

Exercise for Hand Osteoarthritis: A Cochrane Systematic Review

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ABSTRACT. Objective. To assess the benefits and harms of exercise compared with other interventions, including placebo or no intervention, in people with hand osteoarthritis (OA).

Methods. Systematic review using Cochrane Collaboration methodology. Six electronic databases were searched up until September 2015. Inclusion criteria: randomized or controlled clinical trials comparing therapeutic exercise versus no exercise, or comparing different exercise programs. Main outcomes: hand pain, hand function, finger joint stiffness, quality of life, adverse events, and withdrawals because of adverse effects. Risk of bias and quality of the evidence were assessed.

Results. Seven trials were included in the review, and up to 5 trials ($n = 381$) were included in the pooled analyses with data from postintervention. Compared to no exercise, low-quality evidence indicated that exercise may improve hand pain [5 trials, standardized mean difference (SMD) -0.27 , 95% CI -0.47 to -0.07], hand function (4 trials, SMD -0.28 , 95% CI -0.58 to 0.02), and finger joint stiffness (4 trials, SMD -0.36 , 95% CI -0.58 to -0.15) in people with hand OA. Quality of life was evaluated by 1 study (113 participants) showing very low-quality evidence for no difference. Three studies reported on adverse events, which were very few and not severe.

Conclusion. Pooled results from 5 studies with low risk of bias showed low-quality evidence for small to moderate beneficial effects of exercise on hand pain, function, and finger joint stiffness postintervention. Estimated effect sizes were small, and whether they represent a clinically important change may be debated. (First Release October 15 2017; *J Rheumatol* 2017;44:1850–8; doi:10.3899/jrheum.170424)

Key Indexing Terms:

OSTEOARTHRITIS

HAND

EXERCISE

COCHRANE SYSTEMATIC REVIEW

Hand osteoarthritis (OA) is a frequent joint disorder in the adult population¹. People with hand OA often experience hand pain, finger joint stiffness, and reduced grip strength,

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This report is based on a Cochrane review published in The Cochrane Library 2017, Issue 1 (see www.thecochranelibrary.com for information). Cochrane reviews are regularly updated as new evidence emerges and in response to feedback, and The Cochrane Library should be consulted for the most recent version of the review.

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Accepted for publication June 23, 2017.*

which may further result in activity limitations and participation restrictions^{2,3,4,5,6}. Previous research showed that the average grip strength in women with hand OA was < 60% that of healthy age- and sex-matched individuals, and that reduced grip strength was related to activity limitations and participation restrictions³.

Currently, no cure for OA is known, and treatment aims to reduce pain and functional disability. Pharmacological treatment for hand OA is confined to symptomatic treatment, and surgical treatment is limited to cases of severe OA in the first carpometacarpal (CMC1) joint. Nonpharmacological modalities are recommended for all people with OA, and information, exercise, and weight reduction constitute core treatment recommendations^{7,8,9,10}. The European League Against Rheumatism (EULAR) guidelines recommend exercise therapy for hand OA¹¹, whereas this is not included in the American College of Rheumatology (ACR) guidelines⁷. The guidelines from the UK National Institute for Health and Care Excellence state that exercise should be a core treatment for people with clinical symptomatic OA, but acknowledge that the evidence for effects of exercise in hand OA is limited and that the mechanisms of exercise on the hip and hand may be different from those for knee OA¹⁰.

For knee and hip OA, the effect of exercise on pain and function has been well documented^{12,13,14,15,16}, but for hand

OA the effect remains uncertain. Seven reviews have been published to sum up the evidence on nonpharmacological interventions for hand OA^{11,17,18,19,20,21,22}, and 1 presented results from metaanalyses comparing therapeutic exercise versus control, including 1 or 2 studies in the analyses²². In the last 4 years, 5 randomized controlled trials (RCT) on the effect of hand OA therapy have been published^{23,24,25,26,27}. Hence, there is a need to systematically evaluate current research and to suggest directions for future research on the effectiveness of exercise therapy in people with hand OA.

The objective of this systematic review was to assess the benefits and harms of exercises compared to other interventions, including placebo or no intervention, in people with hand OA.

MATERIALS AND METHODS

This paper is a shortened co-publication of a Cochrane review²⁸. A more detailed description of the methodology can be found in the original publication. Ethical approval for this type of study is not required by the policy of our institution.

Inclusion and exclusion criteria. We considered for inclusion all randomized (parallel group or crossover, including cluster-randomized and quasi-randomized) and controlled clinical trials comparing therapeutic exercise with no exercise, and trials comparing different exercise programs. We included studies of participants 18 years of age and older with a physician-confirmed (i.e., radiological or clinical or both) diagnosis of hand OA. Studies including diverse populations were accepted only if we could extract data for hand OA separately. We considered for inclusion interventions assessing benefits and harms of exercise versus other interventions for hand pain and function. Exercise therapy was defined as interventions targeting muscle strength, joint mobility, joint stability training, or a combination of these. We excluded studies investigating postoperative exercise. We considered for inclusion studies that also applied other treatment modalities (e.g., patient education, self-management strategies) if treatment, except for exercise therapy, was similar across intervention and control groups.

Search strategy. We searched the following databases without language restrictions from inception to September 2015: the Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, CINAHL, PEDro, and OTseeker. We screened the reference lists of all included full-text articles and performed searches for unpublished complete and ongoing studies using the International Clinical Trials Registry Platform of the World Health Organization and RCT registers: ClinicalTrials.gov, International Standard Randomised Controlled Trial Number Register, Current Controlled Trials, Australian New Zealand Clinical Trials Registry, and UMIN Clinical Trials Registry. We reviewed unpublished and grey literature using the database OpenSIGLE (System for Information on Grey Literature in Europe). Further, we searched congress proceedings from Osteoarthritis Research Society International (OARSI), EULAR, and ACR from 2008 until September 2015.

Study selection and data collection. Two review authors (NØ, GS) independently screened retrieved records and extracted data from included studies. If agreement was not achieved, a third review author (IK or KBH) adjudicated. A standardized data extraction form was used to extract raw data (i.e., means and SD for continuous outcomes and number of events for dichotomous outcomes) for outcomes of interest. We attempted to contact trial authors to obtain additional data and method descriptions.

Assessment of risk of bias in included studies. Two review authors (NØ, GS) independently assessed the risk of bias in the included studies, except for 1 study²⁵ that was assessed by a different pair of review authors (GS, TU). The risk of bias was assessed regarding random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other

potential threats to validity, according to the Cochrane risk-of-bias tool. Each of these criteria was explicitly judged as a low, high, or unclear risk of bias.

Outcome measures. The main outcomes for benefit were hand pain and hand function in addition to radiographic joint structure changes, quality of life, and finger joint stiffness, according to the proposed outcomes for OA intervention reviews recommended by the Cochrane Musculoskeletal Group. When more than 1 measure of pain was reported in a study, we chose the highest in the following hierarchy of outcome measures: (1) pain overall (e.g., visual analog scale or numerical rating scale pain), (2) pain on hand usage, (3) Australian/Canadian Hand Osteoarthritis Index (AUSCAN) pain subscale, (4) other algofunctional scales validated for use in hand OA, (5) patient's global assessment, and (6) physician's global assessment. The corresponding hierarchy used for physical function measures was (1) AUSCAN function subscale, (2) other algofunctional scales validated for use in hand OA, (3) hand function measured by performance-based tests (e.g., grip strength, pinch strength), and (4) global disability score. Information on the number of intervention-related adverse events (AE; i.e., increased joint inflammation or hand pain) and number of participants withdrawn from the studies because of AE was included when available. Secondary outcomes included fulfillment of OARSI/Outcome Measures in Rheumatology Controlled Trials (OMERACT) responder criteria²⁹, joint mobility, psychological well-being, aesthetic damage, and need for surgery.

The main timepoint of interest was the first assessment after completion of the exercise program. When data for longer-term followup were available, we extracted such data and categorized them by short-term (< 6 mos), medium-term (6–12 mos), and longterm (> 12 mos) followup.

Data analysis. We assumed that results of included studies reflected a distribution of effect sizes rather than a fixed effect size; we therefore used a random-effects model to pool outcomes from a sufficiently homogeneous set of studies in metaanalyses. The risk ratio (RR) with 95% CI was calculated for dichotomous outcomes, and standardized mean difference (SMD) with 95% CI was calculated for continuous outcomes. We analyzed ordinal scales with 11 or more points as continuous data in metaanalyses.

Heterogeneity was assessed using the Cochran Q test to test the hypothesis that all studies measured the same effects. We also assessed the magnitude of heterogeneity with the I² statistic in accordance with the Cochrane Handbook for Systematic Reviews³⁰. We did not perform planned subgroup or sensitivity analyses because there was only a small number of studies, but we evaluated the influence of using end-of-treatment scores versus change scores for investigation of heterogeneity. For the 2 × 2 factorial trial, we followed the Cochrane Handbook³⁰ recommendation and used a subset including 2 of the 4 groups (Hand exercise only and Leaflet and advice) and omitted the other 2 groups (Joint protection and Joint protection and hand exercise combined) because an interaction of exercise and joint protection cannot be ruled out. Data were generously provided by the study authors.

Summary of findings table. The main results of the review are presented in a summary of findings table, including an overall grading of the evidence using the Grading of Recommendations Assessment, Development, and Evaluation working group approach. The absolute and relative magnitude of effect and the number needed to treat were calculated using the Visual RxNNT calculator³¹ for dichotomous and the Wells calculator software for continuous outcomes.

RESULTS

Description of studies. A detailed description of the results can be found in the original publication²⁸. The literature search yielded 802 citations after duplicates were removed (Figure 1). We identified 5 additional citations by hand-searching congress proceedings and trial registers. We excluded 792 of 807 citations upon completion of abstract screening. Of 14 full texts and 1 congress abstract, 7 met the

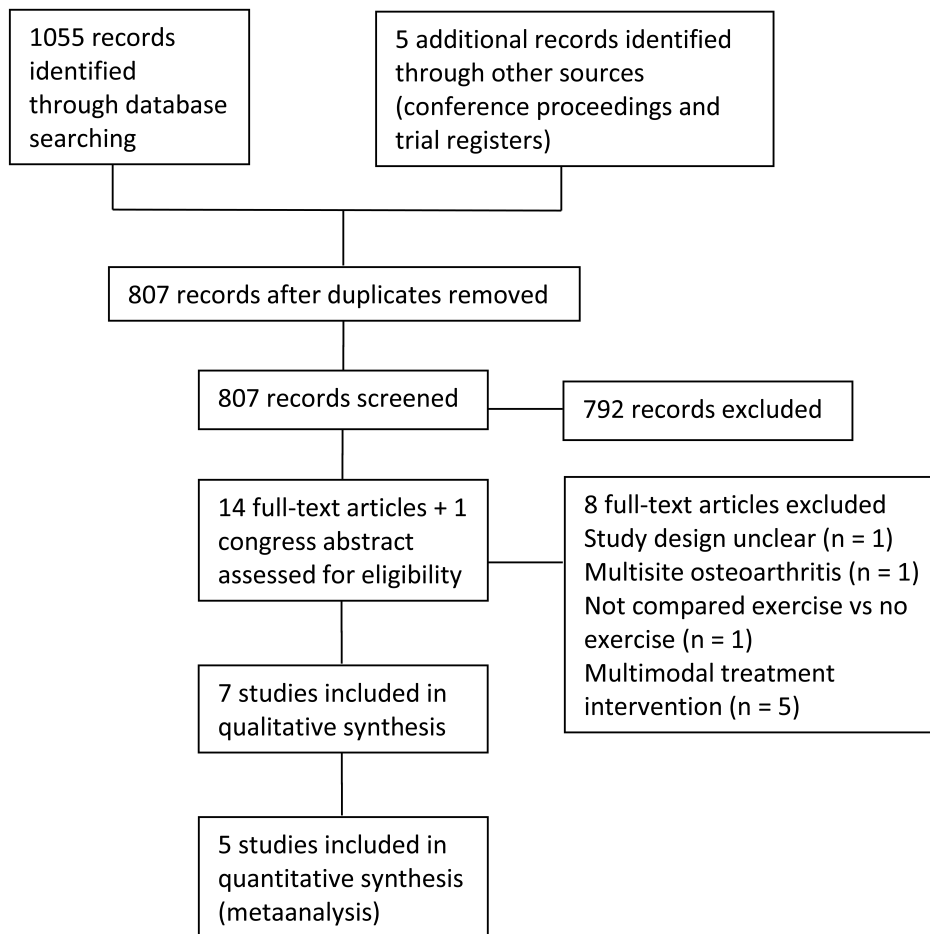


Figure 1. Study flow diagram.

inclusion criteria^{23,25,26,27,32,33,34}, whereas 8 full-text reports were excluded for different reasons (Figure 1).

All 7 included studies were RCT (Table 1), but 1 was characterized as a “pilot RCT”²³. Five studies used a parallel-group design, one a 2 × 2 factorial design, and one a crossover design. One study evaluated the effect of 2 different exercise programs for CMC1 OA²³, whereas the remaining 6 evaluated hand exercise versus no exercise (control intervention). Two trial authors provided original (nonimputed) data to extract posttreatment scores²⁶ or isolated treatment arm scores (Leaflet and advice and Exercise only)²⁷.

The participants were recruited in different settings from elderly persons living in the community to primary or specialist care, and the sample sizes varied greatly, from 19 to 130 participants (Table 1). The majority of participants were female (range 66–100%), and mean age was most frequently between 60–65 years. The exercise interventions varied widely in content (i.e., type of exercises, adding lower and upper arm exercises), mode (i.e., group-based, home-based, or a combination), dosage (i.e., from 3 times daily to 3 times a week), and supervision (i.e., from all sessions supervised to all home-based; Table 1). The aims of

the exercise interventions were relatively consistent among the studies: to reduce pain, increase grip and pinch strength, increase dexterity, maintain joint stability, and increase or maintain range of motion. Adherence to the exercise program was reported in 4 studies by self-report (diary; n = 3) or session attendance (n = 1). Self-reported adherence to the recommended frequency of exercise sessions ranged between 78% and 94%. In the fourth study, 67% fulfilled at least 16 of the 18 scheduled exercise sessions.

Risk of bias. A detailed description of the risk of bias for each of the included studies is presented in the original publication. Most trials were considered free from selection bias, but 5 studies^{25,26,27,32,34} had limitations regarding blinding of participants and personnel (performance bias) and blinding of outcome assessment (detection bias) for self-reported outcomes. The most recent study³⁴ was published only as a congress abstract and provided insufficient information for assessment of all risk-of-bias items. Three studies^{23,32,33} had high dropout rates and were considered to have high risk of attrition bias, but overall the risk of bias in included studies was considered low. However, because there were (very) few studies (participants) and imprecise results (wide CI), we

Table 1. Characteristics of included studies.

Study	No.	Female, %	Age, Yrs, Mean	Trial Type	Setting	Followup	Intervention	Comparison
Davenport 2012, UK	39	82	60	Pilot RCT	Hand center	3, 6 mos	3 specific CMC exercises 3–4×/day for 6 mos. Home-based with 3 reviews.	General exercise regimen for CMC 3–4×/day
Dziedzic 2015, UK	130*	66	66	RCT	Primary care/research clinic	3, 6, 12 mos	10 hand exercises daily for 1 yr. Group (4 sessions)/home-based.	No exercise
Hennig 2015, Norway	80	100	61	RCT	Outpatient secondary care	3 mos	5 hand exercises 3×/week for 3 mos. Home-based.	No exercise
Lefler 2004, USA	19	90	81	RCT	Elderly living in community	6 weeks	3 hand exercises 3×/week for 6 weeks. Supervised.	No exercise
Nery 2015, Brazil	60	NR	NR	RCT	NR	6, 12 weeks	Exercises 2×/week for 12 weeks.	No exercise
Rogers 2009, USA	76	85	75	Crossover	Elderly living in community	16, 32, 48 weeks	9 hand/arm exercises 3×/week. Home-based.	No exercise (apply hand cream)
Østerås 2014, Norway	130	90	66	RCT	Primary/secondary care	3, 6 mos	8 hand/arm exercises 3×/week. Group (4 sessions)/home-based.	No exercise

* Dziedzic 2015 (the SMOoH trial) had a factorial design with 4 groups and included a total of 257 randomized participants. In this review we used a subset including 2 of the 4 groups (Hand exercise only and Leaflet and advice) and omitted the other 2 groups (Joint protection and Joint protection and hand exercise combined). No.: no. participants randomly assigned; NR: not reported; RCT: randomized controlled trial; CMC: carpometacarpal.

downgraded the overall quality of the body of evidence to (very) low (Table 2).

Effects of interventions. Five studies including 381 participants comparing exercise with no exercise were included in the metaanalyses.

Hand pain. Five studies assessed hand pain and provided posttreatment data on 381 participants^{25,26,27,32,34}. Pooled results showed a small beneficial effect of exercise on pain (SMD random-effects model -0.27 , 95% CI -0.47 to -0.07 ; Table 2, Figure 2). Between-study heterogeneity was negligible ($I^2 = 0\%$).

Hand function. Four studies evaluated participant-reported hand function and provided posttreatment data on 369 participants^{25,26,27,34}. Pooled results demonstrated a beneficial effect of exercise on function (SMD -0.28 , 95% CI -0.58 to 0.02 ; Table 2, Figure 3). We considered between-study heterogeneity moderate to substantial ($I^2 = 51\%$). Reasons for this heterogeneity were studied, and exclusion of data from Østerås, *et al*²⁵ reduced heterogeneity to a negligible level ($I^2 = 0\%$). Close inspection of scores revealed that the mean pain level at baseline was slightly higher for the exercise group than for the control group, and that the mean pain level was slightly reduced in the exercise group and increased in the control group posttreatment. Inclusion of change scores instead of posttreatment scores from Østerås, *et al*²⁵ resulted in a negligible heterogeneity level ($I^2 = 5\%$) and demonstrated a beneficial effect of exercise on function (SMD -0.32 , 95% CI -0.53 to -0.10).

Quality of life. One study assessed quality of life and provided posttreatment data on 113 participants showing that the effect of exercise on quality of life in people with hand OA is uncertain (MD 0.30 , 95% CI -3.72 to 4.32)²⁷.

Finger joint stiffness. Four studies evaluated participant-reported finger joint stiffness and provided post-treatment data on 368 participants^{25,26,27,34}. Pooled results showed a small to moderate beneficial effect from exercise on finger joint stiffness (SMD -0.36 , 95% CI -0.58 to -0.15 ; Table 2, Figure 4). Between-study heterogeneity was negligible ($I^2 = 6\%$).

AE and withdrawals due to AE. Three studies reported on in total 4 AE among 309 participants^{25,26,27}. Reported AE were increased hand pain, finger joint inflammation, or neck/shoulder pain. Pooled data showed that the likelihood of occurrence of AE was higher in the exercise group than for the no exercise group, but the effect was uncertain (RR 4.55 , 95% CI 0.53 – 39.31). Two studies^{25,26} each reported 1 AE leading to study withdrawal. Pooled data showed that the likelihood of withdrawal due to AE was higher in the exercise group than in the no exercise group, but the effect was uncertain (RR 2.88 , 95% CI 0.30 – 27.18).

Medium-term and longterm followup. Two studies^{25,27} provided 6-month followup data (220 participants), and 1 of these²⁷ (Dziedzic, *et al*, 102 participants) also provided 12-month followup data. Pooled results of these studies showed an uncertain effect on hand pain (SMD 0.09 , 95% CI -0.18 to 0.35), hand function (SMD -0.05 , 95% CI -0.31 to

Table 2. Summary of findings: hand exercise compared to no exercise (posttreatment).

Outcomes	Illustrative Assumed risk No exercise	Comparative Risks* (95% CI) Corresponding risk Hand exercise	Relative Effect (95% CI)	No. Study Participants	Quality of the Evidence (GRADE)	Comments
Hand pain: self-report questionnaires. Scale from 0 to 10 (0 represents no pain). Followup: median 3 mos	Mean hand pain in the control groups: 3.9 points ¹	Mean hand pain in the intervention group: 0.5 points lower (0.1–0.9 points lower)		381 (5 studies)	⊕⊕⊕⊕ low ^{2,3}	SMD –0.27 (–0.47 to –0.07). Absolute reduction in pain 5% (1%–9%) on a 0–10 scale. Relative change 13% (3%–22%). NNTB: 9 (5–32)
Hand function: self-report questionnaires. Scale from 0 to 36 (0 represents no physical disability). Followup: median 3 mos	Mean hand function in the control groups: 14.5 points ⁴	Mean hand function in the intervention groups: 2.2 points lower (0.2 points higher to 4.6 points lower)		369 (4 studies)	⊕⊕⊕⊕ low ^{2,3}	SMD –0.28 (–0.58 to 0.02). Absolute improvement in hand function 6% (0.4% worsening to 13% improvement). Relative change 15% (1% worsening to 32% improvement). NNTB: 9 (5–52)
Radiographic joint structure changes: not measured.	Not measured	Not measured	Not estimable	0 (0)	Not applicable	Radiographic joint changes were not measured.
Quality of life: self-report questionnaires. Scale from 0 to 100 (100 represents maximum quality of life). Followup: mean 3 mos	Mean quality of life in the control groups: 50.4 points ⁵	Mean quality of life in the intervention group was 0.3 points higher (3.5 points lower to 4.1 points higher)		113 (1 study)	⊕⊕⊕⊕ very low ^{2,6}	MD 0.30 (–3.72 to 4.32). Absolute improvement in quality of life 0.3% (4% worsening to 4% improvement). Relative change in quality of life 0.6% (7% worsening to 8% improvement).
Finger joint stiffness: self-reported questionnaires. Scale from 0 to 10 (0 represents no stiffness). Followup: mean 3 mos	Mean finger joint stiffness in the control groups: 4.5 points ⁷	Mean finger joint stiffness in the intervention groups: 0.7 points lower (0.3–1.0 points lower)		368 (4 studies)	⊕⊕⊕⊕ low ^{2,3}	SMD –0.36 (–0.58 to –0.15). Absolute reduction in finger joint stiffness 7% (3%–10%). Relative change 14% (6%–23%). NNTB: 7 (4–15)
Adverse events: followup 3–6 mos	0 per 1000	32 per 1000 ⁸	RR 4.55 (0.53–39.31)	309 (3 studies)	⊕⊕⊕⊕ very low ^{2,6}	Absolute risk difference: 2% more events (2% fewer to 5% more). Relative difference: 355% (47% decrease to 3831% increase)
Withdrawal due to adverse events: followup 3–6 months	0 per 1000	13 per 1000 ⁹	RR 2.88 (0.30–27.18)	309 (3 studies)	⊕⊕⊕⊕ very low ^{2,6}	Absolute risk difference: 1% more events (2% fewer to 3% more). Relative difference: 188% (70% decrease to 2618% increase)

*The basis for the assumed risk (e.g., the median control group risk across studies) is given below. The corresponding risk (and its 95% CI) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI). GRADE Working Group levels of evidence: high quality — further research is very unlikely to change our confidence in the estimate of effect; moderate quality — further research is likely to have an important effect on our confidence in the estimate of effect and may change the estimate; low quality — further research is very likely to have an important effect on our confidence in the estimate of effect and is likely to change the estimate; very low quality — we are very uncertain about the estimate. ¹ Control group baseline hand pain mean (SD) 3.9 (1.8) from Østerås 2014. ² Downgraded because of risk of detection bias on self-reported outcomes (lack of blinding of participants). ³ Downgraded because of imprecision (few participants, wide CI). ⁴ Control group baseline hand function mean (SD) 14.5 (8.0) from Dziedzic 2015. ⁵ Control group baseline quality of life mean (SD) 50.4 (10.3) from Dziedzic 2015. ⁶ Downgraded 2 levels for imprecision owing to very few participants and CI crossing 0. ⁷ Control group baseline finger joint stiffness mean (SD) 4.5 (1.8) from Østerås 2014. ⁸ The few adverse events (n = 4) included increased finger joint inflammation and increased hand or shoulder/neck pain. ⁹ Adverse events leading to withdrawal included high and sustained hand pain (n = 1) or shoulder/neck pain (n = 1). RR: risk ratio; SMD: standardized mean difference; NNTB: number needed to treat for an additional beneficial outcome.

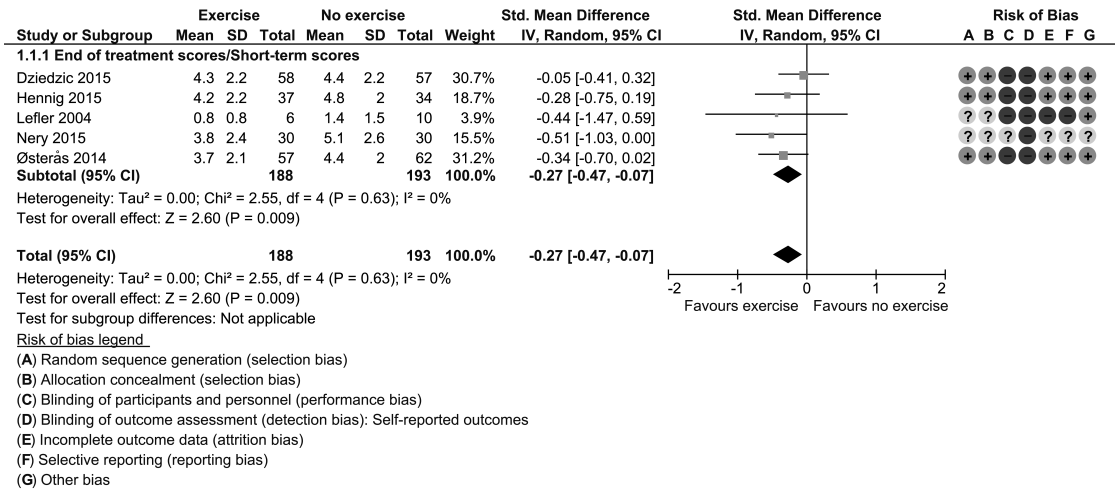


Figure 2. Forest plot of comparison of exercise versus no exercise. Outcome: hand pain postintervention. Dziedzic 2015 (the SMOotH trial) had a factorial design with 4 groups and included a total of 257 randomized participants. In this review we used a subset of 2 of the 4 groups (Hand exercise only and Leaflet and advice) and omitted the other 2 groups (Joint protection and Joint protection and hand exercise combined). All studies included a global measure of hand pain (visual analog scale or numerical rating scale; Lefler 2004: 6 pain categories).

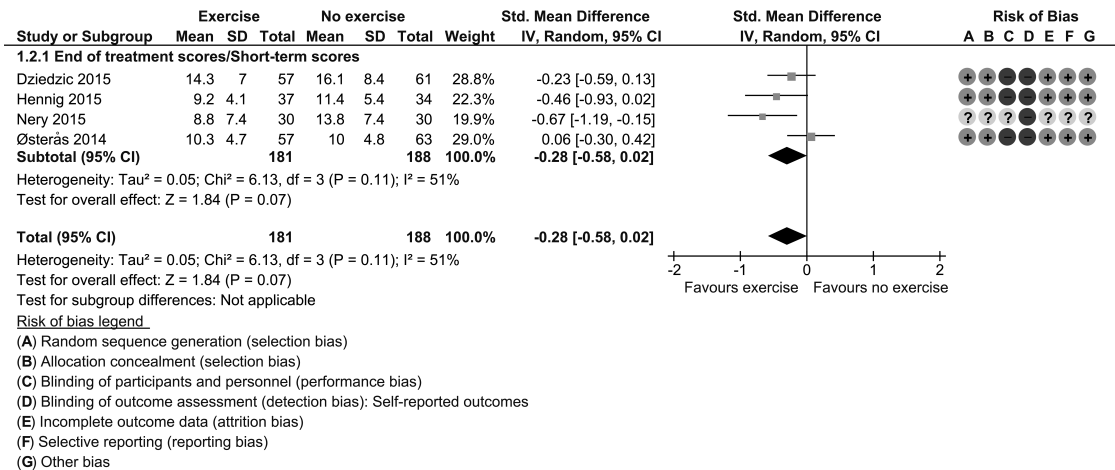


Figure 3. Forest plot of comparison of exercise versus no exercise. Outcome: hand function postintervention. Dziedzic 2015 (the SMOotH trial) had a factorial design with 4 groups and included a total of 257 randomized participants. In this review we used a subset of 2 of the 4 groups (Hand exercise only and Leaflet and advice) and omitted the other 2 groups (Joint protection and Joint protection and hand exercise combined). Two studies (Dziedzic 2015; Nery 2015) measured hand function using the Australian/Canadian Hand Osteoarthritis Index, and 2 other studies (Hennig 2015; Østerås 2014) used the Functional Index for Hand OsteoArthritis.

0.21), and finger joint stiffness (SMD -0.12, 95% CI -0.38 to 0.14). This indicates that at the 6-month and 12-month followups, the effect of the exercise intervention was uncertain.

Minor outcomes: grip strength, pinch strength, and OARSI/OMERACT responder criteria. Five studies evaluated effects on grip strength among 362 participants and provided posttreatment data^{25,26,27,32,34}. Pooled results showed a small to moderate improvement in grip strength (SMD 0.34, 95% CI -0.01 to 0.69). Between-study heterogeneity was

substantial (I² = 59%). Reasons for this heterogeneity were studied, and exclusion of data from Østerås, *et al*²⁵ reduced heterogeneity to a moderate level (I² = 42%). Three studies evaluated effects on pinch strength among 179 participants and provided posttreatment data^{27,32,34}. Pooled results showed a small, but uncertain beneficial effect (SMD 0.20, 95% CI -0.10 to 0.49). Between-study heterogeneity was negligible (I² = 0%). Three studies reported on fulfillment of the OARSI/OMERACT responder criteria among 305 participants^{25,26,27}. Pooled results showed higher RR among the

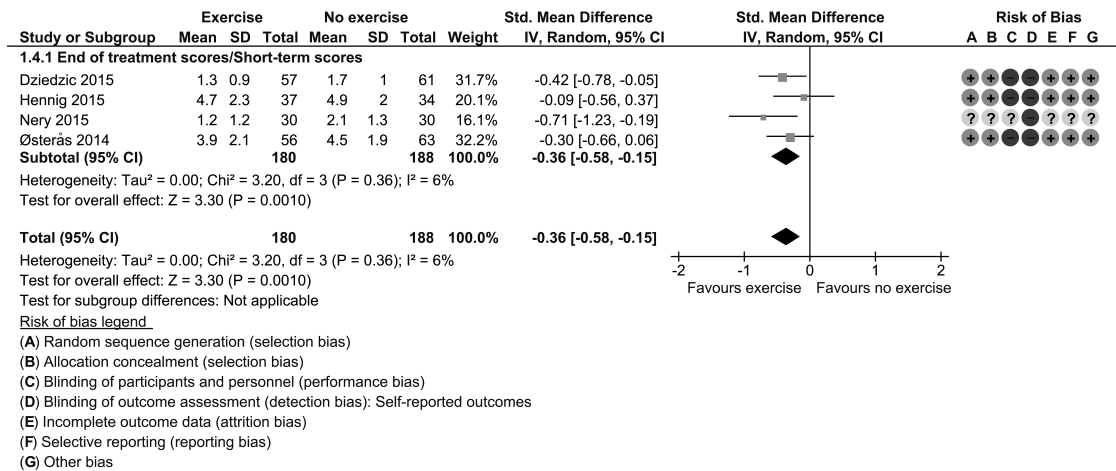


Figure 4. Forest plot of comparison of exercise versus no exercise. Outcome: finger joint stiffness postintervention. Dziedzic 2015 (the SMOotH trial) had a factorial design with 4 groups and included a total of 257 randomized participants. In this review we used a subset including 2 of the 4 groups (Hand exercise only and Leaflet and advice) and omitted the other 2 groups (Joint protection and Joint protection and hand exercise combined). Two studies (Dziedzic 2015; Nery 2015) measured finger joint stiffness using the Australian/Canadian Hand Osteoarthritis Index, and 2 other studies (Hennig 2015; Østerås 2014) used the Functional Index for Hand Osteoarthritis.

exercise group than in the no exercise group for fulfilling these criteria (RR 2.80, 95% CI 1.40–5.62). Between-study heterogeneity was moderate (I² = 42%). Omission of 1 study²⁷, in which the 95% CI for the RR crossed the value of 1, caused the I² to drop to 35% (RR 3.76, 95% CI 1.60–8.84).

Comparison of different exercise programs. Only 1 included study compared different exercise programs²³. The authors compared specific dynamic stability exercises versus general exercises for CMC1 OA, and reported no differences in pain, self-reported function, or pinch strength between groups at the 3-month and 6-month followups.

DISCUSSION

Results of metaanalyses suggest that performing hand exercise is beneficial in reducing hand pain and finger joint stiffness postintervention, but the effect is not sustained at later followup. We also found benefits from exercise on self-reported hand function, but heterogeneity between the studies was greater and the CI was slightly larger. Evidence was insufficient to show the effect of exercise on quality of life among people with hand OA. There were very few AE related to the exercise intervention, which resulted in very wide CI for the estimates.

The results of this review indicated a small to moderate beneficial effect of exercise in people with hand OA, but the absolute effect may not be clinically meaningful. Reductions in pain (0 to 10 scale), function (0 to 36 scale), and stiffness (0 to 10 scale) of 0.5, 2.2, and 0.7 points, respectively, would probably not be considered clinically important changes compared to the suggested absolute improvement of 15%³⁵. However, baseline levels of pain, function, and stiffness were generally mild to moderate, leaving a limited scope for

improvement. The most recent study³⁴ seemed to show larger beneficial outcome as compared to the others, but we could only extract limited information from a congress abstract, so several methodological and quality aspects of that study remain to be determined. Compared with effects of other therapies for hand OA (i.e., splints and nonsteroidal anti-inflammatory drugs)^{11,20}, the effect of exercise was similar, suggesting exercise as a non-harmful treatment alternative. Given that we have limited knowledge of the optimal exercise dosage for people with hand OA, and that we rely mainly on self-reported data on adherence to the prescribed dosage, the actual dosage followed by participants in the included studies may have been insufficient to produce an optimal effect. As with other exercise interventions, the effect did not seem to be sustained over the long term, which is reasonable if the exercise was discontinued. However, very few harms were reported, meaning that the exercise program was well tolerated.

Seven systematic reviews^{11,17,18,19,20,21,22} and 1 overview of reviews³⁶ have evaluated nonsurgical or nonpharmacological treatment of people with hand OA. Most of them were not able to pool exercise data in a metaanalysis, and conclusions from 2 of the reviews were inconsistent because they conclude that exercise has “no overall effect”²¹ versus “may reduce pain and stiffness and improve function”²⁰. However, these conclusions were based on a very small number of studies with few participants and methodological shortfalls. Except for 2 studies^{32,33}, we excluded from this review all studies included in previous reviews for various reasons (i.e., multimodal intervention, unclear study design, etc.)^{37,38,39,40}. A systematic review of nonpharmacological interventions²² included 4 studies, 3 of which we included in the current

review^{27,32,33} and 1 we excluded⁴⁰. The authors of this review concluded that they had found (very) low-quality evidence showing no significant improvement in pain, function, and stiffness at short-term or long-term followup, but they uncovered moderate-quality evidence showing an effect on grip strength at short-term followup²².

Our study has several strengths. We performed a systematic review and metaanalysis using Cochrane methods, with predefined outcomes and a published protocol, and assessed outcomes of relevance as recommended by Cochrane Musculoskeletal Group. We conducted an extensive literature search including a hand search of register databases and congress proceedings, but we may have missed relevant publications or ongoing trials. We expect minimal extracting and reporting bias because the review was done by 2 independent authors, but data from 2 studies were reanalyzed, leaving the possibility of mistakes. One study was only a congress abstract and the decision to include it in this review may be debated. Further, we were unable to contact the authors in 2 other studies, which had implications for the risk-of-bias assessment. Although it is difficult, or impossible, to blind participants and personnel to treatment allocation in studies comparing exercise versus no exercise, lack of blinding on self-reported outcomes may have led to inflated effect sizes. The external validity of the review is limited by the small number of included studies, and results should be generalized with caution.

Qualitative analyses performed in 2 previously published review studies identified potential pathways for the effect of exercise in knee OA^{41,42}. However, a better understanding of such pathways is also warranted for hand OA. Research is warranted to determine the optimal exercise program and the optimal dosage of exercise for hand OA. Thereafter, additional RCT are needed to evaluate the effect of an optimal exercise program for hand OA. This exercise program may need to be customized for different phenotypes of hand OA (i.e., CMC1 OA, erosive hand OA, etc.). Monitoring adherence to the exercise program and to the prescribed dosage is important, because it will be a prerequisite for determining whether a beneficial effect of exercise has occurred.

Currently, low-level evidence from studies with low risk of bias suggests that exercise may reduce hand pain and finger joint stiffness and may improve hand function among people with hand OA. Estimated effect sizes were small, and whether they represent a clinically important change may be debated. Inclusion of a small number of studies and few participants led to wide CI; therefore, further research is very likely to have an important effect on our confidence in the estimates of effect and is likely to change the estimates.

ACKNOWLEDGMENT

The authors thank Hilde Iren Flaatten and Kari Engen Matre for local librarian assistance with the literature search strategy and literature search, and Tamara Rader, Cochrane Musculoskeletal Review Group, for the literature search.

REFERENCES

1. Bijlsma JW, Berenbaum F, Lafeber FP. Osteoarthritis: an update with relevance for clinical practice. *Lancet* 2011;377:2115-26.
2. Zhang Y, Niu J, Kelly-Hayes M, Chaisson CE, Aliabadi P, Felson DT. Prevalence of symptomatic hand osteoarthritis and its impact on functional status among the elderly: The Framingham Study. *Am J Epidemiol* 2002;156:1021-7.
3. Kjekken I, Dagfinrud H, Slatkowsky-Christensen B, Mowinckel P, Uhlig T, Kvien TK, et al. Activity limitations and participation restrictions in women with hand osteoarthritis: patients' descriptions and associations between dimensions of functioning. *Ann Rheum Dis* 2005;64:1633-8.
4. Elliott AL, Kraus VB, Fang F, Renner JB, Schwartz TA, Salazar A, et al. Joint-specific hand symptoms and self-reported and performance-based functional status in African Americans and Caucasians: The Johnston County Osteoarthritis Project. *Ann Rheum Dis* 2007;66:1622-6.
5. Kloppenburg M. Hand osteoarthritis—an increasing need for treatment and rehabilitation. *Curr Opin Rheumatol* 2007;19:179-83.
6. Stamm T, van der Giesen F, Thorstenson C, Steen E, Birrell F, Bauernfeind B, et al. Patient perspective of hand osteoarthritis in relation to concepts covered by instruments measuring functioning: a qualitative European multicentre study. *Ann Rheum Dis* 2009;68:1453-60.
7. Hochberg MC, Altman RD, April KT, Benkhalti M, Guyatt G, McGowan J, et al. American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care Res* 2012;64:455-74.
8. 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;72:1125-35.
9. McAlindon TE, Bannuru RR, Sullivan MC, Arden NK, Berenbaum F, Bierma-Zeinstra SM, et al. OARSI guidelines for the non-surgical management of knee osteoarthritis. *Osteoarthritis Cartilage* 2014;22:363-88.
10. National Clinical Guideline Centre (UK). Osteoarthritis. Care and management in adults. London: National Institute for Health and Care Excellence (Clinical guideline CG 177); 2014.
11. Zhang W, Doherty M, Leeb BF, Alekseeva L, Arden NK, Bijlsma JW, et al. EULAR evidence based recommendations for the management of hand osteoarthritis: report of a Task Force of the EULAR Standing Committee for International Clinical Studies Including Therapeutics (ESCSIT). *Ann Rheum Dis* 2007; 66:377-88.
12. Uthman OA, van der Windt DA, Jordan JL, Dziedzic KS, Healey EL, Peat GM, et al. Exercise for lower limb osteoarthritis: systematic review incorporating trial sequential analysis and network meta-analysis. *BMJ* 2013;347:f5555.
13. Juhl C, Christensen R, Roos EM, Zhang W, Lund H. Impact of exercise type and dose on pain and disability in knee osteoarthritis: a systematic review and meta-regression analysis of randomized controlled trials. *Arthritis Rheumatol* 2014;66:622-36.
14. Fransen M, McConnell S, Hernandez-Molina G, Reichenbach S. Exercise for osteoarthritis of the hip. *Cochrane Database Syst Rev* 2014:CD007912.
15. Fransen M, McConnell S, Harmer AR, Van der Esch M, Simic M, Bennell KL. Exercise for osteoarthritis of the knee. *Cochrane Database Syst Rev* 2015;1:CD004376.
16. Beumer L, Wong J, Warden SJ, Kemp JL, Foster P, Crossley KM. Effects of exercise and manual therapy on pain associated with hip osteoarthritis: a systematic review and meta-analysis. *Br J Sports Med* 2016;50:458-63.

17. Towheed TE. Systematic review of therapies for osteoarthritis of the hand. *Osteoarthritis Cartilage* 2005;13:455-62.
18. Mahendira D, Towheed TE. Systematic review of non-surgical therapies for osteoarthritis of the hand: an update. *Osteoarthritis Cartilage* 2009;17:1263-8.
19. Valdes K, Marik T. A systematic review of conservative interventions for osteoarthritis of the hand. *J Hand Ther* 2010;23:334-50.
20. Kjekken I, Smedslund G, Moe RH, Slatkowsky-Christensen B, Uhlig T, Hagen KB. Systematic review of design and effects of splints and exercise programs in hand osteoarthritis. *Arthritis Care Res* 2011;63:834-48.
21. Ye L, Kalichman L, Spittle A, Dobson F, Bennell K. Effects of rehabilitative interventions on pain, function and physical impairments in people with hand osteoarthritis: a systematic review. *Arthritis Res Ther* 2011;13:R28.
22. Bertozzi L, Valdes K, Vanti C, Negrini S, Pillastrini P, Villafane JH. Investigation of the effect of conservative interventions in thumb carpometacarpal osteoarthritis: systematic review and meta-analysis. *Disabil Rehabil* 2015;37:2025-43.
23. Davenport JB, Jansen V, Yeandle N. Pilot randomized controlled trial comparing specific dynamic stability exercises with general exercises for thumb carpometacarpal joint osteoarthritis. *Hand Therapy* 2012;17:60-7.
24. Stukstette MJ, Dekker J, den Broeder AA, Westeneng JM, Bijlsma JW, van den Ende CH. No evidence for the effectiveness of a multidisciplinary group based treatment program in patients with osteoarthritis of hands on the short term; results of a randomized controlled trial. *Osteoarthritis Cartilage* 2013;21:901-10.
25. Østerås N, Hagen KB, Grotle M, Sand-Svartrud AL, Mowinckel P, Kjekken I. Limited effects of exercises in people with hand osteoarthritis: results from a randomized controlled trial. *Osteoarthritis Cartilage* 2014;22:1224-33.
26. Hennig T, Haehre L, Hornburg VT, Mowinckel P, Norli ES, Kjekken I. Effect of home-based hand exercises in women with hand osteoarthritis: a randomised controlled trial. *Ann Rheum Dis* 2015;74:1501-8.
27. Dzedzic K, Nicholls E, Hill S, Hammond A, Handy J, Thomas E, et al. Self-management approaches for osteoarthritis in the hand: a 2x2 factorial randomised trial. *Ann Rheum Dis* 2015;74:108-18.
28. Østerås N, Kjekken I, Smedslund G, Moe RH, Slatkowsky-Christensen B, Uhlig T, et al. Exercise for hand osteoarthritis. *Cochrane Database Syst Rev* 2017:CD010388.
29. Pham T, van der Heijde D, Altman RD, Anderson JJ, Bellamy N, Hochberg M, et al. OMERACT-OARSI initiative: Osteoarthritis Research Society International set of responder criteria for osteoarthritis clinical trials revisited. *Osteoarthritis Cartilage* 2004;12:389-99.
30. Higgins J, Green S. *Cochrane handbook for systematic reviews of interventions*, version 5.1.0 (updated March 2011). The Cochrane Collaboration; 2011. [Internet. Accessed July 31, 2017.] Latest version available from: <http://training.cochrane.org/handbook>
31. Cates C. Dr Chris Cates' EBM Website, Visual Rx, Version 3.0. [Internet. Accessed September 14, 2017.] Available from: www.nntonline.net/visualrx
32. Lefler C, Armstrong J. Exercise in the treatment of osteoarthritis in the hands of the elderly. *Clin Kinesiol* 2004;58:13-7.
33. Rogers MW, Wilder FV. Exercise and hand osteoarthritis symptomatology: a controlled crossover trial. *J Hand Ther* 2009;22:10-7.
34. Nery MV, Martinez A, Jennings F, Souza M, Natour J. Effectiveness of a progressive resistance strength programme on hand osteoarthritis: a randomized controlled trial [abstract]. *Arthritis Rheumatol* 2015;67 Suppl 10:953.
35. Tubach F, Ravaud P, Martin-Mola E, Awada H, Bellamy N, Bombardier C, et al. Minimum clinically important improvement and patient acceptable symptom state in pain and function in rheumatoid arthritis, ankylosing spondylitis, chronic back pain, hand osteoarthritis, and hip and knee osteoarthritis: results from a prospective multinational study. *Arthritis Care Res* 2012; 64:1699-707.
36. Moe RH, Kjekken I, Uhlig T, Hagen KB. There is inadequate evidence to determine the effectiveness of nonpharmacological and nonsurgical interventions for hand osteoarthritis: an overview of high-quality systematic reviews. *Phys Ther* 2009;89:1363-70.
37. Garfinkel MS, Schumacher HR Jr., Husain A, Levy M, Reshetar RA. Evaluation of a yoga based regimen for treatment of osteoarthritis of the hands. *J Rheumatol* 1994;21:2341-3.
38. Wajon A, Ada L. No difference between two splint and exercise regimens for people with osteoarthritis of the thumb: a randomised controlled trial. *Aust J Physiother* 2005;51:245-9.
39. Boustedt C, Nordenskiöld U, Lundgren NA. Effects of a hand-joint protection programme with an addition of splinting and exercise: one year follow-up. *Clin Rheumatol* 2009;28:793-9.
40. Stamm TA, Machold KP, Smolen JS, Fischer S, Redlich K, Graninger W, et al. Joint protection and home hand exercises improve hand function in patients with hand osteoarthritis: a randomized controlled trial. *Arthritis Rheum* 2002;47:44-9.
41. Beckwee D, Vaes P, Cnudde M, Swinnen E, Bautmans I. Osteoarthritis of the knee: why does exercise work? A qualitative study of the literature. *Ageing Res Rev* 2013;12:226-36.
42. Runhaar J, Luijsterburg P, Dekker J, Bierma-Zeinstra SM. Identifying potential working mechanisms behind the positive effects of exercise therapy on pain and function in osteoarthritis: a systematic review. *Osteoarthritis Cartilage* 2015;23:1071-82.