Journal of Physiotherapy 67 (2021) 177–189

Journal of PHYSIOTHERAPY

journal homepage: www.elsevier.com/locate/jphys

Research

Patient education improves pain and function in people with knee osteoarthritis with better effects when combined with exercise therapy: a systematic review

Anthony J Goff [a,b], Danilo De Oliveira Silva [a], Mark Merolli [c], Emily C Bell [a], Kay M Crossley [a], Christian J Barton [a,d,e]

[a] *La Trobe Sport and Exercise Medicine Research Centre, School of Allied Health, Human Services and Sport, La Trobe University, Melbourne, Australia;* [b] *Health and Social Sciences, Singapore Institute of Technology, Singapore;* [c] *Centre for Health, Exercise, and Sports Medicine, The University of Melbourne, Melbourne, Australia;* [d] *Department of Physiotherapy, Podiatry and Prosthetics and Orthotics, School of Allied Health, Human Services and Sport, La Trobe University, Melbourne, Australia;* [e] *Department of Surgery, St Vincent's Hospital, University of Melbourne, Melbourne, Australia*

KEY WORDS

Patient education
Knee
Osteoarthritis
Physical therapy
Systematic review

ABSTRACT

Question: Is patient education effective as a standalone intervention or combined with other interventions for people with knee osteoarthritis? **Design**: Systematic review of randomised controlled trials. MEDLINE, EMBASE, SPORTDiscus, CINAHL and Web of Science were searched from inception to April 2020. The Cochrane Risk of Bias tool was used for included studies, and Grading of Recommendations, Assessment, Development and Evaluations (GRADE) was used to interpret certainty of results. **Participants**: People with knee osteoarthritis. **Intervention**: Any patient education intervention compared with any non-pharmacological comparator. **Outcome measures**: Primary outcomes were self-reported pain and function. **Results**: Twenty-nine trials involving 4,107 participants were included, informing low to very-low certainty evidence. Nineteen of 28 (68%) pooled comparisons were not statistically significant. Patient education was superior to usual care for pain (SMD −0.35, 95% CI −0.56 to −0.14) and function in the short term (−0.31, 95% CI −0.62 to 0.00), but inferior to exercise therapy for pain in the short term (0.77, 95% CI 0.07 to 1.47). Combining patient education with exercise therapy produced superior outcomes compared with patient education alone for pain in the short term (0.44, 95% CI 0.19 to 0.69) and function in the short (0.81, 95% CI 0.54 to 1.08) and medium term (0.39, 95% CI 0.15 to 0.62). When using the Western Ontario and McMaster Universities Osteoarthritis Index for these comparisons, clinically important differences indicated that patient education was inferior to exercise therapy for pain in the short term (MD 1.56, 95% CI 0.14 to 2.98) and the combination of patient education and exercise therapy for function in the short term (8.94, 95% CI 6.05 to 11.82). **Conclusion**: Although patient education produced statistically superior short-term pain and function outcomes compared with usual care, differences were small and may not be clinically important. Patient education should not be provided as a standalone treatment and should be combined with exercise therapy to provide statistically superior and clinically important short-term improvements in function compared with education alone. **Registration**: PROSPERO CRD42019122004. **[Goff AJ, De Oliveira Silva D, Merolli M, Bell EC, Crossley KM, Barton CJ (2021) Patient education improves pain and function in people with knee osteoarthritis with better effects when combined with exercise therapy: a systematic review. *Journal of Physiotherapy* 67:177–189]**

Introduction

Knee osteoarthritis (OA) is a leading cause of disability worldwide, affecting up to one in four people over the age of 50 years.[1,2] The growing healthcare burden related to knee OA in many developed countries is considered unsustainable. For example, A$905 million was spent in Australia in 2013 on knee replacement surgery alone, a figure expected to rise to $1.38 billion by 2030.[3] All major clinical practice guidelines recommend patient education, exercise therapy and weight management as first-line interventions for knee OA.[4–7] These recommendations are supported by compelling evidence of the effectiveness and cost-effectiveness of exercise therapy[8–10] and weight management[11–13] in people with knee OA. However, the inclusion of patient education as a first-line intervention for people with knee OA in clinical practice guidelines is often justified by evidence relating to people with OA elsewhere in the body, other forms of arthritis or chronic pain.[14–17]

The search for the most recently published high-quality evidence synthesis evaluating the effectiveness of patient education on pain and function in people with OA was completed in 2012.[18] This

https://doi.org/10.1016/j.jphys.2021.06.011

Cochrane review[18] did not distinguish knee OA from other arthritic conditions, and reported little to no benefit of patient education programs for pain, function and quality of life compared with providing information only, usual care only or no treatment. Other more-recent reviews have focused on self-efficacy and quality of life outcomes in people with knee OA following education.[19,20] The review that examined self-efficacy reported no difference when patient education was compared with a combination of patient education and exercise therapy.[19] The review that examined quality of life reported no difference when self-directed education was compared with a combination of self-directed education and physical activity or therapist-facilitated patient education alone.[20] No recent comprehensive review specifically evaluating pain and function outcomes in people with knee OA exists to guide clinical practice guidelines.

The primary objectives of this review were to estimate the effects of patient education on self-reported pain and function outcomes as a standalone intervention or in combination with other interventions for people with knee OA. The secondary aims of this review were to estimate the effects of patient education on psychological outcomes and to estimate the effects of therapist-facilitated education compared with self-directed education on pain and function outcomes for people with knee OA.

Therefore, the research question for this systematic review was:

Is patient education effective as a standalone intervention or combined with other interventions for people with knee osteoarthritis?

Box 1. Inclusion criteria.

Design
- Randomised controlled trials including cluster randomised controlled trials

Participants
- People with clinically or radiographically diagnosed knee osteoarthritis

Intervention
- Any form of patient education

Outcome measures
- Primary: self-reported joint-related pain or function scales
- Secondary: self-reported psychological outcomes

Comparisons
- Any other non-pharmacological intervention including usual care or no treatment

Methods

The protocol for this systematic review was prospectively registered in January 2019. Design and reporting of this review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[21]

Identification and selection of studies

A comprehensive search strategy was devised based on the Cochrane Handbook[22] and a previous review investigating patient education in patellofemoral pain,[23] and applied to each of the following databases from inception to April 2020: MEDLINE via OVID, EMBASE via OVID, SPORTDiscus via EBSCO, CINAHL via EBSCO, and Web of Science. The search strategy was developed using Medical Subject Headings and key words to identify randomised controlled trials in adults with knee OA. The search strategies can be found in Appendix 1 on the eAddenda.

All references were imported into a reference management software[a] and duplicates were removed. Two reviewers (AJG and DOS) independently reviewed the titles and abstracts, obtaining full-text copies of potentially eligible articles for review. Full texts were then independently reviewed by the same two reviewers to determine eligibility based upon the inclusion criteria shown in Box 1. In the case of disagreements, a third reviewer (CJB) was consulted to reach consensus.

Randomised controlled trials, including cluster randomised trials, delivering any form of patient education for people with either clinical or radiographically confirmed knee OA,[4–7,24] compared with any non-pharmacological intervention were considered for inclusion in this review, even if the patient educational intervention was the control intervention. No date, setting or language restrictions were applied. Non-randomised controlled trials, cross-sectional studies, case series and case reports were excluded from this review.

Assessment of characteristics of studies

Risk of bias was assessed by two independent reviewers (AJG and MM) using the Cochrane Risk of Bias Tool[25] categories: random sequence generation; allocation concealment; blinding of participants and personnel; blinding of outcome assessment; incomplete outcome data; selective reporting; and other bias (imbalances in baseline characteristics and compliance with the intervention). Following consultation and agreement between three people in the research team (AJG, DOS and CJB), trials were classified as low risk of bias when they appropriately reported that they met at least four of these seven criteria, and high risk of bias otherwise.

Data analysis

Participant and study characteristics and means and SDs for primary and secondary outcomes were extracted by two reviewers independently (AJG and ECB). Primary outcomes were self-reported joint-related pain and function measures, such as Western Ontario and McMaster Universities Osteoarthritis Index[26] (WOMAC) and a visual analogue scale for pain. Secondary outcomes were self-reported psychological measures, such as the arthritis self-efficacy scale,[27] pain catastrophising scale[28] and Coping Strategies Questionnaire.[29] Authors were contacted a maximum of two times via email to request necessary data when it could not be extracted from a published manuscript (eg, data were pooled for hip and knee OA, or mean changes were reported) before the manuscript was excluded. When a trial reported data that required transformation to a different statistic for meta-analysis, appropriate calculations were made according to the Cochrane Handbook[22] and previous research.[30]

Data analysis of primary and secondary outcomes was completed using Cochrane Collaboration software[b]. Data were pooled when trials investigated similar patient education interventions as a standalone intervention or in combination with other interventions. Overall estimate of effect was calculated using a random-effects model and reported as a SMD and 95% CI. Based upon consideration of recommendations from Cohen[31] and the Cochrane Handbook,[22] the effect sizes were categorised as small (< 0.3), moderate (0.3 to < 0.5), large (0.5 to < 0.8) or very large (≥ 0.80). Heterogeneity was quantified with the I^2 statistic.

The certainty of evidence for pooled trials was assessed and interpreted using Grading of Recommendations, Assessment, Development and Evaluations (GRADE)[32,33] and summarised using GRADE Pro Software[c]. Although it was planned to use a modified version of van Tulder's criteria,[34] it was decided to follow the Cochrane Handbook's recommendation to use GRADE. Full details of upgrade and downgrade criteria for all categories of GRADE, including heterogeneity, can be found in Table 1 on the eAddenda.

Data that could not be pooled were presented in table format and pooled data were presented using forest plots and summarised as SMDs and 95% CIs. In addition to this planned analysis, when all trials containing the same intervention type used the same outcome measure, MD was also calculated using a random-effects model to aid clinical interpretation. Each was subsequently

compared against suggested minimum clinically important differences (MCID) in published literature.[35,36] MCIDs of 1.5 points for pain[35] and 6 points for function[36] were nominated on the respective subsections of the WOMAC outcome measure. When a manuscript represented mean or MCID in a scaled format, it was converted back into the outcome's original raw form for pooling and interpretation.

Due to large variation in when outcome measures were assessed, we introduced subgrouping of short-term (< 6 months), medium-term (6 to < 12 months) and long-term (≥ 12 months) results where possible. These timelines are in line with Cochrane reviews investigating patient education in OA and exercise therapy in knee OA.[18,37]

A post hoc comparison between therapist-facilitated and self-directed education was deemed important, considering potential differences in healthcare resources and outcomes between the two. Therapist-facilitated education was classified as any educational intervention where the education was actively facilitated by a healthcare professional, regardless of profession (eg, physiotherapist, dietician, doctor), including one-to-one consultations, group classes, telephone consultations and telerehabilitation. Self-directed education was classified as any educational intervention that did not involve a healthcare professional explanation or opportunity for participants to ask questions related to the educational content (eg, leaflets, booklets, websites).

Although sensitivity analyses of effect were not planned, they were deemed necessary due to included trials with: multiple groups with similar interventions, multiple data outcomes within the same pre-specified time point, or multiple outcome measures for the same construct.

A planned mixed-methods analysis including a content evaluation of included trials and a cross-sectional analysis of general web content will be published elsewhere. Splitting of these further evaluations from this systematic review was considered necessary to improve clarity and impact of each component.

Results

Flow of studies through the review

Flow of trials through the review process can be found in Figure 1. Following removal of duplicates, 4,528 records were screened and 128 full-text articles were assessed for eligibility. This assessment led to the exclusion of 99 articles, primarily due to an ineligible study design (n = 47) or inability to acquire the necessary data from authors (n = 25). Full details of all excluded trials can be found in Appendix 2 on the eAddenda. Twenty-nine trials involving 4,107 participants were included for analysis.

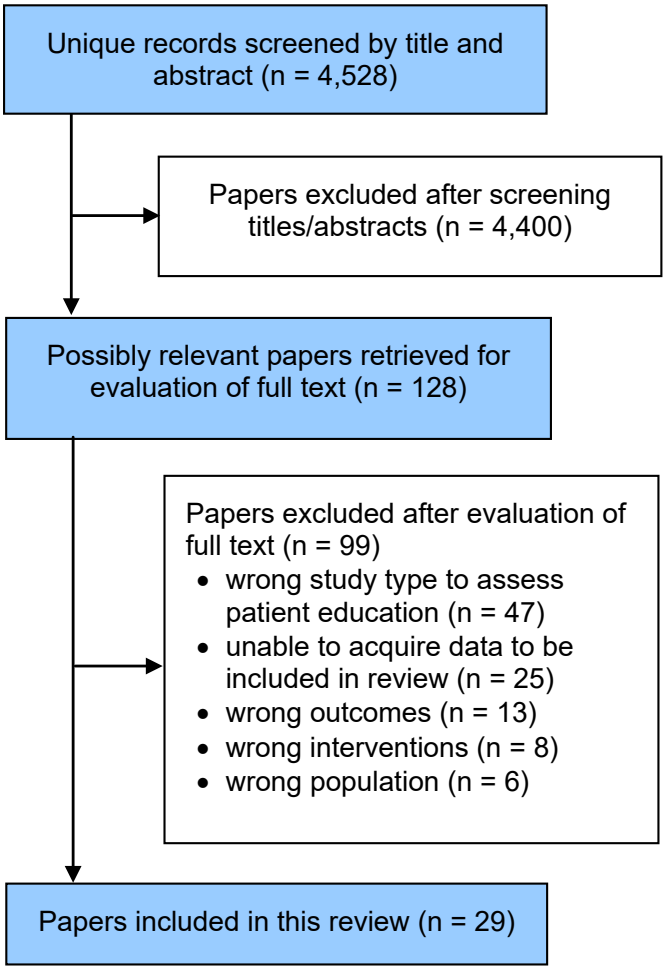


Figure 1. Flow of trials through the review.

Characteristics of trials

Characteristics of the 29 included trials are provided in Table 2. Twenty-eight trials included evaluation of patient education as a standalone intervention.[38–65] When patient education was combined with other interventions, it was always combined with exercise therapy (n = 10).[43–45,51,53,56–58,62,66] A total of 41 patient education interventions were identified across the 29 trials. Of the 41 patient education interventions, 14 were provided as a control, all of which were provided as standalone interventions.[38,42,44–47,49–52,56,58,62,63,65] More details can be found for the included trials and interventions in Table 3 on the eAddenda.

Results from risk of bias can be found in Figure 2. Before final decisions were made, there was a 91% agreement rate between the two independent reviewers. Eleven trials (38%) were classified as low risk of bias according to the definition of ≥ 4/7 categories on the Cochrane Risk of Bias Tool,[39,42,43,45,47,48,51,53,55,56,60] with the remaining 18 (62%) classified as having high risk of bias.[38,40,41,44,46,49,50,52,54,57–59,61–66] All trials were downgraded for performance and detection bias.

Effects of intervention

The results of data pooling for primary outcomes are shown in Figure 3 (ie, the effects of patient education as a standalone intervention) and Figure 4 (ie, the effects of patient education in combination with other interventions). The summarised results of pooled outcomes for secondary outcomes can be found in Table 4. The results of data pooling for secondary outcomes can be found in Figure 5 on the eAddenda. Summary GRADE tables for all comparisons are shown in Table 5 on the eAddenda. The summarised results of un-pooled data are shown in Table 6 on the eAddenda. The summarised results of MD analysis for all possible comparisons are shown in Table 7. Forest plots for all MD comparisons can be found in Figure 6 on the eAddenda. Note that more detailed forest plots for Figures 3 and 4 are available as Figures 7 and 8 on the eAddenda.

Patient education as a standalone intervention

Very-low certainty evidence indicated that patient education is superior to usual care for pain in the short term (SMD −0.35, 95% CI −0.56 to −0.14) based on six trials[41,48,54,55,60,61] (Figure 3a). Low certainty evidence indicated that patient education produces similar outcomes to usual care for pain in the medium term (SMD −0.10, 95% CI −0.26 to 0.05, four trials,[40,41,48,60] Figure 3b). Very-low certainty evidence indicated that patient education produces similar outcomes to usual care for pain in the long term (SMD −0.12, 95% CI −0.30 to 0.05, two trials,[39,40] Figure 3c). Very-low certainty evidence indicated that patient education is superior to usual care for function in the short term (SMD −0.31, 95% CI −0.62 to 0.00, six trials,[41,48,55,59,60,61] Figure 3d) but produces similar outcomes for function in the

Table 2
Characteristics of included trials.

Study	Participants			Intervention	
	Eligible population	Education	Comparator	Education	Comparator
Ackerman et al (2012)	Orthopaedic or rheumatology patients	Age (*y*) = 64 (11) M/F (%) = 38/62 BMI = 30 (24 to 35)	Age (*y*) = 67 (11) M/F (%) = 42/62 BMI = 29 (26 to 35)	Patient education (therapist-facilitated) (n = 58)	Patient education (self-directed) (n = 62)
Allen et al (2010)[a]	Primary care patients from a Veterans' medical centre	Age (*y*) = 60 (10) M/F (%) = 92/8 BMI = 32.0 (7.0)	Age (*y*) = 60 (11) M/F (%) = 93/7 BMI = 31.6 (6.5)	Patient education (therapist-facilitated) (n = 172)	Usual care (n = 172)
Allen et al (2016)	Overweight patients recruited from a Veterans' medical centre	Age (*y*) = 60 (9) M/F (%) = 87/13 BMI = 34.3 (6.0)	Age (*y*) = 62 (9) M/F (%) = 95/5 BMI = 33.4 (5.7)	Patient education (therapist-facilitated) (n = 151)	Usual care (n = 149)
Allen et al (2019)	African Americans recruited from a Veterans' medical centre	Age (*y*) = 59 (10) M/F (%) = 51/49 BMI = 35.6 (8.4)	Age (*y*) = 59 (11) M/F (%) = 51/49 BMI = 34.8 (7.9)	Patient education (therapist-facilitated) (n = 124)	Usual care (n = 124)
Ay et al (2013)[a]	NR	Age (*y*) = 59 (12) M/F (%) = 3/17 BMI = NR	Age (*y*) = 62 (11) M/F (%) = 25/75 BMI = NR	Patient education (therapist-facilitated) + exercise therapy (n = 20)	Exercise therapy (n = 20)
Baker et al (2001)	Community-dwelling	Age (*y*) = 69 (6) M/F (%) = 15/85 BMI = 31 (4)	Age (*y*) = 68 (6) M/F (%) = 83/17 BMI = 32 (5)	Patient education (therapist-facilitated) (n = 23)	Exercise therapy (n = 23)
Bennell et al (2016)	Community-dwelling	Age (*y*) = 63 (8) M/F (%) = 39/61 BMI = 30.8 (20)	Age (*y*) = 63 (8) M/F (%) = 41/59 BMI = 31.5 (6)	Patient education (therapist-facilitated) (n = 74)	Exercise therapy (n = 75)
			Age (*y*) = 65 (8) M/F (%) = 40/60 BMI = 31.0 (6)		Patient education (therapist-facilitated) + exercise therapy (n = 73)
Brosseau et al (2016)[a]	Community-dwelling	Age (*y*) = 62 (7) M/F (%) = 37/63 BMI = 29.9 (5.3)	Age (*y*) = 64 (10) M/F (%) = 30/70 BMI = 29.4 (5.4)	Patient education (self-directed) (n = 74)	Patient education (self-directed) + exercise therapy (n = 79)
Chen et al (2019)	Community-dwelling	Age (*y*) = 69 (7) M/F (%) = 14/86 BMI = 25.4 (3.5)	Age (*y*) = 69 (8) M/F (%) = 17/83 BMI = 25 (3.5)	Patient education (therapist-facilitated) (n = 70)	Patient education (therapist-facilitated) + exercise therapy (n = 70)
Cheung et al (2017)[b]	Community-dwelling	Age (*y*) = 72 (8) M/F (%) = NR BMI = 27.8 (7.9)	Age (*y*) = 74 (8) M/F (%) = NR BMI = 29.2 (7.1)	Patient education (therapist-facilitated) (n = 23)	Exercise therapy (n = 28)
Cheung et al (2020)	Community-dwelling	Age (*y*) = 623 (6) M/F (%) = 72/28 BMI = 22.1 (2.1)	Age (*y*) = 64 (6) M/F (%) = 82/18 BMI = 22.7 (1.3)	Patient education (therapist-facilitated) (n = 18)	Acupressure (n = 17)
Coleman et al (2012)	Primary care	Age (*y*) = 65 (8) M/F (%) = 20/80 BMI = NR	Age (*y*) = 65 (9) M/F (%) = 31/69 BMI = NR	Patient education (therapist-facilitated) (n = 71)	Usual care (n = 75)
De Rezende et al (2016)[b]	Trauma and orthopaedic patients	Age (*y*) = NR M/F (%) = NR BMI = NR	Age (*y*) = NR M/F (%) = NR BMI = NR	Patient education (therapist-facilitated) (Group 1a) (n = 29)	Patient education (self-directed) (Group 4b) (n = 29)
De Rezende et al (2017)[b]	Trauma and orthopaedic patients	Age (*y*) = NR M/F (%) = NR BMI = NR	Age (*y*) = NR M/F (%) = NR BMI = NR	Patient education (therapist-facilitated) (Group 1a) (n = 29)	Patient education (self-directed) (Group 4b) (n = 29)

Table 2 (*Continued*)

Study	Participants			Intervention	
	Eligible population	Education	Comparator	Education	Comparator
Dias et al (2017)	Community-dwelling	Age (*y*) = 71 (5) M/F (*%*) = 0/100 BMI = 30.0 (5.2)	Age (*y*) = 71 (5) M/F (*%*) = 0/100 BMI = 30.5 (4.3)	Patient education (therapist-facilitated) (n = 32)	Patient education (therapist-facilitated) + exercise therapy (n = 33)
Ettinger et al (1997)[b]	Community-dwelling	Age (*y*) = 69 (6) M/F (*%*) = 36/64 BMI = NR	Age (*y*) = 68 (6) M/F (*%*) = 27/73 BMI = NR	Patient education (therapist-facilitated) (n = 149)	Exercise therapy (n = 146)
Farr et al (2010)	Community-dwelling	Age (*y*) = 56 (6) M/F (*%*) = 28/72 BMI = 28 (4.0)	Age (*y*) = 56 (7) M/F (*%*) = 27/73 BMI = 27.5 (4.5)	Patient education (therapist-facilitated) (n = 57)	Exercise therapy (n = 52)
			Age (*y*) = 54 (7) M/F (*%*) = 21/79 BMI = 27.2 (4.2)		Patient education (therapist-facilitated) + exercise therapy (n = 62)
Ganji et al (2018)	Patients referred to an elderly care clinic	Age (*y*) = 65 (6) M/F (*%*) = NR BMI = NR	Age (*y*) = 65 (5) M/F (*%*) = NR BMI = NR	Patient education (therapist-facilitated) (n = 42)	Usual care (n = 41)
Helminen et al (2015)	Recruited from primary healthcare	Age (*y*) = 65 (7) M/F (*%*) = 29/71 BMI = 30.1 (6)	Age (*y*) = 63 (7) M/F (*%*) = 32/68 BMI = 29.9 (6.3)	Patient education (therapist-facilitated) (n = 55)	Usual care (n = 56)
Hinman et al (2020)	Community-dwelling	Age (*y*) = 63 (8) M/F (*%*) = 38/62 BMI = 31.2 (7.6)	Age (*y*) = 62 (9) M/F (*%*) = 37/63 BMI = 31.1 (6.8)	Patient education (therapist-facilitated) (n = 88)	Patient education (therapist-facilitated) + exercise therapy (n = 87)
Keefe et al (2004)	Patients recruited from rheumatology clinics	Age (*y*) = 60 (12) M/F (*%*) = 50/50 BMI = NR	Age (*y*) = 60 (9) M/F (*%*) = 66/34 BMI = NR	Patient education (therapist-facilitated) (n = 18)	Exercise therapy (n = 16)
			Age (*y*) = 60 (9) M/F (*%*) = 35/65 BMI = NR		Patient education (therapist-facilitated) + exercise therapy (n = 20)
			Age (*y*) = 58 (14) M/F (*%*) = 39/61 BMI = NR		Usual care (n = 18)
Messier et al (2004)	Community-dwelling	Age (*y*) = 69 (0.1)[c] M/F (*%*) = 32/68 BMI = 34.2 (0.6)[c]	Age (*y*) = 69 (0.8)[c] M/F (*%*) = 26/74 BMI = 34.2 (0.6)[c]	Patient education (therapist-facilitated, healthy lifestyle) (n = 78)	Exercise therapy (n = 80)
		Age (*y*) = 68 (0.7)[c] M/F (*%*) = 28/72 BMI = 34.5 (0.6)[c]	Age (*y*) = 69 (0.8)[c] M/F (*%*) = 26/74 BMI = 34.0 (0.7)[c]	Patient education (therapist-facilitated, weight loss focus) (n = 82)	Patient education (therapist-facilitated, weight loss focus) + exercise therapy (n = 76)
Murphy et al (2018)	Community-dwelling	Age (*y*) = 65 (8) M/F (*%*) = 23/77 BMI = 32.9 (6.3)	Age (*y*) = 61 (9) M/F (*%*) = 27/73 BMI = 29.8 (5.3)	Patient education (therapist-facilitated) (n = 31)	Usual care (n = 15)
O'Brien et al (2018)	Patients on orthopaedic consultation waitlist	Age (*y*) = 63 (11) M/F (*%*) = 34/66 BMI = 33.4 (3.4)	Age (*y*) = 60 (14) M/F (*%*) = 42/58 BMI = 32.1 (3.1)	Patient education (therapist-facilitated) (n = 59)	Usual care (n = 60)
O'Moore et al (2018)	Recruited from health care organisations	Age (*y*) = 63 (7) M/F (*%*) = 14/86 BMI = NR	Age (*y*) = 60 (6) M/F (*%*) = 32/68 BMI = NR	Patient education (self-directed) (n = 44)	Usual care (n = 25)

Table 2 (*Continued*)

Study	Eligible population	Participants: Education	Participants: Comparator	Intervention: Education	Intervention: Comparator
Oh et al (2020)	General community	Age (*y*) = 71 (5) M/F (%) = NR BMI = 25.7 (3.8)	Age (*y*) = 72 (6) M/F (%) = NR BMI = 24.6 (2.5)	Patient education (therapist-facilitated) (n = 20)	Patient education (therapist-facilitated) + exercise therapy (n = 40)
Qingguang et al (2017)	Recruited from community centres	Age (*y*) = 65 (3) M/F (%) = 0/100 BMI = 25.0 (3.4)	Age (*y*) = 65 (3) M/F (%) = 0/100 BMI = 25.2 (3.5)	Patient education (therapist-facilitated) (n = 23)	Exercise therapy (n = 23)
Taglietti et al (2018)	Recruited from primary healthcare facility	Age (*y*) = 69 (7) M/F (%) = 38/62 BMI = 29.2 (0.8)	Age (*y*) = 67 (6) M/F (%) = 26/74 BMI = 30.4 (0.9)	Patient education (therapist-facilitated) (n = 29)	Exercise therapy (n = 31)
Victor et al (2005)	Patients referred to rheumatology clinics	Age (*y*) = 62 (11) M/F (%) = 25/75 BMI = NR	Age (*y*) = 65 (11) M/F (%) = 32/68 BMI = NR	Patient education (therapist-facilitated) (n = 120)	Patient education (self-directed) (n = 73)

Age and BMI data are mean (SD) or median (IQR), except where noted.
BMI = body mass index, F = female, M = male, NR = not reported.
[a] Trial included at least one other intervention group that was not used in analysis.
[b] Trial included at least one other intervention group that was used for sensitivity analysis only.
[c] Standard error.

medium term (SMD −0.17, 95% CI −0.40 to 0.07, four trials,[40,41,48,60] Figure 3e).

Very-low certainty evidence indicated that patient education is inferior to exercise therapy for pain in the short term (SMD 0.77, 95% CI 0.07 to 1.47, five trials,[43,46,53,63,64] Figure 3f) but produces similar results for pain in the medium term (SMD 0.12, 95% CI −0.11 to 0.36, four trials,[42,43,53,58] Figure 3g) and long term (SMD 0.18, 95% CI −0.11 to 0.46, three trials,[43,52,58] Figure 3h). Very-low certainty evidence indicated that patient education produces similar outcomes for function in the short term (SMD 0.33, 95% CI −0.02 to 0.69, three trials,[43,46,63] Figure 3i) and medium term (SMD 0.23, 95% CI −0.08 to 0.54, two trials[42,43] Figure 3j).

Patient education in combination with other interventions

Very-low certainty evidence indicated that patient education combined with exercise therapy produces similar outcomes compared with exercise therapy alone for pain in the short term (SMD 0.61, 95% CI −0.40 to 1.62, three trials,[43,53,66] Figure 4a) and medium term (SMD −0.10, 95% CI −0.30 to 0.50, two trials,[43,53] Figure 4b), and for function in the short term (SMD 1.32, 95% CI −0.57 to 3.20, two trials,[43,66] Figure 4c).

Very-low certainty evidence indicated that patient education combined with exercise therapy is superior to patient education alone for pain in the short term (SMD 0.44, 95% CI 0.19 to 0.69, five trials,[43,45,51,53,62] Figure 4d). Low certainty evidence indicated that patient education combined with exercise therapy produces similar outcomes to patient education alone for pain in the medium term (SMD 0.14, 95% CI −0.04 to 0.32, four trials,[43,53,56,58] Figure 4e). Low certainty evidence indicated that patient education combined with exercise therapy produces similar outcomes to patient education alone for pain in the long term (SMD 0.17, 95% CI −0.13 to 0.33, two trials,[43,56] Figure 4f). Low certainty evidence indicated that patient education combined with exercise therapy produces superior outcomes compared with patient education alone for function in the short term (0.81, 95% CI 0.54 to 1.08, three trials,[43,51,62] Figure 4g) and medium term (SMD 0.39, 95% CI 0.15 to 0.62, two trials,[43,56] Figure 4h). Very-low certainty evidence indicated that patient education combined with exercise therapy produces similar outcomes compared with patient education alone for function in the long term (SMD 0.24, 95% CI −0.06 to 0.54, two trials,[43,56] Figure 4i).

Secondary outcomes

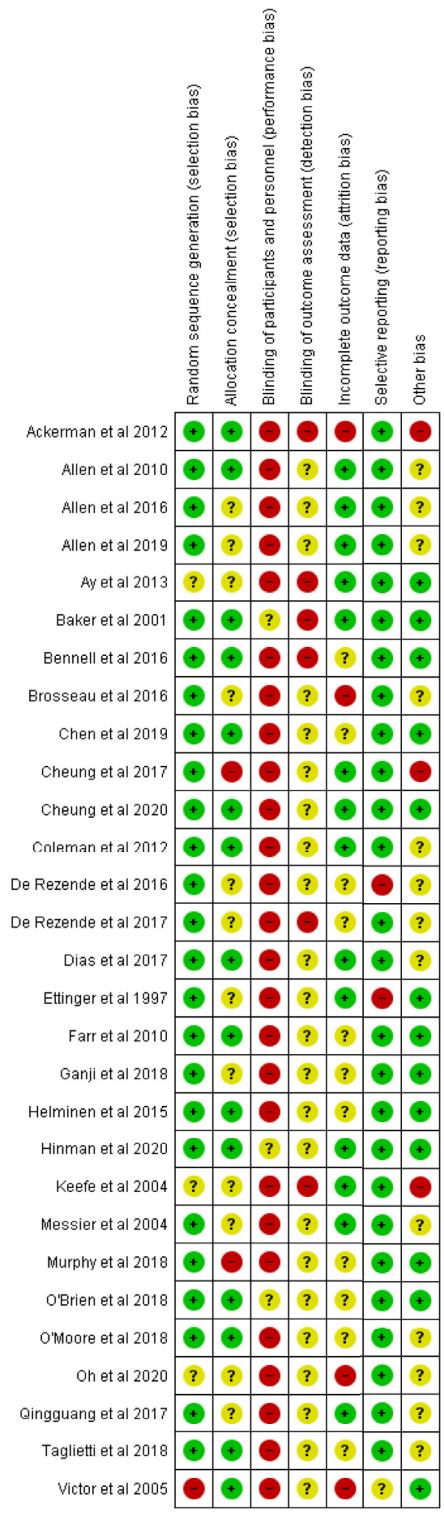
Full details of all comparisons can be found in Table 4 and Figure 5 (see eAddenda for Figure 5). Very-low certainty evidence indicated that patient education combined with exercise therapy is superior to patient education alone in the short term for self-efficacy (SMD 0.46, 95% CI 0.02 to 0.89, two trials,[43,57] Figure 5g on the eAddenda). Very-low certainty evidence indicated that patient education is superior for pain coping compared with usual care (SMD −0.71, 95% CI −1.32 to −0.01) and exercise therapy (SMD −0.96, 95% CI −1.42 to −0.49, two trials,[43,57] Figure 5f on the eAddenda) in the short term.

Sensitivity analyses

Multiple sensitivity analyses were performed during data analysis. There were five instances where performing a sensitivity analysis for alternate options would have changed outcome or size of effect. Details can be found in Appendix 3 on the eAddenda. The selection of comparisons used in this review was always based upon similarity of outcome, time points and interventions across pooled trials.

Discussion

This review provides a comprehensive synthesis of evidence related to patient education for knee OA, which can inform guidelines, clinical practice and future research. It is important to note that recommendations are primarily informed by very-low certainty



+ = Low risk of bias

? = Unclear risk of bias

- = High risk of bias

A trial was classified as low risk of bias if ≥ 4/7 items were reported as low risk of bias

Figure 2. Risk of bias for included trials.

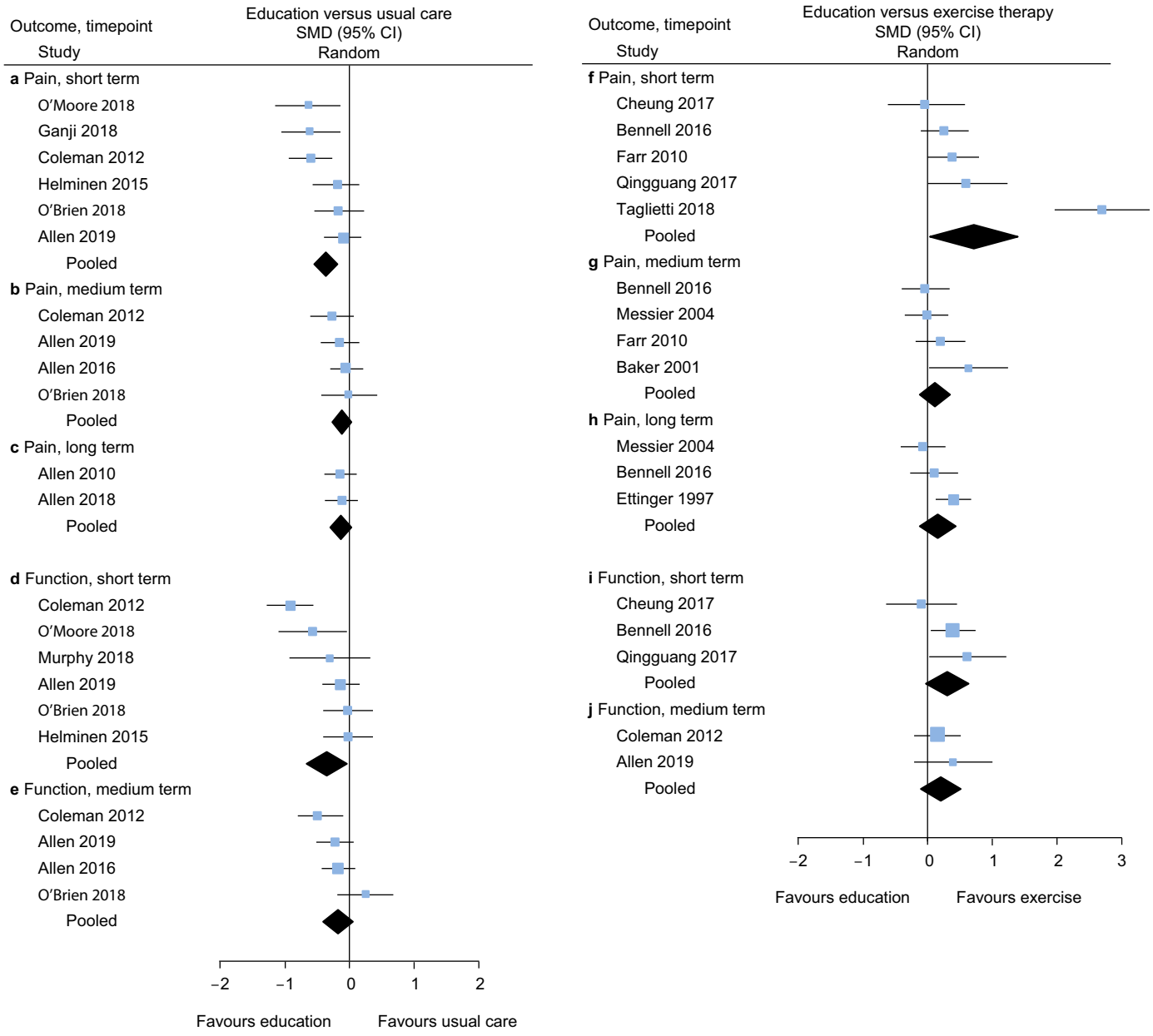


Figure 3. Effect of patient education: relative to usual care on pain in the **(a)** short, **(b)** medium and **(c)** long term and on function in the **(d)** short and **(e)** medium term; and relative to exercise on pain in the **(f)** short, **(g)** medium and **(h)** long term and on function in the **(i)** short and **(j)** medium term.

evidence. Pooling of 19 comparisons was possible; however, only six (32%) produced statistically significant findings. Of these six comparisons, two were clinically important for pain (ie, > 1.5 points)[36] or function (ie, > 6 points)[37] using the respective subsections of the WOMAC. Exercise therapy produced statistically superior and clinically important improvements in pain compared with patient education alone, and combining patient education with exercise therapy resulted in statistically superior and clinically important short-term improvements in function compared with education alone. It is therefore recommended that patient education should be provided in combination with exercise therapy whenever possible.

Very-low certainty evidence indicated that patient education produces a moderate beneficial effect at reducing pain and improving function in the short term compared with usual care. However, improvements may not be clinically important for either pain or function using the WOMAC, questioning its value in isolation. It is worth noting that as patient education is a guideline-recommended first-line intervention for people with knee OA,[4–7] education provided as part of usual care is unknown. Further research is warranted to investigate the effectiveness of patient education versus a wait-and-see approach.

Very-low certainty evidence indicated that patient education combined with exercise therapy produces moderate, statistically significant short-term improvements in pain, and very large, statistically and clinically important short-term improvements in function compared with patient education alone. Low-certainty evidence indicated that functional improvements are maintained in the medium term; however, differences are not clinically important. Although not statistically significant, very-low certainty evidence indicated that patient education combined with exercise therapy produces clinically important improvements in short-term pain and function compared with exercise therapy alone. Further research is warranted to explore the benefits of combining patient education with exercise therapy. A possible explanation for enhanced outcomes may be that providing patient education alongside exercise therapy improves exercise therapy adherence in people with knee OA.[11,67] Additionally, research across a number of musculoskeletal conditions suggests that patient education may improve illness perceptions,[68] self-efficacy[69] and fear-avoidance behaviours;[70] and create positive attitudes towards,[71] and a safer environment in which to attempt, exercise therapy. One way to potentially sustain improvements in the medium to long term could be providing additional face-

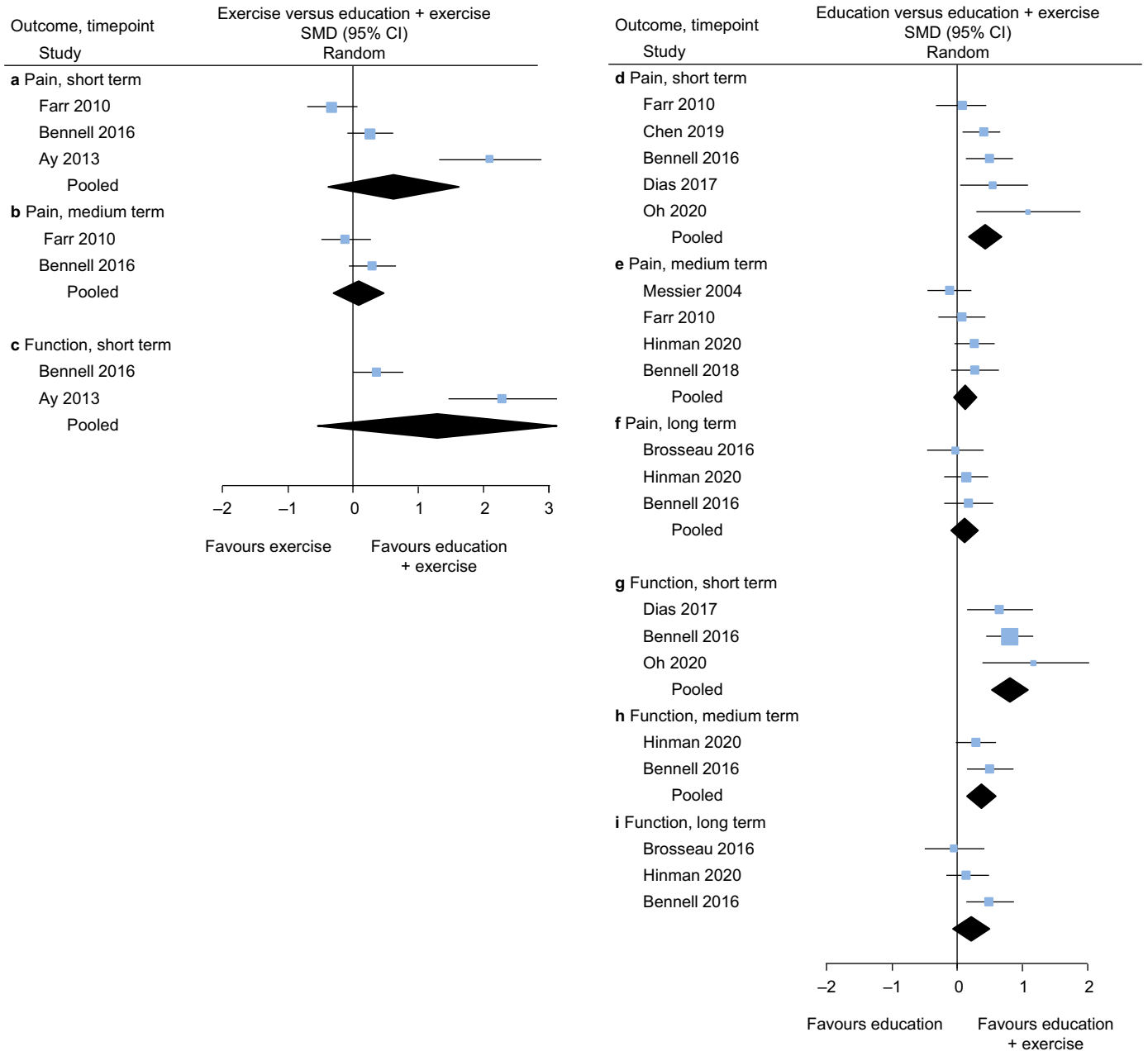


Figure 4. Effect of patient education in combination with exercise therapy: relative to exercise therapy alone on pain in the **(a)** short and **(b)** medium term and on function in the **(c)** short term; and relative to education alone on pain in the **(d)** short, **(e)** medium and **(f)** long term and on function in the **(g)** short, **(h)** medium and **(i)** long term.

to-face education sessions following the immediate treatment period, which unlike exercise therapy does not appear to have been explored. Booster exercise therapy sessions have been found to improve adherence to treatment in people with OA and low back pain.[72]

Very-low certainty evidence indicated that patient education is inferior to exercise therapy for pain outcomes, with a large and clinically important difference in the short-term, but these are not sustained in the medium term or long term. Very-low certainty evidence indicated that patient education produces similar outcomes compared with exercise therapy for function in the short term and medium term. These findings are in contrast to a recent review, which identified that patient education produces similar pain and function outcomes compared with exercise therapy in younger people with knee pain.[27] The lack of improvements in pain in younger people with knee pain may reflect a reduced need for exercise therapy in a less chronic condition. Additionally, it may also highlight the greater role of exercise therapy for people with knee OA due to associated high rates of comorbidities[73] and systemic inflammation.[74]

Very-low certainty evidence indicated that patient education has a moderate effect at improving short-term pain coping compared with usual care, and with a very large effect compared with exercise therapy. This is likely due to the highly targeted nature of education interventions to specifically develop pain coping skills in the trials associated with this comparison.[39,43,57] Combining patient education with exercise therapy did not appear to improve pain coping compared with patient education alone in the short term. However, very-low certainty evidence indicated that a combination of patient education and exercise therapy is superior to patient education alone, with a large effect for self-efficacy in the short term. These findings are in contrast to a previous review,[19] which reported that patient education programs combined with exercise therapy produced similar outcomes to patient education programs alone for self-efficacy outcomes in people with knee OA. These contrasting findings may be explained by the inclusion of different trials in the analysis of total arthritis self-efficacy scale[27] score in this review, rather than the pain, function and other subsections used in Brand

Table 4
Summary of secondary outcomes (SMD) for all pooled data.

Comparison	Outcome	Time point	n	SMD (95% CI)	Certainty	Figure in eAddenda
Patient education versus usual care	Self-efficacy	short	2	−0.41 (−0.82 to 0.01)	very low	5a
	Pain catastrophising	short	3	−0.02 (−0.45 to 0.42)	very low	5b
	Pain coping	short	2	−0.71 (−1.32 to −0.01)	very low	5c
Patient education versus exercise therapy	Self-efficacy	short	2	0.09 (−0.82 to 0.65)	very low	5d
	Pain catastrophising	short	2	−0.16 (−0.62 to 0.30)	very low	5e
	Pain coping	short	2	−0.96 (−1.42 to −0.49)	very low	5f
Patient education versus patient education + exercise therapy	Self-efficacy	short	2	0.46 (0.02 to 0.89)	very low	5g
	Pain catastrophising	short	2	0.15 (−0.15 to 0.46)	very low	5h
	Pain coping	short	2	0.04 (−0.34 to 0.26)	very low	5i
Therapist-facilitated education versus self-directed education	Pain	short	3	0.03 (−0.29 to 0.23)	very low	5j
		long	3	−0.04 (−0.48 to 0.39)	very low	5k
	Function	short	2	0.09 (−0.21 to 0.40)	very low	5l
		long	2	−0.05 (−0.53 to 0.62)	very low	5m

n = number of trials, SMD = standardised mean difference, 95% CI = 95% confidence interval.

et al's review.[19] The current findings combined with Brand et al's[19] findings suggest that patient education with or without exercise therapy has the potential to impact different domains of self-efficacy for people with knee OA; however, the relationship is not well understood and requires further investigation. Enhanced pain coping and self-efficacy is desirable due to known association with improvements in pain, function and physical activity,[69,75,76] which has the potential to enhance quality of life and reduce healthcare utilisation for people with knee OA. The psychological benefits of patient education identified in this review highlight the importance of considering outcomes beyond pain and function when guiding treatment recommendations based on available evidence.

Very-low certainty evidence indicated that therapist-facilitated education produces similar short-term and long-term pain and function outcomes compared with self-directed education. An important consideration in interpreting these findings is the approaches used in therapist-facilitated education and the content of each education intervention. Participants in De Rezendes's[49,50] self-directed education intervention received DVD recordings of the face-to-face therapist-facilitated education lectures and workshops. Therefore, the delivery method was different between groups; however, the content was the same. In comparison, both Ackerman et al's[38] and Victor et al's[65] delivery method and content were different between therapist-facilitated education and self-directed education interventions. The varied interventions used in these trials makes it challenging to draw any clear conclusions related to how to provide patient education for people with knee OA.

Delivery of patient education interventions in this review varied from singular lectures[66] and intensive group-based sessions over a number of sessions[38,43] to provision of self-directed education materials with or without follow-up telephone calls[39–41,45–47] or home visits.[38,42] The content of patient education interventions was equally varied, ranging from interventions targeting basic knowledge acquisition[45,48,51,66] to more complex psychologically informed self-management skill development.[41,43,57] Combined, these variations reflect the lack of recommendations for delivery method and content in clinical practice guidelines[4–7] and the lack of studies identifying how people with knee OA learn best. With the growing emphasis placed around patient-centred care for people with knee OA[4–7,77] and other musculoskeletal conditions,[78] further research evaluating ways to match delivery methods and/or content to the individual needs or preferences of people with knee OA is warranted. This could include consideration of blended learning approaches used for other chronic conditions,[79,80] as well as in tertiary medical[81] and healthcare[82] education for people with knee OA. Identifying optimal mode and content of patient education will influence how healthcare providers develop educational interventions and prioritise resources for people with knee OA.

It is important to consider that the results in this review were informed by all patient education interventions. Education interventions were included regardless of intervention development process (co-design, based on learning theory, etc) or whether they were used as a control. The decision to include all patient education interventions was chosen to reduce selection bias and appropriately assess all patient education interventions in published literature for people with knee OA. Further analysis of interventions based on development process or whether the intervention was designed as a control or not may impact these results. Certainty of the findings is limited due to the low and very-low categorisation of evidence using GRADE, and findings may change in the future with updated reviews on this topic. The variation and nature of patient education interventions, combined with the self-reported outcome measures assessed in this review significantly impacted risk of bias assessment, and the indirectness and imprecision measures of GRADE. The large heterogeneity between the included trials also impacted the imprecision measure of GRADE. Assessment of publication bias[29] was not possible for any comparison due to the small number of trials included within each comparison. Caution should be taken when applying the recommendations to younger people with knee OA (eg, post-traumatic knee OA), as the typical mean age of participants in this review was in the 60s. Lastly, clinical interpretation of results was not possible for all comparisons, and significant variation exists for MCID values for WOMAC pain and function subsections in knee OA.[83] Clinical interpretation of results may change depending upon the comparative MCID chosen and the inclusion of future research.

Although patient education produced statistically superior short-term pain and function outcomes compared with usual care, the differences were small and may not be clinically important. Patient education should not be provided as a standalone treatment and should be combined with exercise therapy to provide statistically superior and clinically important short-term improvements in function compared with education alone.

Table 7
Mean difference (95% CI) for all possible comparisons.

Comparison	n	Outcome	Time point	MD (95% CI)	MD better than MCID	Figure in eAddenda
Pain						
Patient education versus usual care	4	WOMAC pain	medium	−0.40 (−0.94 to 0.14)	N	6a
Patient education versus exercise therapy	5	WOMAC pain	short	1.56 (0.14 to 2.98)	Y	6d
Patient education versus exercise therapy	4	WOMAC pain	medium	0.42 (−0.39 to 1.23)	N	6e
Exercise therapy versus patient education + exercise therapy	3	WOMAC pain	short	2.01 (−1.16 to 5.18)	Y	6h
Exercise therapy versus patient education + exercise therapy	2	WOMAC pain	medium	0.31 (−0.97 to 1.59)	N	6i
Patient education versus patient education + exercise therapy	5	WOMAC pain	short	1.48 (0.48 to 2.49)	N	6k
Patient education versus patient education + exercise therapy	4	WOMAC pain	medium	0.49 (−0.07 to 1.06)	N	6l
Patient education versus patient education + exercise therapy	3	WOMAC pain	long	0.45 (−0.22 to 1.13)	N	6m
Therapist-facilitated education versus self-directed education	3	WOMAC pain	short	−0.15 (−0.99 to 0.68)	N	6q
Therapist-facilitated education versus self-directed education	3	WOMAC pain	long	−0.13 (−2.00 to 1.74)	N	6r
Function						
Patient education versus usual care	6	WOMAC function	short	−2.43 (−4.71 to −0.16)	N	6b
Patient education versus usual care	4	WOMAC function	medium	−2.12 (−4.55 to 0.31)	N	6c
Patient education versus exercise therapy	3	WOMAC function	short	3.36 (−1.00 to 7.71)	N	6f
Patient education versus exercise therapy	2	WOMAC function	medium	2.78 (−1.11 to 6.67)	N	6g
Exercise therapy versus patient education + exercise therapy	2	WOMAC function	short	13.08 (−5.44 to 31.60)	Y	6j
Patient education versus patient education + exercise therapy	3	WOMAC function	short	8.94 (6.05 to 11.82)	Y	6n
Patient education versus patient education + exercise therapy	2	WOMAC function	medium	4.61 (1.88 to 7.33)	N	6o
Patient education versus patient education + exercise therapy	3	WOMAC function	long	2.69 (−0.26 to 5.65)	N	6p
Therapist-facilitated education versus self-directed education[a]	2	WOMAC function	short	1.02 (−2.91 to 4.94)	N	6s
Therapist-facilitated education versus self-directed education	2	WOMAC function	long	0.71 (−7.98 to 9.40)	N	6t
Pain coping						
Patient education versus usual care	2	CSQ	short	−19 (−31 to −7)	N/A	6u
Patient education versus exercise therapy	2	CSQ	short	−25 (−33 to −1)	N/A	6v
Patient education versus patient education + exercise therapy	2	CSQ	short	−1 (−9 to 7)	N/A	6w

CSQ = Coping Strategies Questionnaire, MD = mean difference, MCID = minimal clinically important difference, N = no, n = number of trials, N/A = not assessed, 95% CI = 95% confidence intervals, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, Y = yes.
MCID values are 1.5 for pain and 6 for function. Negative MD = supports first listed intervention in comparison. Positive MD = supports second listed intervention in comparison.
[a] Assumed a typo in manuscript by Victor et al 2005: mean of 21 (SD 7) for control and 21 (SD 10) for experimental for the WOMAC function section at 1 month, rather than the reported 2.1 (SD 7) and 2.1 (SD 10), respectively.

What was already known on this topic: Patient education, exercise therapy and weight management are recommended by all major guidelines as a first-line intervention for people with knee osteoarthritis. Evidence supporting the effectiveness and cost-effectiveness for exercise therapy and weight management has been synthesised in recent systematic reviews. There is a lack of an up-to-date evidence synthesis for patient education to inform guidelines and practice.
What this study adds: The review findings indicate that patient education may reduce pain and improve function compared with usual care, although differences may not be clinically important, questioning its value in isolation. Combining patient education with exercise therapy should be encouraged considering statistically superior and clinically important improvements in function compared with patient education alone.

Footnotes: [a] EndNote X8, Thomson Reuters, Carlsbad, USA. [b] RevMan 5.3, The Nordic Cochrane Centre, Copenhagen, Denmark. [c] GRADEpro GDT, McMaster University, Ontario, Canada.

eAddenda: Figures 5 to 8, Tables 1, 3, 5 and 6, and Appendices 1 to 3 can be found online at https://doi.org/10.1016/j.jphys.2021.06.011

Ethics approval: Not applicable.

Competing interests: Nil.

Source(s) of support: Anthony Goff holds a sponsorship from Singapore Institute of Technology for the completion of his PhD at La Trobe. Christian J Barton was supported by an MRFF TRIP Fellowship (APP1150439). The financial sponsors played no role in the design, execution, analysis and interpretation of data, or writing of the study.

Acknowledgements: Nil.

Provenance: Not invited. Peer reviewed.

Correspondence: Dr Christian Barton, La Trobe Sport and Exercise Medicine Research Centre, School of Allied Health, Human Services and Sport, La Trobe University, Melbourne, Australia. Email: C.Barton@latrobe.edu.au

References

1. Cross M, Smith E, Hoy D, Nolte S, Ackerman I, Fransen M, et al. The global burden of hip and knee osteoarthritis: estimates from the global burden of disease 2010 study. *Ann Rheum Dis*. 2014;73:1323–1330.
2. Litwic A, Edwards MH, Dennison EM, Cooper C. Epidemiology and burden of osteoarthritis. *Br Med Bull*. 2013;105:185–199.
3. Ackerman IN, Bohensky MA, Zomer E, Tacey M, Gorelik A, Brand CA, et al. The projected burden of primary total knee and hip replacement for osteoarthritis in Australia to the year 2030. *BMC Musculoskelet Disord*. 2019;20:90.
4. Fernandes L, Hagen KB, Bijlsma JW, Andreassen O, Christensen P, Conaghan PG, et al. EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis. *Ann Rheum Dis*. 2013;72:1125–1135.
5. Conaghan PG, Dickson J, Grant RL. Care and management of osteoarthritis in adults: summary of NICE guidance. *BMJ*. 2008;336:502–503.
6. McAlindon TE, Bannuru RR, Sullivan M, Arden NK, Berenbaum F, Bierma-Zienstra ZM, et al. OARSI guidelines for the non-surgical management of knee osteoarthritis. *Osteoarthritis Cartilage*. 2014;22:363–388.
7. Kolasinski SL, Neogi T, Hochberg MC, Oatis C, Guyatt G, Block J, et al. 2019 American College of Rheumatology/Arthritis Foundation guideline for the management of osteoarthritis of the hand, hip, and knee. *Arthritis Rheumatol*. 2020;72:220–233.
8. Ackerman IN, Skou ST, Roos EM, Barton CJ, Kemp J, Crossley KM, et al. Implementing a national first-line management program for moderate-severe knee osteoarthritis in Australia: a budget impact analysis focusing on knee replacement avoidance. *Osteoarthr Cartil Open*. 2020:100070.
9. Verhagen A, Ferreira M, Reijneveld-van de Vendel E, Teirlinck CH, Runhaar J, van Middlekoop M, et al. Do we need another trial on exercise in patients with knee osteoarthritis?: no new trials on exercise in knee OA. *Osteoarthritis Cartilage*. 2019;27:1266–1269.
10. Fransen M, McConnell S, Harmer AR, Van der Esch M, Simic M, Bennell KL. Exercise for osteoarthritis of the knee: a Cochrane systematic review. *Br J Sports Med*. 2015;49:1554.
11. Gay C, Chabaud A, Guilley E, Coudeyre E. Educating patients about the benefits of physical activity and exercise for their hip and knee osteoarthritis. Systematic literature review. *Ann Phys Rehabil Med*. 2016;59:174–183.
12. Hall M, Castelein B, Wittoek R, Calders P, Van Ginckel A. Diet-induced weight loss alone or combined with exercise in overweight or obese people with knee osteoarthritis: a systematic review and meta-analysis. *Semin Arthritis Rheum*. 2019;48:765–777.

13. Losina E, Smith KC, Paltiel AD, Collins JE, Suter LG, Hunter DJ, et al. Cost-effectiveness of diet and exercise for overweight and obese patients with knee osteoarthritis. *Arthritis Care Res*. 2019;71:855–864.
14. Hansson EE, Jönsson-Lundgren M, Ronnheden A-M, Sörensson E, Bjärnung Å, Dahlberg LE. Effect of an education programme for patients with osteoarthritis in primary care-a randomized controlled trial. *BMC Musculoskelet Disord*. 2010;11:244.
15. Buszewicz M, Rait G, Griffin M, Nazareth I, Patel A, Atkinson A, et al. Self management of arthritis in primary care: randomised controlled trial. *BMJ*. 2006;333:879.
16. Broderick JE, Keefe FJ, Bruckenthal P, Junghaenel DU, Schneider S, Schwartz JE, et al. Nurse practitioners can effectively deliver pain coping skills training to osteoarthritis patients with chronic pain: a randomized, controlled trial. *Pain*. 2014;155:1743–1754.
17. Du S, Yuan C, Xiao X, Chu J, Qiu Y, Qian H. Self-management programs for chronic musculoskeletal pain conditions: a systematic review and meta-analysis. *Patient Educ Couns*. 2011;85:e299–e310.
18. Kroon FP, van der Burg LR, Buchbinder R, Osborne RH, Johnston RV, Pitt V. Self-management education programmes for osteoarthritis. *Cochrane Database Syst Rev*. 2014:CD008963.
19. Brand E, Nyland J, Henzman C, Mcginnis M. Arthritis self-efficacy scale scores in knee osteoarthritis: a systematic review and meta-analysis comparing arthritis self-management education with or without exercise. *J Orthop Sports Phys Ther*. 2013;43:895–910.
20. Briani RV, Ferreira AS, Pazzinatto MF, Pappas E, Silva DDO, de Azevedo FM. What interventions can improve quality of life or psychosocial factors of individuals with knee osteoarthritis? A systematic review with meta-analysis of primary outcomes from randomised controlled trials. *Br J Sports Med*. 2018;52:1031–1038.
21. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche P, Ioannidis JPA, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol*. 2009;62:e1–e34.
22. Higgins JP, Thomas J, Chandler J, Cumpston M, Li T, Page M, et al. eds. *Cochrane handbook for systematic reviews of interventions*. Chichester, UK: John Wiley & Sons; 2019.
23. de Oliveira Silva D, Pazzinatto MF, Rathleff MS, Holden S, Bell E, Azevedo S, et al. Patient education for patellofemoral pain: a systematic review. *J Orthop Sports Phys Ther*. 2020;50:388–396.
24. Kohn MD, Sassoon AA, Fernando ND. Classifications in brief: Kellgren-Lawrence classification of osteoarthritis. *Clin Orthop Relat Res*. 2016;474:1886–1893.
25. Higgins JP, Altman DG, Gøtzsche PC, Juni P, Moher D, Oxman A, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ*. 2011;343:d5928.
26. Bellamy N, Buchanan W. A preliminary evaluation of the dimensionality and clinical importance of pain and disability in osteoarthritis of the hip and knee. *Clin Rheumatol*. 1986;5:231–241.
27. Lorig K, Chastain RL, Ung E, Shoor S, Holman HR. Development and evaluation of a scale to measure perceived self-efficacy in people with arthritis. *Arthritis Rheum*. 1989;32:37–44.
28. Sullivan MJ, Bishop SR, Pivik J. The pain catastrophizing scale: development and validation. *Psychol Assess*. 1995;7:524.
29. Monticone M, Ferrante S, Giorgi I, Galandra C, Rocca B, Foti C. The 27-item coping strategies questionnaire—revised: confirmatory factor analysis, reliability and validity in italian-speaking subjects with chronic pain. *Pain Res Manag*. 2014;19.
30. Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. *BMC Med Res Methodol*. 2005;5:13.
31. Cohen J. A power primer. *Psychol Bull*. 1992;112:155.
32. Schünemann H, Brożek J, Guyatt G, Oxman A. *Handbook for grading the quality of evidence and the strength of recommendations using the GRADE approach* (updated October 2013). GRADE Working Group; 2013.
33. Guyatt GH, Oxman AD, Kunz R, Vist GE, Falck-Ytter Y, Schünemann HJ. GRADE: what is "quality of evidence" and why is it important to clinicians. *BMJ*. 2008;3:995–998.
34. Van Tulder M, Furlan A, Bombardier C, Bouter L, Editorial Board of the Cochrane Collaboration Back Review Group. Updated method guidelines for systematic reviews in the cochrane collaboration back review group. *Spine*. 2003;28:1290–1299.
35. Angst F, Aeschlimann A, Stucki G. Smallest detectable and minimal clinically important differences of rehabilitation intervention with their implications for required sample sizes using WOMAC and SF-36 quality of life measurement instruments in patients with osteoarthritis of the lower extremities. *Arthritis Care Res*. 2001;45:384–391.
36. Tubach F, Ravaud P, Baron G, Falissard B, Logeart I, Bellamy N, et al. Evaluation of clinically relevant changes in patient reported outcomes in knee and hip osteoarthritis: the minimal clinically important improvement. *Ann Rheum Dis*. 2005;64:29–33.
37. Hurley M, Dickson K, Hallett R, Grant R, Hauari H, Walsh N, et al. Exercise interventions and patient beliefs for people with hip, knee or hip and knee osteoarthritis: a mixed methods review. *Cochrane Database Syst Rev*. 2018;4:CD010842.
38. Ackerman IN, Buchbinder R, Osborne RH. Challenges in evaluating an Arthritis Self-Management Program for people with hip and knee osteoarthritis in real-world clinical settings. *J Rheumatol*. 2012;39:1047–1055.
39. Allen KD, Oddone EZ, Coffman CJ, Grant R, Hauari H, Walsh N, et al. Telephone-based self-management of osteoarthritis: a randomized trial. *Ann Intern Med*. 2010;153:570–579.
40. Allen KD, Yancy Jr WS, Bosworth HB, Coffman CJ, Jeffreys AS, Datta SK, et al. A combined patient and provider intervention for management of osteoarthritis in veterans: a randomized clinical trial. *Ann Intern Med*. 2016;164:73–83.
41. Allen KD, Somers TJ, Campbell LC, Arbeeva L, Coffman CJ, Cené CW, et al. Pain coping skills training for African Americans with osteoarthritis: results of a randomized controlled trial. *Pain*. 2019;160:1297.
42. Baker KR, Nelson ME, Felson DT, Layne JE, Sarno R, Roubenoff R. The efficacy of home based progressive strength training in older adults with knee osteoarthritis: a randomized controlled trial. *J Rheumatol*. 2001;28:1655–1665.
43. Bennell KL, Ahamed Y, Jull G, Bryant C, Hunt MA, Forbes AB, et al. Physical therapist-delivered pain coping skills training and exercise for knee osteoarthritis: randomized controlled trial. *Arthritis Care Res*. 2016;68:590–602.
44. Brosseau L, Wells GA, Kenny GP, Reid R, Maetzel A, Tugwell P, et al. The implementation of a community-based aerobic walking program for mild to moderate knee osteoarthritis (OA): a knowledge translation (KT) randomized controlled trial (RCT): Part I: the uptake of the Ottawa Panel clinical practice guidelines (CPGs). *BMC Public Health*. 2012;12:871.
45. Chen H, Zheng X, Huang H, Liu C, Wan Q, Shang S. The effects of a home-based exercise intervention on elderly patients with knee osteoarthritis: a quasi-experimental study. *BMC Musculoskelet Disord*. 2019;20:160.
46. Cheung C, Wyman JF, Bronas U, McCarthy T, Rudser K, Mathiason MA. Managing knee osteoarthritis with yoga or aerobic/strengthening exercise programs in older adults: a pilot randomized controlled trial. *Rheumatol Int*. 2017;37:389–398.
47. Cheung DST, Yeung W-F, Suen LK-P, Chung Chong T, Ho Y-S, Yu BY-M, et al. Self-administered acupressure for knee osteoarthritis in middle-aged and older adults: a pilot randomized controlled trial. *Acupunct Med*. 2020;38:75–85.
48. Coleman S, Briffa NK, Carroll G, Inderjeeth C, Cook N, McQuade J. A randomised controlled trial of a self-management education program for osteoarthritis of the knee delivered by health care professionals. *Arthritis Res Ther*. 2012;14:R21.
49. de Rezende MU, Hissadomi MI, de Campos GC, Frucchi R, Felicio Pailo A, Pasqualin T, et al. One-year results of an educational program on osteoarthritis: a prospective randomized controlled trial in Brazil. *Geriatr Orthop Surg Rehabil*. 2016;7:86–94.
50. de Rezende MU, Frucchi R, Pailo AF, Campos GCD, Pasqualin T, Hissadomi MI. PARQVE: Project Arthritis recovering quality of life through education: two-year results. *Acta Ortop Bras*. 2017;25:18–24.
51. Dias JM, Cisneros L, Dias R, Fritsch C, Gomes W, Pereira L, et al. Hydrotherapy improves pain and function in older women with knee osteoarthritis: a randomized controlled trial. *Braz J Phys Ther*. 2017;21:449–456.
52. Ettinger WH, Burns R, Messier SP, Applegate W, Rejeski WJ, Morgan T, et al. A randomized trial comparing aerobic exercise and resistance exercise with a health education program in older adults with knee osteoarthritis: the Fitness Arthritis and Seniors Trial (FAST). *JAMA*. 1997;277:25–31.
53. Farr JN, Going SB, McKnight PE, Kasle S, Cussler EC, Cornett M. Progressive resistance training improves overall physical activity levels in patients with early osteoarthritis of the knee: a randomized controlled trial. *Phys Ther*. 2010;90:356–366.
54. Ganji R, Pakniat A, Armat MR, Tabatabaeichehr M, Mortazavi H. The effect of self-management educational program on pain intensity in elderly patients with knee osteoarthritis: a randomized clinical trial. *Open Access Maced J Med Sci*. 2018;6:1062–1066.
55. Helminen E-E, Sinikallio SH, Valjakka AL, Väisänen-Rouvali RH, Arokoski JP. Effectiveness of a cognitive-behavioural group intervention for knee osteoarthritis pain: a randomized controlled trial. *Clin Rehabil*. 2015;29:868–881.
56. Hinman RS, Campbell PK, Lawford BJ, Briggs AM, Gale J, Bills C, et al. Does telephone-delivered exercise advice and support by physiotherapists improve pain and/or function in people with knee osteoarthritis? Telecare randomised controlled trial. *Br J Sports Med*. 2020;54:790–797.
57. Keefe FJ, Blumenthal J, Baucom D, Affleck G, Waugh R, Caldwell DS, et al. Effects of spouse-assisted coping skills training and exercise training in patients with osteoarthritic knee pain: a randomized controlled study. *Pain*. 2004;110:539–549.
58. Messier SP, Loeser RF, Miller GD, Morgan TM, Rejeski WJ, Sevick MA, et al. Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis: the Arthritis, Diet, and Activity Promotion Trial. *Arthritis Rheum*. 2004;50:1501–1510.
59. Murphy SL, Janevic MR, Lee P, Williams DA. Occupational therapist-delivered cognitive-behavioral therapy for knee osteoarthritis: a randomized pilot study. *Am J Occup Ther*. 2018;72.
60. O'Brien K, Wiggers J, Williams A, Campbell E, Hodder RK, Wolfenden L, et al. Telephone-based weight loss support for patients with knee osteoarthritis: a pragmatic randomised controlled trial. *Osteoarthritis Cartilage*. 2018;26:485–494.
61. O'moore KA, Newby JM, Andrews G, Hunter DJ, Bennell K, Smith J, et al. Internet cognitive-behavioral therapy for depression in older adults with knee osteoarthritis: a randomized controlled trial. *Arthritis Care Res*. 2018;70:61–70.
62. Oh S-L, Kim D-Y, Bae J-H, Lim J-Y. Effects of rural community-based integrated exercise and health education programs on the mobility function of older adults with knee osteoarthritis. *Aging Clin Exp Res*. 2020:1–10.
63. Qingguang Z, Lingyan H, Jingxian L, Zhang Y, Min F, Li J, et al. Effect of Taijiquan practice versus wellness education on knee proprioception in patients with knee osteoarthritis: a randomized controlled trial. *J Tradit Chin Med*. 2017;37:774–781.
64. Taglietti M, Facci LM, Trelha CS, de Melo FC, da Silva DW, Sawczuk G, et al. Effectiveness of aquatic exercises compared to patient-education on health status in individuals with knee osteoarthritis: a randomized controlled trial. *Clin Rehabil*. 2018;32:766–776.
65. Victor CR, Triggs E, Ross F, Lord J, Axford JS. Lack of benefit of a primary care-based nurse-led education programme for people with osteoarthritis of the knee. *Clin Rheumatol*. 2005;24:358–364.
66. Ay S, Koldaş Doğan Ş, Evcik D. Is there an effective way to prescribe a home-based exercise program in patients with knee osteoarthritis? A randomized controlled study. *Turk J Phys Med Rehabil*. 2013;59.
67. Greaves CJ, Sheppard KE, Abraham C, Hardeman W, Roden M, Evans PH, et al. Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. *BMC Public Health*. 2011;11:1–12.

68. Claassen AA, Schers HJ, Koëter S, van der Laan WH, Kremers-van de Hei KC, Botman J, et al. Preliminary effects of a regional approached multidisciplinary educational program on healthcare utilization in patients with hip or knee osteoarthritis: an observational study. *BMC Fam Pract*. 2018;19:82.
69. Zhaoyang R, Martire LM, Sliwinski MJ. Morning self-efficacy predicts physical activity throughout the day in knee osteoarthritis. *Health Psychol*. 2017;36:568.
70. Vlaeyen JW, Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. *Pain*. 2000;85:317–332.
71. Nijs J, Roussel N, Van Wilgen CP, Köke A, Smeets R. Thinking beyond muscles and joints: therapists' and patients' attitudes and beliefs regarding chronic musculoskeletal pain are key to applying effective treatment. *Man Ther*. 2013;18:96–102.
72. Nicolson PJ, Bennell KL, Dobson FL, Van Ginckel A, Holden MA, Hinman RS. Interventions to increase adherence to therapeutic exercise in older adults with low back pain and/or hip/knee osteoarthritis: a systematic review and meta-analysis. *Br J Sports Med*. 2017;51:791–799.
73. Muckelt PE, Roos E, Stokes M, McDonough S, Gronne DT, Ewings S, et al. Comorbidities and their link with individual health status: a cross-sectional analysis of 23,892 people with knee and hip osteoarthritis from primary care. *J Comorb*. 2020;10:2235042X20920456.
74. Belluzzi E, El Hadi H, Granzotto M, Rossato M, Ramonda R, Macchi V, et al. Systemic and local adipose tissue in knee osteoarthritis. *J Cell Physiol*. 2017;232:1971–1978.
75. Degerstedt Å, Alinaghizadeh H, Thorstensson CA, Olsson CB. High self-efficacy–a predictor of reduced pain and higher levels of physical activity among patients with osteoarthritis: an observational study. *BMC Musculoskelet Disord*. 2020;21:1–13.
76. Marks R. Self-efficacy and arthritis disability: an updated synthesis of the evidence base and its relevance to optimal patient care. *Health Psychol Open*. 2014;1:2055102914564582.
77. Caneiro J, O'Sullivan PB, Roos EM, Smith AJ, Choong P, Dowsey M, et al. Three steps to changing the narrative about knee osteoarthritis care: a call to action. *Br J Sports Med*. 2020;54:256–258.
78. Lin I, Wiles L, Waller R, Goucke R, Nagree Y, Gibberd M, et al. What does best practice care for musculoskeletal pain look like? Eleven consistent recommendations from high-quality clinical practice guidelines: systematic review. *Br J Sports Med*. 2020;54:79–86.
79. Sangrar R, Docherty-Skippen SM, Beattie K. Blended face-to-face and online/computer-based education approaches in chronic disease self-management: a critical interpretive synthesis. *Patient Educ Couns*. 2019;102:1822–1832.
80. Talboom-Kamp EP, Verdijk NA, Kasteleyn MJ, Numans ME, Chavannes NH. From chronic disease management to person-centered eHealth; a review on the necessity for blended care. *Clinical eHealth*. 2018;1:3–7.
81. Vallée A, Blacher J, Cariou A, Sorbets E. Blended learning compared to traditional learning in medical education: systematic review and meta-analysis. *J Med Internet Res*. 2020;22:e16504.
82. Mącznik AK, Ribeiro DC, Baxter GD. Online technology use in physiotherapy teaching and learning: a systematic review of effectiveness and users' perceptions. *BMC Med Educ*. 2015;15:160.
83. Angst F, Benz T, Lehmann S, Aeschlimann A, Angst J. Multidimensional minimal clinically important differences in knee osteoarthritis after comprehensive rehabilitation: a prospective evaluation from the Bad Zurzach Osteoarthritis Study. *RMD Open*. 2018;4:e000685.