health professional versus exercise therapy plus education delivered by a health professional for pain (as above).

There was low-credibility evidence from 3 trials[36,47,48] (314 participants) of greater short-term reduction in knee pain with supervised exercise therapy plus health education material compared with health education material alone (SMD, 1.12; 95% CI: 0.07, 2.17) (**FIGURE 3**). There was low-credibility evidence from 1 trial[48] (131 participants) of no difference between health education material and supervised exercise therapy plus health education material for knee pain in the long term (SMD, 0.31; 95% CI: −0.04, 0.65). There was low-credibility evidence from 3 trials[8,21,43] (209 participants) of no difference between health education material verbally delivered by a health professional and exercise therapy plus health professional–delivered education for knee pain in the short term (SMD, 0.14; 95% CI: −0.56, 0.85) (**FIGURE 3**) and medium term (SMD, 0.30; 95% CI: −0.30, 0.89) (**FIGURE 3**).

Effect of Education Intervention Versus Exercise Therapy on Secondary Outcomes

Regarding the secondary analyses, data were available for pooling on (1) the effect of health education material versus exercise therapy on self-reported function, and (2) the effect of health professional–delivered education versus exercise therapy plus health professional–delivered education on self-reported function and knee extensor isometric strength (**FIGURE 4**). The results that could not be pooled were synthesized qualitatively and are summarized in **APPENDIX F** (available at www.jospt.org).

There was low-credibility evidence from 3 trials[36,47,48] (314 participants) indicating greater self-reported function in the short term after exercise therapy compared to health education material (SMD, −1.28; 95% CI: −2.28, −0.27) (**FIGURE 4**). There was very low–credibility evidence from 2 trials[8,43] (163 participants) of no difference between health professional–delivered education and exercise therapy plus health professional–delivered education for self-reported function in the short term (SMD, −0.73; 95% CI: −1.57, 0.11) (**FIGURE 4**). There was low-credibility evidence from 3 trials[8,21,43] (145 participants) of no difference between health professional–delivered education and exercise therapy for knee extensor isometric strength in people with PFP in the short term (SMD, −0.29; 95% CI: −0.62, 0.04) (**FIGURE 4**).

Findings from one trial indicated that knee range of motion,[36] and another that vastus medialis cross-sectional area and volume,[47] increased more in the short

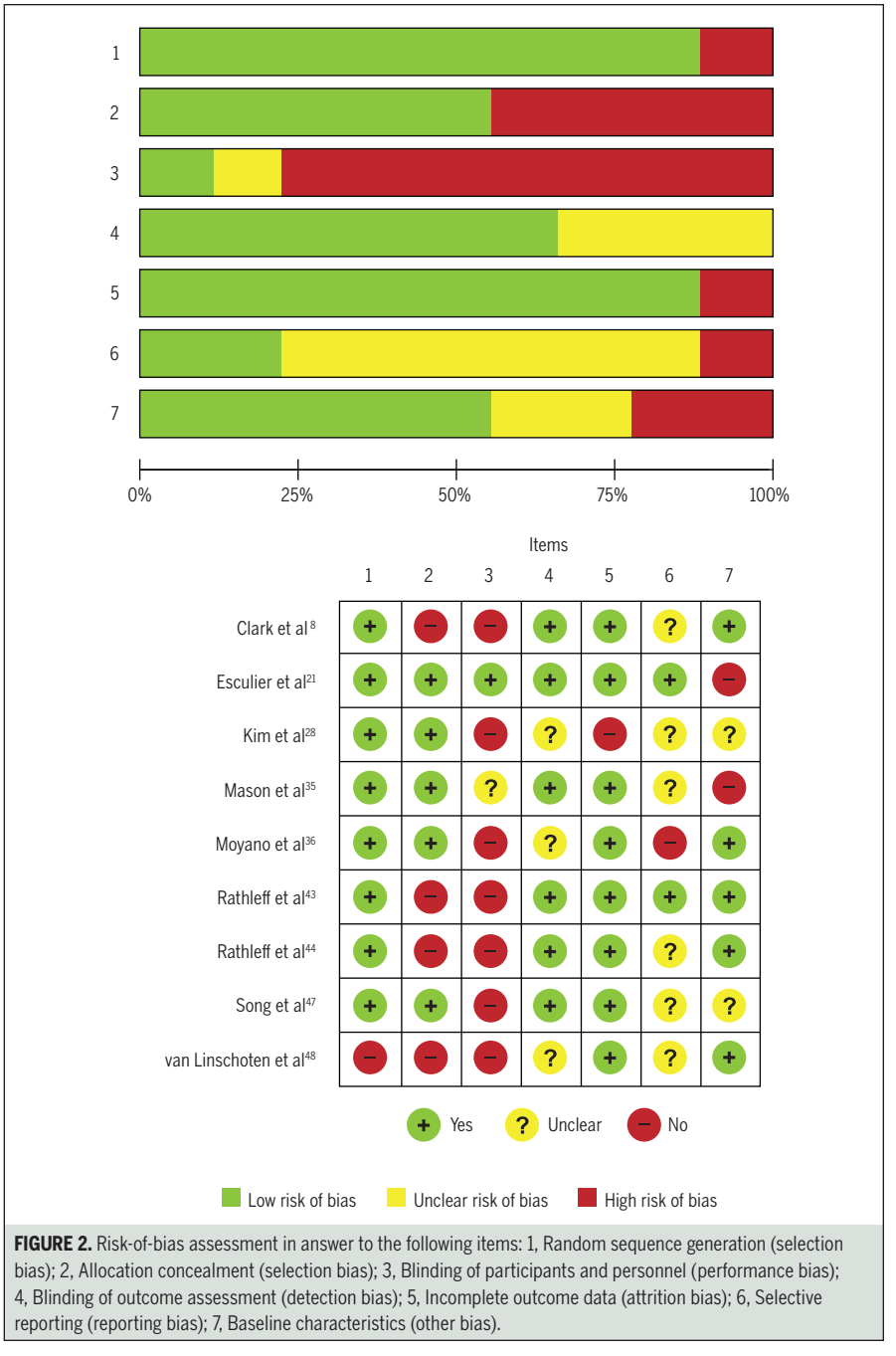


FIGURE 2. Risk-of-bias assessment in answer to the following items: 1, Random sequence generation (selection bias); 2, Allocation concealment (selection bias); 3, Blinding of participants and personnel (performance bias); 4, Blinding of outcome assessment (detection bias); 5, Incomplete outcome data (attrition bias); 6, Selective reporting (reporting bias); 7, Baseline characteristics (other bias).

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term with supervised exercise therapy compared to health education material (**APPENDIX F**). Findings from individual studies indicated no difference between health professional–delivered education and exercise therapy plus health professional–delivered education for knee-related quality of life,[43] anxiety,[8] depression,[8] and weekly running distance[21] in people with PFP in the short term (**APPENDIX F**).

Effect of Education Intervention Versus Other Interventions

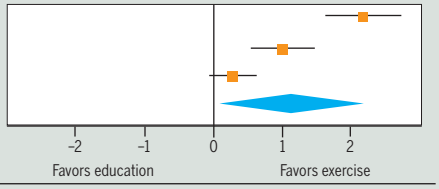
There was no difference between health education delivered by a health professional and taping plus health professional–delivered education on worst knee pain (SMD, −0.54; 95% CI: −1.16, 0.09), knee pain ascending or descending stairs, self-reported function, anxiety, depression, and knee extensor isometric strength[8,35] (**APPENDIX F**). There was no difference between health professional–delivered education and gait retraining plus health professional–delivered education on worst knee pain (SMD, −0.28; 95% CI: −0.86, 0.30) and weekly running distance for runners with PFP in the short term (**APPENDIX F**).[21]

DISCUSSION

We identified 9 trials evaluating education interventions in people with PFP. Low-credibility evidence suggested that patient education delivered by a health care professional produced similar improvements in pain and function as those seen after exercise therapy combined with health professional–delivered education. There was low-credibility evidence that health education material was inferior to exercise therapy for improvements in self-reported pain and function.

Health Education Material Versus Exercise Therapy: Short Term

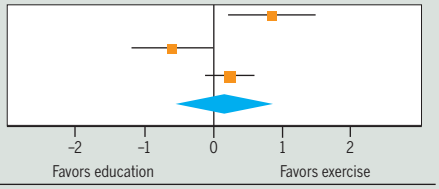
	Education		Exercise			
Study	Mean ± SD	Total, n	Mean ± SD	Total, n	Weight	SMD IV, Random (95% Confidence Interval)
Moyano et al[36]	6.57 ± 1.39	26	2.30 ± 2.14	68	32.4%	2.16 (1.60, 2.71)
Song et al[47]	4.81 ± 2.55	30	2.34 ± 2.44	59	33.3%	0.99 (0.52, 1.45)
van Linschoten et al[48]	4.60 ± 3.00	66	3.81 ± 2.90	65	34.3%	0.27 (−0.08, 0.61)
Total[a]		122		192	100.0%	1.12 (0.07, 2.17)



[a]*Heterogeneity: $\tau^2 = 0.80$, $\chi^2 = 32.99$, $df = 2$ ($P < .0001$), $I^2 = 94\%$. Test for overall effect: $z = 2.09$ ($P = .04$).*
Abbreviations: IV, inverse variance; SMD, standardized mean difference.

Health Professional–Delivered Education Versus Exercise Therapy: Short Term

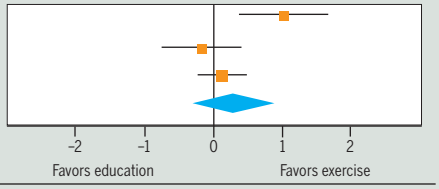
	Education		Exercise			
Study	Mean ± SD	Total, n	Mean ± SD	Total, n	Weight	SMD IV, Random (95% Confidence Interval)
Clark et al[8]	4.2 ± 1.4	22	3.0 ± 1.39	20	30.9%	0.83 (0.20, 1.46)
Esculier et al[21]	3.1 ± 1.6	23	4.4 ± 2.5	23	31.9%	−0.61 (−1.20, −0.02)
Rathleff et al[43]	5.1 ± 2.7	59	4.0 ± 6.4	62	37.3%	0.22 (−0.14, 0.58)
Total[a]		104		105	100.0%	0.14 (−0.56, 0.85)



[a]*Heterogeneity: $\tau^2 = 0.31$, $\chi^2 = 10.87$, $df = 2$ ($P = .004$), $I^2 = 82\%$. Test for overall effect: $z = 0.40$ ($P = .69$).*
Abbreviations: IV, inverse variance; SMD, standardized mean difference.

Health Professional–Delivered Education Versus Exercise Therapy: Medium Term

	Education		Exercise			
Study	Mean ± SD	Total, n	Mean ± SD	Total, n	Weight	SMD IV, Random (95% Confidence Interval)
Clark et al[8]	5.1 ± 1.3	22	3.7 ± 1.4	20	29.5%	1.02 (0.37, 1.67)
Esculier et al[21]	2.3 ± 1.8	23	2.7 ± 2.7	23	31.7%	−0.17 (−0.75, 0.41)
Rathleff et al[43]	5.1 ± 7.6	59	4.1 ± 7.8	62	38.9%	0.13 (−0.23, 0.49)
Total[a]		104		105	100.0%	0.30 (−0.30, 0.89)



[a]*Heterogeneity: $\tau^2 = 0.20$, $\chi^2 = 7.85$, $df = 2$ ($P = .02$), $I^2 = 75\%$. Test for overall effect: $z = 0.97$ ($P = .33$).*
Abbreviations: IV, inverse variance; SMD, standardized mean difference.

FIGURE 3. Meta-analyses for knee pain.

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Implications for Practice

If a health professional delivers patient education alone, it may be as effective for improving pain and function as combining education with exercise therapy, gait retraining, or taping interventions. This is despite requiring a much smaller number of visits (one sixth on average). The most consistent education content delivered by health professionals in the included trials was (1) advice on load management, (2) advice on self-management of pain, and (3) explanation of the nature and possible causes of PFP.

Health education material may be less effective compared with exercise therapy for improving pain, function, and physical outcomes such as knee range of motion, quadriceps cross-sectional area, and muscle volume in people with PFP.[36] Key differences between health education material and health professional–delivered education include shorter consultation time or fewer sessions and reduced specific guidance on PFP management. Most of the educational material used in the trials is not available for public use, which limits implementation and translation of findings into clinical practice.

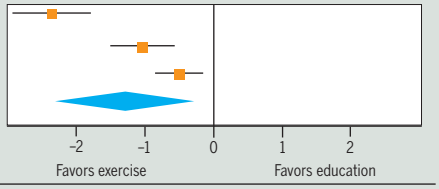
Implications for Research

Patient education is not mentioned as a recommended intervention in recent international consensus statements on managing PFP.[12,16] We suggest that future clinical practice guidelines and consensus statements consider addressing the role of patient education. However, trials on education are needed, because the current evidence is of low credibility at best.

Education content and mode of delivery may play an important role in the potential for education to assist a patient's recovery. We did not identify any trials evaluating online education for people with PFP. Previous research has reported benefits of online education and exercise interventions for other musculoskeletal

Health Education Material Versus Exercise Therapy—Knee Function: Short Term

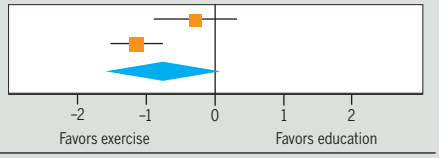
	Education		Exercise			
Study	Mean ± SD	Total, n	Mean ± SD	Total, n	Weight	SMD IV, Random (95% Confidence Interval)
Moyano et al[36]	29.95 ± 10.6	26	61.14 ± 13.99	68	32.2%	−2.35 (−2.92, −1.78)
Song et al[47]	75.7 ± 10.9	30	86.11 ± 9.44	59	33.3%	−1.04 (−1.50, −0.57)
van Linschoten et al[48]	74.9 ± 17.6	66	83.2 ± 14.8	65	34.4%	−0.51 (−0.86, −0.16)
Total[a]		122		192	100.0%	−1.28 (−2.28, −0.27)



[a]*Heterogeneity: $\tau^2 = 0.73$, $\chi^2 = 29.48$, $df = 2$ ($P < .0001$), $I^2 = 93\%$. Test for overall effect: $z = 2.49$ ($P = .01$).*
Abbreviations: IV, inverse variance; SMD, standardized mean difference.

Health Professional–Delivered Education Versus Exercise Therapy—Knee Function: Short Term

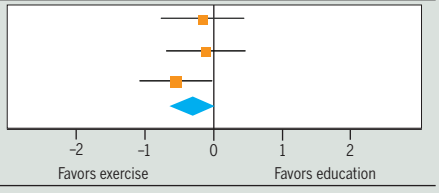
	Education		Exercise			
Study	Mean ± SD	Total, n	Mean ± SD	Total, n	Weight	SMD IV, Random (95% Confidence Interval)
Clark et al[8]	86.2 ± 15.8	22	90 ± 11.8	20	46.1%	−0.27 (−0.87, 0.34)
Rathleff et al[43]	81 ± 5.88	59	89 ± 8.03	62	53.9%	−1.13 (−1.51, −0.74)
Total[a]		81		82	100.0%	−0.73 (−1.57, 0.11)



[a]*Heterogeneity: $\tau^2 = 0.30$, $\chi^2 = 5.48$, $df = 1$ ($P = .02$), $I^2 = 82\%$. Test for overall effect: $z = 1.70$ ($P = .09$).*
Abbreviations: IV, inverse variance; SMD, standardized mean difference.

Health Professional–Delivered Education Versus Exercise Therapy—Knee Extensor Strength: Short Term

	Education		Exercise			
Study	Mean ± SD	Total, n	Mean ± SD	Total, n	Weight	SMD IV, Random (95% Confidence Interval)
Clark et al[8]	279.9 ± 155.1	22	307.9 ± 193.6	20	29.3%	−0.16 (−0.76, 0.45)
Esculier et al[21]	70.9 ± 15.2	23	72.7 ± 17	23	32.2%	−0.11 (−0.69, 0.47)
Rathleff et al[43]	2.17 ± 0.59	29	2.54 ± 0.74	28	38.5%	−0.55 (−1.08, −0.02)
Total[a]		74		71	100.0%	−0.29 (−0.62, 0.04)



[a]*Heterogeneity: $\tau^2 = 0.00$, $\chi^2 = 1.46$, $df = 2$ ($P = .48$), $I^2 = 0\%$. Test for overall effect: $z = 1.74$ ($P = .08$).*
Abbreviations: IV, inverse variance; SMD, standardized mean difference.

FIGURE 4. Self-reported knee function and strength meta-analyses.

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conditions, including improvements in pain.[4-6] Recent digital and social media innovations provide opportunities for enhanced knowledge translation,[3] and an increasing number of people use the internet to seek health information.[10,45] Further research and development of online education for people with PFP is needed. Such an approach could yield an effective and highly scalable management strategy at low cost.

There are currently no published trials evaluating patient education compared to a no-treatment control in people with PFP. A trial has reported improvements of large effect in pain and function in people with knee osteoarthritis in favor of education compared to no treatment.[11] Testing efficacy of education should be a priority for PFP research. Considering recent reports of psychological factors associated with PFP, including kinesiophobia,[33,40] pain catastrophizing,[32,40] depression,[32] and anxiety,[32,33] development and evaluation of educational interventions that incorporate psychological support should also be a future research priority.

Limitations

Our findings from very low– to low-credibility evidence that health professional–delivered education produces outcomes similar to those of exercise therapy, taping, or gait retraining are based on high heterogeneity in some meta-analyses. Variable outcomes are possibly the result of the different education and exercise therapy interventions evaluated. These findings indicate that any recommendation on patient education remains challenging, and further research is warranted to determine whether patient education is effective in improving clinical outcomes. In addition, 44%of the studies included in our systematic review did not conceal participant allocation, which may be an important source of bias. Overall, the description of educational interventions was poor (eg, 85% did not clearly describe the content of the intervention). Only 1 trial provided the educational content used,[43] and previous reviews have highlighted limited[26] and sometimes inaccurate[29] reporting related to exercise therapy. This is a barrier to implementing current education interventions in clinical practice. We recommend that future studies adopt the TIDieR guidelines to design their education interventions.

Education interventions appear to have been developed with limited codesign elements, including partnership with patients and other stakeholders in the development of interventions.[14,49] Development of education strategies may also benefit from inclusion of cognitive, behavioral, or learning theories, which, when used, are associated with moderate to large effects on patient self-efficacy in people with other chronic musculoskeletal conditions.[19,22] Such an approach has also been reported to result in large improvements in pain and function in a large (n = 151) adolescent PFP cohort.[41] Further evaluation of similar interventions in people of all ages with PFP via high-quality trials is warranted.

CONCLUSION

Health professional–delivered education produced similar outcomes in pain and function compared to exercise therapy plus health professional–delivered education in people with PFP at 3 and 6 months post intervention. Health education material alone was inferior to exercise therapy for improving pain and function at 3 months post intervention. ◉

KEY POINTS

FINDINGS: Health professional–delivered education produced similar outcomes in pain and function compared to exercise therapy plus health professional–delivered education at 3 and 6 months post intervention. Health education material alone was inferior to exercise therapy for improving pain and function at 3 months post intervention.

IMPLICATIONS: Health professional–delivered education provided similar outcomes to those of exercise therapy in fewer sessions. Advice about load management, self-management of pain, and explanation of the nature and possible causes of patellofemoral pain were the most consistent types of education used. Health education material alone should be prescribed with caution, as it was inferior to exercise therapy for most outcomes in people with patellofemoral pain.

CAUTION: Low-credibility evidence and high heterogeneity in the meta-analyses suggest that the results may change in the presence of future evidence.

STUDY DETAILS

AUTHOR CONTRIBUTIONS: All authors were fully involved in the study and preparation of the manuscript. Each of the authors has read and concurs with the content in the final manuscript.

DATA SHARING: All data relevant to the study are included in the article or are available as online appendices.

PATIENT AND PUBLIC INVOLVEMENT: Patients or public partners were not involved in the design, conduct, or interpretation of this systematic review.

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APPENDIX A

SEARCH HISTORY

1. anterior knee pain.ab,kf,ti,tw.
2. (patella or patellofemoral).ab,kf,ti,tw.
3. (pain or syndrome or dysfunction).ab,kf,ti,tw.
4. 2 and 3
5. 1 or 4
6. Clinical trials as topic/
7. Randomized Controlled Trial/
8. Controlled Clinical Trials as Topic/
9. Randomized controlled trial.pt.
10. Controlled clinical trial.pt.
11. randomized.ab.
12. placebo.ab.
13. randomly.ab.
14. trial.ti.
15. ((clinical or controlled or comparative or placebo or prospective* or randomi#ed) adj3 (trial or study)).tw.
16. (random* adj7 (allocar or allot* or assign* or basis* or divid* or order*).tw.
17. ((allocar or allot* or assign* or divid*) adj3 (condition* or experiment* or intervention* or treatment* or therap* or control* or group*)).tw.
18. 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17
19. 5 and 18

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APPENDIX B

GRADE RATINGS

Health Education Material Compared to Supervised Exercise Therapy Plus Education Material

	Study Limitations (Risk of Bias)	Indirectness	Inconsistency	Imprecision	Publication Bias	GRADE Conclusion[a]
Knee pain: short term	No	No	Yes	Yes	No	Low credibility
Knee pain: long term	No	No	Yes	Yes	Yes	Very low credibility
Self-reported function: short term	No	No	Yes	Yes	No	Low credibility

Abbreviation: GRADE, Grading of Recommendations Assessment, Development and Evaluation.
[a]GRADE Working Group grades of evidence: high credibility, further research is very unlikely to change our confidence in the estimate of effect; moderate credibility, further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate; low credibility, further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; very low credibility, we are very uncertain about the estimate.

Health Professional–Delivered Education Compared to Exercise Therapy Plus Health Professional–Delivered Education

	Study Limitations (Risk of Bias)	Indirectness	Inconsistency	Imprecision	Publication Bias	GRADE Conclusion[a]
Knee pain: short term	No	No	Yes	No	Yes	Low credibility
Knee pain: medium term	No	No	Yes	No	Yes	Low credibility
Self-reported function: short term	No	No	Yes	Yes	Yes	Very low credibility
Knee extensor isometric strength: short term	No	No	Yes	Yes	No	Low credibility

Abbreviation: GRADE, Grading of Recommendations Assessment, Development and Evaluation.
[a]GRADE Working Group grades of evidence: high credibility, further research is very unlikely to change our confidence in the estimate of effect; moderate credibility, further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate; low credibility, further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; very low credibility, we are very uncertain about the estimate.

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APPENDIX C

DESCRIPTION OF INTERVENTIONS DELIVERED BY STUDIES, BASED ON THE TEMPLATE FOR INTERVENTION DESCRIPTION AND REPLICATION GUIDELINE

Education Intervention

Study	Provider	How	Where	When and How Much	Tailoring	How Well	What
Clark et al[8]	Physical therapist	Face-to-face sessions	NR	6 face-to-face sessions over 3 mo	Standardized	NR	Nature and possible causes of PFP, anatomy, footwear, appropriate sporting activities, pain-controlling drugs, stress relaxation techniques, ice, massage, diet, weight advice, prognosis, and self-help
Esculier et al[21]	Physical therapist	Face-to-face sessions	Clinic	5 face-to-face sessions over 8 wk	Individualized weekly running programs	NR	Education on load management and instruction to self-modify running training according to symptoms. Education on pain management
Mason et al[35]	Physical therapist	NR	NR	1 session	Standardized	NR	Advice and overview of knee anatomy and function, especially in relation to the loading of the patellofemoral joint and the importance of the quadriceps muscle
Moyano et al[36]	Physical therapist	Health education material	Clinic	1 session	Standardized	NR	NR
Rathleff et al[43]	Physical therapist	Face-to-face session and leaflet	School	1 face-to-face session, 30 min in duration	Standardized	NR	Reasons for pain, pain management, how to modify physical activity using pacing and load management strategies, and information on optimal knee alignment during daily tasks
Rathleff et al[44]	Physical therapist	Face-to-face session and leaflet	School	1 face-to-face session, 30 min in duration	Standardized	NR	Reasons for pain, pain management, how to modify physical activity, how to return slowly to sports, how to cope with knee pain, and information on optimal knee alignment during sit-to-stand, standing, walking, stair walking, and cycling
Song et al[47]	Physical therapist	Health education material	NR	1 session	Standardized	NR	Health education material regarding PFP
van Linschoten et al[48]	GP or sport physician	Health education material (leaflet)	NR	1 session	Standardized	NR	Information about PFP and advice to refrain from all sports activities that provoke pain. Instructions for daily isometric quadriceps contractions

Abbreviations: GP, general practitioner; NR, not reported; PFP, patellofemoral pain.

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APPENDIX C

Exercise Intervention

Study	Provider	How	Where	When and How Much	Tailoring	How Well	What
Clark et al[8]	Physical therapist	Face-to-face sessions	NR	6 face-to-face sessions over 3 mo	NR	Adherence in diary sheet	Hamstring, iliotibial band, quadriceps, and gastrocnemius stretches Quadriceps and hip strengthening Functional isotonic exercises
Esculier et al[21]	Physical therapist	Face-to-face sessions	Clinic	5 face-to-face sessions over 8 wk	Standardized home exercise program and personalized program	NR	Standardized home exercise program aimed at improving strength, capacity to sustain mechanical load, and dynamic control of the lower limbs
Mason et al[35]	Physical therapist	Home sessions	Patients' homes	3 face-to-face sessions over 1 wk	Standardized with personalized dosage adjustments	A weekly exercise diary indicating the number of sessions completed each day	Quadriceps strengthening and stretching exercises
Moyano et al[36]	Physical therapist	Face-to-face sessions	Clinic	3 face-to-face sessions of 20-60 min in duration per week over 16 wk	Standardized with personalized stretching adjustments	NR	Hip and knee stretching exercises
Rathleff et al[43]	Physical therapist	A combination of supervised group training sessions and unsupervised (5-page leaflet) home-based exercises	School	3 face-to-face group sessions plus 4 home sessions of 15 min in duration per week over 3 mo	Standardized with personalized dosage adjustments	Adherence was recorded as attendance. Adherence to home exercises was monitored by weekly follow-ups using SMS	A combination of supervised group training sessions and unsupervised home-based exercises Supervised group training sessions consisted of neuromuscular training of the muscles around the foot, knee, and hip and strength and stretch training for the knee and hip
Rathleff et al[44]	Physical therapist	Face-to-face group and home sessions	School	3 face-to-face group sessions plus 4 home sessions of 15 min in duration per week over 3 mo	Standardized with personalized dosage adjustments	Adherence was recorded as attendance. Adherence to home exercises was monitored by weekly follow-ups using SMS	A combination of supervised group training sessions and unsupervised home-based exercises Supervised group training sessions consisted of neuromuscular training of the muscles around the foot, knee, and hip and strength and stretch training for the knee and hip
Song et al[47]	Physical therapist	Exercise sessions	NR	3 weekly exercise sessions over 8 wk	Standardized with personalized dosage adjustments	NR	Simple leg-press exercise, performed unilaterally, starting from 45° of knee flexion to full extension. Or, a 50-N hip adduction force was applied to the distal one third of the thigh; this force was achieved by tying a blue Thera-Band to an arm of the leg-press machine
van Linschoten et al[48]	Physical therapist	Face-to-face and home sessions	NR	9 face-to-face sessions over 6 wk plus exercises daily for 25 min over 3 mo	Standardized with personalized dosage adjustments	Patients received a diary to register their amount of exercise	Static and dynamic muscular exercises for the quadriceps, adductor, and gluteal muscles The intervention also included balance exercises and flexibility exercises for major thigh muscles

Abbreviations: NR, not reported; SMS, short message service.

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APPENDIX C

Taping Intervention

Study	Provider	How	Where	When and How Much	Tailoring	How Well	What
Clark et al[8]	Physical therapist	Face-to-face sessions	NR	6 face-to-face sessions over 3 mo	During the fourth and fifth visits, taping was only applied during painful activities	Adherence in diary sheet	Tape was applied from the lateral border of the patella, pulling medially and upward over the medial femoral condyle
Mason et al[35]	Physical therapist	Face-to-face and home sessions	Patients' homes	1 session	Taping was specifically applied and targeted to the patient's requirements	Tape was replaced by the treating physical therapist if it came off during the week	Patients had infrapatellar taping applied for 1 wk

Abbreviation: NR, not reported.

Gait Retraining

Study	Provider	How	Where	When and How Much	Tailoring	How Well	What
Esculier et al[21]	Physical therapist	Face-to-face sessions	Clinic	5 face-to-face sessions over 8 wk	Individualized weekly programs	NR	Runners were asked to increase step rate by 7.5% to 10%. Runners were also asked to run softer and to adopt a non–rearfoot-strike pattern

Abbreviation: NR, not reported.

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APPENDIX D

STUDY CHARACTERISTICS

Study	Population	Education	Participants[a]	Comparator Intervention (plus education)	Participants[a]
Clark et al[8]	Young adults	Health professional–delivered education (n = 22)	Men, n = 13 (59%); women, n = 9 (41%) Age, 27 ± 7 y BMI, 25.2 ± 4.2 kg/m^2	Taping, n = 19	Men, n = 10 (53%); women, n = 9 (47%) Age, 29 ± 6 y BMI, 25.0 ± 3.9 kg/m^2
				Exercise, n = 20	Men, n = 12 (60%); women, n = 8 (40%) Age, 29 ± 6 y BMI, 24.9 ± 4.2 kg/m^2
				Taping plus exercise, n = 20	Men, n = 10 (50%); women, n = 10 (50%) Age, 29 ± 6 y BMI, 24.8 ± 5.7 kg/m^2
Esculier et al[21]	Runners	Health professional–delivered education (n = 23)	Men, n = 8 (35%); women, n = 15 (65%) Age, 30 ± 5 y BMI NR	Exercise, n = 23	Men, n = 9 (39%); women, n = 14 (61%) Age, 33 ± 6 y BMI NR
				Gait retraining, n = 23	Men, n = 9 (39%); women, n = 14 (61%) Age, 28 ± 6 y BMI NR
Kim et al[28]	Adolescents, adults, and elderly persons	Online health education material (n = 286)	Men, n = 111 (39%); women, n = 175 (61%) Age, 52 y BMI, 28 kg/m^2	Simple exercise therapy, n = 290	Men, n = 104 (36%); women, n = 186 (64%) Age, 51 y BMI, 29.2 kg/m^2
				Progressive exercise therapy, n = 284	Men, n = 111 (39%); women, n = 173 (61%) Age, 51 y BMI, 29.1 kg/m^2
Mason et al[35b]	Adolescents, adults, and elderly persons	Health professional–delivered education (n = 15)	NR	Taping, n = 15	NR
				Strengthening, n = 15	NR
				Stretching, n = 15	NR
Moyano et al[36]	Young and older adults	Health education material (n = 26)	Men, n = 21 (81%); women, n = 5 (19%) Age, 39 ± 3 y BMI, 24.5 ± 6.2 kg/m^2	Stretching, n = 35	Men, n = 22 (63%); women, n = 13 (37%) Age, 40 ± 3 y BMI, 24.8 ± 5.1 kg/m^2
				PNF stretching, n = 33	Men, n = 19 (57%); women, 14 (43%) Age, 40 ± 2 y BMI, 25.2 ± 6.5 kg/m^2
Rathleff et al[44]	Female adolescents	Health professional–delivered education (n = 29)	Women, n = 29 (100%) Age, 17 (16-18) y[c] BMI, 21.0 ± 2.0 kg/m^2	Exercise therapy, n = 28	Women, n = 28 (100%) Age, 17 (16-18) y[c] BMI, 20.2 ± 1.7 kg/m^2
Rathleff et al[43]	Adolescents	Health professional–delivered education (n = 59)	Men, n = 9 (15%); women, n = 50 (85%) Age, 17 ± 1 y BMI, 22.4 ± 3.1 kg/m^2	Exercise therapy, n = 62	Men, n = 16 (26%); women, n = 46 (74%) Age, 17 ± 1 y BMI, 21.1 ± 2.5 kg/m^2
Song et al[47]	Young adults	Health education material (n = 30)	Men, n = 4 (13%); women, n = 26 (87%) Age, 43 ± 9 y BMI, 22.5 ± 2.1 kg/m^2	Simple leg-press exercise, n = 30	Men, n = 8 (27%); women, n = 22 (73%) Age, 40 ± 9 y BMI, 23.0 ± 3.0 kg/m^2
				Leg press plus 50 N of hip adduction force, n = 29	Men, n = 8 (28%); women, n = 21 (72%) Age, 38 ± 10 y BMI, 22.2 ± 3.2 kg/m^2

Table continues on page D7.

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APPENDIX D

Study	Population	Education	Participants[a]	Comparator Intervention (plus education)	Participants[a]
van Linschoten et al[48]	Adolescents and adults	Health education material (n = 66)	Men, n = 24 (36%); women, n = 42 (64%) Age, 23 ± 7 y BMI, 23.0 ± 3.4 kg/m^2	Exercise therapy, n = 65	Men, n = 23 (35%); women, n = 42 (65%) Age, 24 ± 8 y BMI, 23.2 ± 3.9 kg/m^2

Abbreviations: BMI, body mass index; NR, not reported; PNF, proprioceptive neuromuscular facilitation.
[a]*Values are mean or mean ± SD unless otherwise indicated.*
[b]*Authors reported anthropometric data of the entire sample before randomization (mean age, 45 years; BMI, 27 kg/m^2).*
[c]*Authors reported data as median (interquartile range).*

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APPENDIX E

PEDRO APPRAISAL TOOL RESULTS

	Criterion[a]											
Study	**1[b]**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Score**
Clark et al[8]	1	1	0	1	0	0	1	1	1	1	1	7
Esculier et al[21]	1	1	1	1	0	0	1	1	1	1	1	8
Kim et al[28]	0	1	0	0	0	0	0	0	1	1	1	4
Mason et al[35]	1	1	1	1	0	0	1	0	0	1	1	6
Moyano et al[36]	1	1	1	1	0	0	0	1	0	1	1	6
Rathleff et al[44]	1	1	0	1	0	0	1	0	0	1	1	5
Rathleff et al[43]	1	1	0	1	0	0	1	0	1	1	1	6
Song et al[47]	1	1	1	1	0	0	1	1	1	1	1	8
van Linschoten et al[48]	1	1	0	1	0	0	0	1	1	1	1	6

Abbreviation: PEDro, Physiotherapy Evidence Database.

[a]Criteria: 1, Eligibility criteria were specified; 2, Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received); 3, Allocation was concealed; 4, The groups were similar at baseline regarding the most important prognostic indicators; 5, There was blinding of all subjects; 6, There was blinding of all therapists who administered the therapy; 7, There was blinding of all assessors who measured at least 1 key outcome; 8, Measures of at least 1 key outcome were obtained from more than 85% of the subjects initially allocated to groups; 9, All subjects for whom outcome measures were available received the treatment or control condition as allocated, or, where this was not the case, data for at least 1 key outcome were analyzed by "intention to treat"; 10, The results of between-group statistical comparisons were reported for at least 1 key outcome; 11, The study provided both point measures and measures of variability for at least 1 key outcome.

[b]This eligibility criterion does not contribute to the total score.

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APPENDIX F

STANDARDIZED MEAN DIFFERENCES OF INDIVIDUAL STUDIES

Health Education Material Versus Exercise Therapy—Other Outcomes: Short Term

Study/Outcome	SMD[a]
Moyano et al[36]	
Knee range of motion	−1.86 (−2.39, −1.34)
Song et al[47]	
Vastus medialis volume	−0.69 (−1.14, −0.24)
Vastus medialis CSA	−0.59 (−1.04, −0.14)

Abbreviations: CSA, cross-sectional area; SMD, standardized mean difference.
[a]*Values in parentheses are 95% confidence interval.*

Health Professional–Delivered Education Versus Exercise Therapy Plus Health Professional–Delivered Education—Other Outcomes: Short Term

Study/Outcome	SMD[a]
Clark et al[8]	
Anxiety (HADS)	−0.52 (−1.10, 0.07)
Depression (HADS)	−0.31 (−0.67, 0.05)
Esculier et al[21]	
Weekly running distance	−0.01 (−0.62, 0.59)
Rathleff et al[43]	
Knee-related quality of life	−0.31 (−0.92, 0.30)

Abbreviations: HADS, Hospital Anxiety and Depression Scale; SMD, standardized mean difference.
[a]*Values in parentheses are 95% confidence interval.*

Health Professional–Delivered Education Versus Taping Plus Health Professional–Delivered Education—Other Outcomes: Short Term

Study/Outcome	SMD[a]
Clark et al[8]	
Worst knee pain	−0.54 (−1.16, 0.09)
Self-reported function	−0.44 (−1.07, 0.18)
Anxiety (HADS)	−0.05 (−0.66, 0.56)
Depression (HADS)	0.06 (−0.55, 0.68)
Knee extensor isometric strength	−0.23 (−0.85, 0.38)
Mason et al[35]	
Pain ascending stairs	−0.29 (−1.01, 0.43)
Pain descending stairs	−0.24 (−0.96, 0.48)

Abbreviations: HADS, Hospital Anxiety and Depression Scale; SMD, standardized mean difference.
[a]*Values in parentheses are 95% confidence interval.*

Health Professional–Delivered Education Versus Gait Retraining Plus Health Professional–Delivered Education—Other Outcomes: Short Term

Study/Outcome	SMD[a]
Esculier et al[21,b]	
Worst knee pain	−0.28 (−0.86, 0.30)
Usual knee pain	−0.42 (−1.01, 0.16)
Weekly running distance	−0.07 (−0.65, 0.51)

Abbreviation: SMD, standardized mean difference.
[a]*Values in parentheses are 95% confidence interval.*
[b]*Participants who were randomized to receive exercise therapy also received the education intervention.*

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