Interventions to improve adherence to exercise for chronic musculoskeletal pain in adults (Review)

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[Intervention Review]

Interventions to improve adherence to exercise for chronic musculoskeletal pain in adults

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ABSTRACT

Background

Chronic musculoskeletal pain (CMP) is a major health problem, accounting for approximately one-quarter of general practice (GP) consultations in the United Kingdom (UK). Exercise and physical activity is beneficial for the most common types of CMP, such as back and knee pain. However, poor adherence to exercise and physical activity may limit long-term effectiveness.

Objectives

To assess the effects of interventions to improve adherence to exercise and physical activity for people with chronic musculoskeletal pain.

Search methods

We searched the trials registers of relevant Cochrane Review Groups. In addition, we searched the Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, CINAHL, AMED, PsycINFO, Science Citation Index and Social Science Citation Index and reference lists of articles to October 2007. We consulted experts for unpublished trials.

Selection criteria

Randomised or quasi-randomised trials evaluating interventions that aimed to improve adherence to exercise and physical activity in adults with pain for three months and over in the axial skeleton or large peripheral joints.

Data collection and analysis

Two of the four authors independently assessed the quality of each included trial and extracted data. We contacted study authors for missing information.

Main results

We included 42 trials with 8243 participants, mainly with osteoarthritis and spinal pain. Methods used for improving and measuring adherence in the included trials were inconsistent. Two of the 17 trials that compared different types of exercise showed positive effects, suggesting that the type of exercise is not an important factor in improving exercise adherence. Six trials studied different methods of delivering exercise, such as supervising exercise sessions, refresher sessions and audio or videotapes of the exercises to take home.

Of these, five trials found interventions improved exercise adherence. Four trials evaluated specific interventions targeting exercise adherence; three of these showed a positive effect on exercise adherence. In eight trials studying self-management programmes, six improved adherence measures. One trial found graded activity was more effective than usual care for improving exercise adherence. Cognitive behavioural therapy was effective in a trial in people with whiplash-associated disorder, but not in trials of people with other CMP. In the trials that showed a positive effect on adherence, association between clinical outcomes and exercise adherence was conflicting.

Authors' conclusions

Interventions such as supervised or individualised exercise therapy and self-management techniques may enhance exercise adherence. However, high-quality, randomised trials with long-term follow up that explicitly address adherence to exercises and physical activity are needed. A standard validated measure of exercise adherence should be used consistently in future studies.

PLAIN LANGUAGE SUMMARY

Strategies for improving adherence to exercise in adults with chronic musculoskeletal pain

This summary of a Cochrane review presents what we know about the effect of different ways of helping people with chronic musculoskeletal pain to stick to exercise and physical activity.

The review shows that we are uncertain which strategies will work for improving adherence to exercise in adults because the effects of the strategies were inconsistent from study to study.

We often do not have precise information about side effects and complications. This is particularly true for rare but serious side effects.

What is chronic musculoskeletal pain (CMP) and what are ways to help people stick to exercise?

Chronic musculoskeletal pain is on-going pain in the bones and joints of the body, for example in the back or knees. It may be the result of a musculoskeletal disease or injury or the cause may not be known.

Exercise can be any activity that enhances or maintains muscle strength, physical fitness and overall health. People exercise for many different reasons including weight loss and strengthening muscles, and improving their energy.

Sometimes it can be difficult to continue with the exercise program that your doctor, nurse or physiotherapist recommends. One way of helping people stick to exercise is called 'graded exercise activity'. This means the exercise is targeted to weaker muscles or painful areas and gets increasingly more challenging. Other ways included supervising exercise sessions, providing 'refresher' sessions to go over the exercise program again, and providing audio or videotapes of the exercises to take home.

BACKGROUND

Chronic musculoskeletal pain is a major health problem (White 1999) treated across many different healthcare settings, including primary care, by a plethora of healthcare providers. It is thought to account for approximately one-quarter of general practitioner (GP) consultations in the United Kingdom (UK) (McCormack 1995). Much of this type of pain is non-specific and standardised definitions are elusive. The Clinical Standards Advisory Group of the National Health Service in the UK defines chronic pain as 'pain persisting beyond the expected time frame for healing or that occurs in disease processes in which healing may never occur' (CSAG 2000). Several other definitions are available, such as use of the three-month cut-off duration (IASP 1986), and 'persistent or episodic pain of a duration or intensity that adversely affects the function or well-being of the patient, attributable to any non-malignant aetiology' (ASA Taskforce 1997). The most common types of chronic musculoskeletal pain that impact significantly on functional disability are spinal pain and knee pain (Breivik 2006;

Elliott 1999). In a pan-European epidemiological survey of 50,000 people in 15 countries, Breivik et al found an average prevalence of chronic pain of moderate to severe intensity of 19% (Breivik 2006). Almost half of those in the survey that reported having pain had spinal pain, and more than 40% had joint pain.

Low back pain is one of the leading causes of disability in people under 45 years, with large direct and indirect healthcare costs (Andersson 1999). In 1998, physical treatments for low back pain cost the UK almost £500 million (Maniadakis 2000). Knee pain in older adults is also a common disabling problem (Thomas 2004), most of which is attributable to osteoarthritis. In older people, the risk of disability from knee osteoarthritis is as great as the risk of disability from cardiac disease, and greater than that due to any other single medical disorder (Guccione 1994).

There is limited randomised controlled trial (RCT) data to demonstrate that the therapeutic approaches used for chronic musculoskeletal pain have clear or consistent benefits. The primary prevention of these conditions has not proved feasible, and modern management approaches are not orientated around a cure but rather around prevention of unnecessary disability and minimising morbidity. Numerous clinical guidelines encourage reassurance, patient education, help with self-management in terms of symptom control and coping, as well as rapid return to normal activities (ARMA 2004; COST B13 2004; Jordan 2003; NICE 2009; Waddell 1999). There has been increasing emphasis on supporting and empowering individuals to be active partners in the management of their condition, for example through patient education and exercise programmes.

With knee pain, most patients are managed in primary care (Creamer 1998; Scott 1998) with analgesics and exercise (Altman 1998; Lane 1997). A review of international guidelines suggests that the best non-pharmacological care consists of education and exercise (Pencharz 2002). Active rehabilitation programmes have been shown to improve joint function and reduce pain, improve strength, walking speed and self-efficacy, and reduce the risk of other chronic conditions (Foley 2003; van Baar 1999). Both aerobic walking and home-based quadriceps strengthening exercise reduce pain and disability (Roddy 2005a). Recent multi-disciplinary guidelines incorporating research-based evidence and expert consensus have addressed specific factors about the role of exercise in knee osteoarthritis (Roddy 2005b). These include the benefit of both aerobic and strengthening exercises, group versus home exercise and the importance of adherence. They advocate regular participation in exercise that should be sustained over the long term. Pragmatic RCTs for knee pain support the usefulness of exercise, although the effect size is relatively small (Roddy 2005a). Studies have suggested an association between high adherence to exercise and improved function in older people with knee osteoarthritis (van Gool 2005), and recent UK guidelines for the clinical management of osteoarthritis that recommend exercise as a core treatment for this patient group have highlighted adherence as a priority of further research, in order to optimise and maintain the benefits of therapy (NICE 2008).

For low back pain, guidelines recommend advice to continue normal activity and supervised, graded reactivation, since this leads to less chronic disability and work loss (COST B13 2004; NICE 2009; Waddell 1999). The most recent and comprehensive systematic review concludes that exercise therapy in general is effective for chronic back pain in terms of both pain and function (Hayden 2005a). This finding supports the conclusions of earlier reviews (Abenhaim 2000; Anon 2001; van Tulder 2000). Individually designed strengthening or stretching programs delivered with supervision seem to be the most effective (Hayden 2005b). Encouraging adherence to achieve high dose of exercise (Hayden 2005b), or adding motivational programmes to the exercise (COST B13 2004) appear to be part of effective strategies to deliver exercise for back pain.

It is clear that exercise therapy, encompassing a wide range of interventions such as general (aerobic) exercise, specific body-region exercises for strengthening and flexibility, continuing normal physical activities, and increasing general physical activity levels, is a core treatment option for patients with knee pain and spinal pain. Achieving and maintaining adherence to exercise therapy in the management of common musculoskeletal pain is therefore important, if the beneficial effects of exercise are to be realised. Available data suggest a difference in exercise efficacy by adherence (Hayden 2005b; van Gool 2005), indicating that adherence is a key link between the process and outcome of health interventions. More broadly, it has been recognised that poor adherence to long-term therapies compromises the effectiveness of treatment (WHO 2003), and several reviews have already been published which focus on the theme of adherence-enhancing interventions (Haynes 2008; Roter 1998; van Dulmen 2007). A number of models and theories have been used in an attempt to understand adherence to health interventions, including the health belief model, the theory of reasoned action, the transtheoretical model, and the theory of planned behaviour and self-efficacy, as summarised in an overview by Brawley and Culos-Reed (Brawley 2000). Although each has its advantages and disadvantages, no single approach can be used to gain a comprehensive understanding of adherence, and questions remain about how best to optimise adherence to exercise and physical activity in the management of common musculoskeletal pain.

Most research to date has focused on adherence to medication (Haynes 2008), or more broadly with medical regimens (Roter 1998). A recent review in the general population concluded that the effects of interventions to increase physical activity are small: it is possible to increase physical activity for at least three months after the intervention stops; the setting does not appear to have an important role in determining whether an intervention is successful; and it is not necessary to have an intensive intervention to achieve effects (Holtzman 2004). Conversely, available reviews of

adherence to treatment in clinical populations suggest that motivational strategies and complex interventions (such as home visits, education, work site visits) appear promising for hypertensive patients (Schroeder 2004), but that no specific type of intervention in particular produces significant effects on adherence to treatment amongst people with type 2 diabetes mellitus (Vermeire 2005). Interventions that target and try to optimise adherence in the management of chronic musculoskeletal pain, including adherence to exercise regimes, are needed.

Adherence with health interventions is a complex problem, especially for individuals with chronic conditions. Not only is it influenced by a number of interdependent factors, including characteristics of the patient, characteristics of the treatment regimen, features of the disease, the relationship between the healthcare provider and the patient, and the clinical setting (Meichenbaum 1987), it is also defined differently by different people, fluctuates over time, and no gold standard measure of adherence exists (Treuth 2002). Indeed, simply measuring adherence behaviour can influence the behaviour itself (Haynes 2008). There is the added complexity of whether adherence to the treatment itself, for example the required number of treatment visits or supervised exercise classes, can be used as a measure of adherence behaviour. Given that this may provide some indication of early willingness to engage in the exercises or physical activity, it would appear a relevant marker to measure and report.

Many terms are used to describe adherence in the literature, including adherence, compliance, concordance, co-operation, partnership and engagement. For the purposes of this review, we use the term adherence, defined as 'the extent to which a person's behaviour corresponds with agreed recommendations from a health care provider' (WHO 2003). In this definition we include levels of exercise behaviour completed over the duration of a course of therapy (including attendance at exercise sessions, as this captures data on exercise behaviour), and level of exercise behaviour after the course of therapy is completed, which provides a better indication of long-term exercise adherence. We have not included adherence to study protocols as a measure of exercise adherence (including attendance at treatment sessions where exercise was not performed and number of drop outs) as we felt that did not sufficiently reflect exercise behaviour.

The purpose of this review was to identify and assess the effectiveness of different interventions that aim to improve adherence to exercise therapy (broadly defined as specific body-region exercises for strengthening and flexibility, continuing normal physical activity, and increasing general physical activity levels) for managing chronic musculoskeletal pain.

OBJECTIVES

To systematically search, critically appraise and summarise all RCTs or quasi-RCTs pertaining to the efficacy and effectiveness of interventions targeting adherence to exercise therapy and physical activity recommendations, in adults, 18 years or over, with chronic musculoskeletal pain. Specific objectives were as follows.

1. Identify RCTs and quasi-RCTs of interventions that aimed to improve exercise adherence in chronic musculoskeletal pain.

2. Critically appraise and assess the quality of the included studies.

3. Describe the range of interventions aimed at improving exercise adherence in chronic musculoskeletal pain.

4. Assess the effectiveness of these interventions on adherence itself and clinical outcomes (pain, functional disability, and quality of life).

5. Describe, in a narrative summary, the features of the interventions that appear to be most effective in improving adherence to exercise therapy in chronic musculoskeletal pain.

METHODS

Criteria for considering studies for this review

Types of studies

We included RCTs and quasi-RCTs in this review.

Types of participants

The population of interest for this review was adults (18 years old and over) with persistent or episodic pain lasting more than three months in the axial skeleton (neck and low back) or large peripheral joints (hip, knee, shoulder). This included people with clinical diagnoses of chronic pain, non-specific musculoskeletal pain, mechanical or simple low back pain and those with a radiological diagnosis of osteoarthritis, or degenerative joint disease or other related conditions that are linked to or secondary to this, such as spondylosis (vertebral osteophytes secondary to disc degeneration (Adams 2002)) or facet joint osteoarthrosis.

We excluded studies exclusively of people with diagnoses of rheumatoid arthritis, ankylosing spondylitis, spondylolisthesis or other defined rheumatological problems. People with these more rare conditions form distinct patient populations that are different from those with chronic musculoskeletal pain and require different management strategies. It was necessary for clarity to restrict the focus of this review to more prevalent chronic musculoskeletal disorders, including spinal pain and osteoarthritis. We also excluded studies of surgical patients or those on surgical waiting lists. We also excluded studies with healthy volunteers, as this group

may not have the same motivation for physical activity as people with chronic musculoskeletal pain. Where mixed populations of participants were included in studies, we included only those with at least 50% of participants meeting the inclusion criteria in the review.

Types of interventions

We included any interventions delivered in primary, outpatient or community care that aimed to improve adherence to exercise or physical activity for treating people with chronic musculoskeletal pain. We expected to find interventions targeted at individuals and couples, such as diaries, prescribed general or therapeutic exercise, improving access to facilities, educational programs and physical activity counselling or coaching. We did not expect interventions targeted at a community level to be common for this population. We excluded interventions delivered through inpatient care, in particular those relating to surgery, from this review.

In this review we have compared interventions that aim to improve adherence to exercise or physical activity either with other interventions with the same aim, control groups that receive no intervention or other exercise interventions in the management of chronic musculoskeletal pain.

Types of outcome measures

The main outcome of interest was adherence to exercise or physical activity advised or prescribed for managing chronic musculoskeletal pain. We expected to see outcome measures such as the proportion of participants engaging in exercise activities, the number or frequency of exercise sessions attended per week, or whether people participated in exercise sessions or not. We were also interested in changes in general exercise or physical activity behaviour. We included any measures found in the literature for these changes.

We also included patient-reported outcomes, such as pain, functional disability, quality of life, and ability to carry out usual daily activities. However, these have been discussed only for interventions that enhanced adherence to exercise using either region-specific validated measures such as the Roland Morris Disability Questionnaire for low back pain, and the WOMAC Osteoarthritis Index for lower limb osteoarthritis or validated measures of general physical function such as the SF36 physical function subscale. We have not classed measures of physical impairment, such as quadriceps strength, timed walk tests, and joint range of movement tests as a measure of function within this review, therefore we have not extracted these data.

We included short- and long-term outcomes where these data were available. Given the need to know about safety of potentially effective interventions, where data on adverse events were reported, we extracted and summarised these. It is plausible that lower adherence might be seen in the context of interventions for which patients report frequent or serious adverse events.

Search methods for identification of studies

An information scientist developed the search strategy in collaboration with clinicians and academics in the reviewing team. Three sections of the search strategy, for adherence, exercise therapy and chronic musculoskeletal pain, were developed separately. We broadly defined exercise therapy as any type of exercise or physical activity including general (aerobic) exercise, specific body-region exercises for strengthening and flexibility, continuing normal physical activity, and increasing general physical activity levels. We used the Cochrane highly sensitive search strategy to find controlled clinical trials. We then combined these four sections of the search strategy to identify studies of relevance to the review. The full search strategy is given in Appendix 1.

We searched the following databases:

- Cochrane Musculoskeletal Group Trials Register (October 2007)
- Cochrane Rehabilitation & Related Therapies Field Trials Register (October 2007)
- *The Cochrane Library* (Cochrane Database of Systematic Reviews, Cochrane Register of Controlled Clinical Trials (CENTRAL), DARE, HTA Database and NHSEED)(Issue 3, 2007)
- MEDLINE (1950 - October 2007)
- EMBASE (1980 - October 2007)
- CINAHL (1982 - October 2007)
- AMED (1985 - October 2007)
- PsycINFO (1840 - October 2007)
- Science Citation Index and Social Science Citation Index
- SPORTDiscus
- Clinical Evidence
- National Research Register
- PEDro
- OTSeeker
- The Trip Database
- Google Scholar
- OMNI Gateway

We did not handsearch any additional journals, as all journals in this area are either indexed on one of the electronic databases or are being handsearched by the Cochrane Collaboration. However, we checked reference lists and tracked citations of important papers using the Science Citation Index and the Social Science Citation Index. We consulted experts in order to find additional papers and unpublished studies and used the OMNI Gateway to find relevant grey literature from health organisations and patient groups. We contacted authors when we needed to clarify data to be able to include trials in the review.

We translated papers published in languages other than English and considered them for inclusion. We included only abstracts of trials where a full report was available in the review.

Data collection and analysis

Two independent reviewers assessed the titles and abstracts of potentially relevant papers identified from the search strategy against the inclusion criteria. We obtained all remaining papers and reviewed them in full before making a final decision on inclusion in or exclusion from the review.

Two of the four review authors quality assessed each included trial and extracted data. We consulted a third reviewer to resolve any differences in opinion. We assessed the quality of the trials using the Delphi List (Verhagen 1998).

The Delphi List consists of the following items.

1. Was a method of randomisation performed?
   i) Was the treatment allocation concealed?
   ii) Were the groups similar at baseline for most important prognostic indicators?
2. Were the eligibility criteria specified?
3. Was the outcome assessor blinded?
4. Was the care provider blinded?
5. Was the patient blinded?
6. Were point estimates and measures of variability reported for primary outcomes?
7. Did the analysis include an intention-to-treat analysis?

We assigned included trials quality scores. However, we used scores only to judge whether a trial report was of high, moderate or low methodological quality and a narrative account of any serious flaws was reported. We have taken a quality score of one, two or three to indicate a poor quality trial; four, five and six as moderate quality; and seven and above as high quality.

We set up electronic forms in Microsoft Access to record the quality assessment and extracted data from each trial. We recorded details of the study, such as setting, patients, interventions, methods and outcomes as well as results for the outcomes of relevance to the review.

We have provided a description of the methodological quality of each of the included studies, and displayed participants' demographic data, details of the studies' characteristics and results. We have presented a narrative summary of the main findings of the review, as we were unable to perform statistical synthesis. The aim was to describe the range of interventions and how effective these appear to be in improving adherence to exercise therapy in chronic musculoskeletal pain. We looked at the effectiveness of the interventions in the context of different subgroups: those with pain at different sites, and differences in type or delivery of exercise (e.g. home- or outpatient-based, or individualised or group interventions).

The protocol and the completed review were peer reviewed by consumers registered with the Cochrane Musculoskeletal Group, as well as experts on this subject. Prior to submitting the review, local clinicians and researchers also commented on the content.

Statistical analysis

Outcome measures, interventions and populations in the included studies were too varied for any formal testing of heterogeneity to be necessary, which made quantitative pooling of the results inappropriate.

Grading of evidence

We used the grading system described in the 2004 book *Evidence-based Rheumatology* (Tugwell 2004), recommended by the Cochrane Musculoskeletal Group.

Platinum: A published systematic review that has at least two individual controlled trials each satisfying the following.

- Sample sizes of at least 50 per group - if these do not find a statistically significant difference, they are adequately powered for a 20% relative difference in the relevant outcome.
- Blinding of patients and assessors for outcomes.
- Handling of withdrawals more than 80% follow up (imputations based on methods such as Last Observation Carried Forward (LOCF) are acceptable).
- Concealment of treatment allocation.

Gold: At least one RCT meeting all of the following criteria for the major outcome(s) as reported.

- Sample sizes of at least 50 per group - if these do not find a statistically significant difference, they are adequately powered for a 20% relative difference in the relevant outcome.
- Blinding of patients and assessors for outcomes.
- Handling of withdrawals more than 80% follow up (imputations based on methods such as LOCF are acceptable).
- Concealment of treatment allocation.

Silver: A randomised trial that does not meet the above criteria. Silver ranking would also include evidence from at least one study of non-randomised cohorts that did and did not receive the therapy, or evidence from at least one high-quality case-control study. A randomised trial with a 'head-to-head' comparison of agents would be considered silver level ranking unless a reference were provided to a comparison of one of the agents to placebo showing at least a 20% relative difference.

Bronze: The bronze ranking is given to evidence if at least one high-quality case series without controls (including simple before/after studies in which patients act as their own control) or if the conclusion is derived from expert opinion based on clinical experience without reference to any of the foregoing (for example, argument from physiology, bench research or first principles).

As all the included studies would be RCTs and blinding of patients and clinicians was not possible for these types of interventions, we anticipated that evidence in this review might all be categorised as silver. We used the system developed by the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) working group (GRADE 2004) in order to arrange RCTs in a hierarchy according to the methodological quality.

Using this system, we initially graded the included RCTs as 'high'. However, we decreased the grade by one or two grades to 'moderate', 'low' or 'very low' to account for the following.

- Serious (-1) or very serious (-2) methodological flaws (In this review, for moderate quality trials deduct one point; low quality trials deduct two points)
- Inconsistency in the evidence (-1)
- Minor (-1) or major (-2) differences in participants, interventions or outcome measures from those of interest
- Lack of data or imprecise results (-1)
- Likelihood of reporting bias (-1)

As suggested by the GRADE working group, we used the following definitions.

High = further research is very unlikely to change our confidence in the estimate of effect

Moderate = further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate

Low = further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate

Very low = any estimate of effect is very uncertain

Clinical relevance tables

We were unable to compile clinical relevance tables for this review, as we performed no statistical analysis.

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies.

We downloaded 6352 unique references from the electronic bibliographic databases. We reduced this to 279 after matching titles and abstracts against the inclusion criteria. We assessed the full text of these papers, which resulted in 42 trials (published in 59 papers) included in the final review.

The main reason for excluding trials was their failure to state an explicit aim to improve exercise adherence, either as an aim of the study or as an aim of the interventions, even if adherence was measured. Another major reason for excluding studies was the failure to report adherence to exercise or physical activity for two or more groups to enable a comparison. We also had to exclude trials where more than 50% of the participants did not have chronic musculoskeletal pain, or were suffering from a different condition, such as rheumatoid arthritis. We have included trials that needed some discussion over whether to include or exclude them from the review, as well as those where we contacted the authors, in the Characteristics of excluded studies table.

All of the included studies are published in English. We found and translated papers in other languages in the search for literature, but none met the inclusion criteria.

Description of study designs

We have reported details of the included trials in the Characteristics of included studies table. All of the included trials were RCTs, with one exception, which was a quasi-randomised trial (Cohen 1983). This study allocated participants to one group until there were enough to run a group session, then switched to recruiting to the other intervention until the next session was full, and so on. The number of groups in each study ranged from two to four parallel groups; there were no crossover trial designs. Two trials were described by their authors as pilot studies (Blixen 2004; Talbot 2003) and one study looked in more detail at a subgroup from a larger trial (Halbert 2001).

A wide variety of comparison groups were used in the studies. Usual care was used in five studies; most commonly this was care from a general practitioner, physiotherapist or a rheumatologist. Six studies had a waiting list control group, where people in the group received the intervention after the end of the follow-up period. Educational or advice booklets were also used as a control intervention in nine studies. Remaining studies compared two or more exercise programmes, some of which were delivered alongside additional therapeutic interventions, such as therapeutic ultrasound (Huang 2005).

Follow up

The average length of the follow up across all the studies was less than nine months, with a range from three weeks (Luszczynska 2006) to 30 months (Harkapaa 1990; Mikesky 2006). Thirteen studies (31%) had a follow up of 12 months and four studies included follow up of more than one year (Ettinger 1997; Jensen 2001; Harkapaa 1990; Mikesky 2006).

Study participants

The 42 trials included a total of 8243 people. The smallest trial was conducted with only 32 people and the largest included 1099 people. All but two of the included trials studied osteoarthritis (23 trials; 4894 people) or spinal pain (17 trials; 2761 people). One trial included 122 people with chronic musculoskeletal pain in various body regions and another trial included 466 computer workers with symptoms of repetitive strain injury (RSI) (Bernaards 2007). None of the trials in people with other conditions, such as shoulder pain or fibromyalgia, met the criteria to be included in the review. Trials of osteoarthritis most commonly focused on the knee joint, and included participants with a radiographic, or clinical diagnosis of osteoarthritis. Four trials included people with

rheumatoid arthritis, but more than half of the participants had osteoarthritis (Barlow 2000; Fries 1997; Lorig 1985; Nour 2006). Most of the trials (n = 25) recruited patients from referrals after consulting a clinician for chronic musculoskeletal pain. Seven trials recruited volunteers responding to advertisements in the local media or placed in clinics, and another four recruited a combination of patients and volunteers. This was usually because of slower recruitment rates than initially expected (Ettinger 1997; Minor 1989; Soukup 1999; Veenhof 2006). There were also five trials of workers with chronic musculoskeletal pain conditions (Bernaards 2007; Harkapaa 1990; Taimela 2000; Viljanen 2003; Ylinen 2003) and one trial that identified people on long-term sick leave due to chronic spinal pain from health insurance data (Jensen 2001).

The trials were conducted mainly in Europe (20 trials; 4348 people) and North America (14 trials; 2813 people). Some were also carried out in Australasia (4 trials; 576 people) and Asia (4 trials; 506 people).

Description of interventions

Although heterogeneous in terms of their design, and the specific content of the interventions, we could broadly group included trials into five categories, which explored the effect of the following on exercise adherence.

- Type of exercise therapy or physical activity
- Delivery of exercise
- Exercise combined with a specific 'adherence' component
- Self-management programmes
- Interventions based on cognitive and/or behavioural principles

Within the studies exploring the type of exercise therapy, the delivery of exercise and exercise combined with a specific 'adherence' component, exercise therapy was either delivered in a group, individually, a home programme, or provided as advice to increase physical activity levels. Exercise programmes included one or more of the following: general (aerobic) exercise (including walking and cycling), local exercise (including joint range of movement, and muscle strengthening, stabilisation, endurance and muscular stretching), balance exercises, functional task training (for example rising from sitting), hydrotherapy, yoga, and tai-chi. One study that included participants with neck disorders also incorporated eye fixation exercises, designed to prevent dizziness (Taimela 2000). Exercise programmes were delivered by a range of professionals, including physiotherapists, a medical consultant, an exercise physiologist, exercise leaders (trained fitness instructors, tai-chi and yoga instructors), and a study coordinator.

Type of exercise or physical activity

Seventeen trials explored the effectiveness of different types of exercise interventions, and the impact that these had on adherence. Direct comparisons were made between two or more different types of exercise, for example, aerobic versus resistance strengthening exercise (Ettinger 1997), back-specific stabilisation exercise versus general exercise (Koumantakis 2005), high versus low intensity exercise, progressed versus un-progressed exercise, and the effect of adding therapeutic ultrasound to an exercise programme (Huang 2005).

(See Table 1 for list of RCTs)

Delivery of exercise

Six trials explored the impact of different modes of exercise delivery. Comparisons included supervised versus un-supervised exercise, out-patient exercise plus refresher sessions versus written and oral instruction on back exercises, group versus individual exercise, and face-to-face exercise supplemented with either a brochure, a brochure plus an audiotape and a brochure plus a videotape.

(See Table 2 for list of RCTs)

Exercise combined with a specific 'adherence' component

Four trials included exercise programmes that incorporated an additional adherence component that was designed to increase the likelihood of participants adopting, and/or maintaining the exercise programme, or to increase their overall physical activity levels. The adherence components ranged in duration from one additional session (Luszczynska 2006) to 24 sessions (30 minutes each) of group problem-solving and discussion three times per week, for eight weeks (Hughes 2004). The adherence components included one or more of the following: education, counselling designed to address participants' readiness to change, positive reinforcement including reward and punishment strategies, goal setting, feedback, skills building including mastery of the exercise programme and identifying ways to continue exercising in the future, self-monitoring through use of an exercise diary, an exercise contract (sometimes referred to as behavioural-contracting), and a graduation certificate awarded upon successful completion of the exercise programme.

(See Table 3 for list of RCTs)

Self-management programmes

Eight trials tested the effectiveness of self-management programmes on enhancing exercise adherence; seven of which were based on the arthritis self-management programme developed by Lorig et al (Lorig 1980). Health professionals and lay leaders who typically suffered from arthritis themselves delivered these interventions. Interventions were delivered in a group, or individually via mail, telephone, or face-to-face in the participant's own home. The exact content of each programme varied, but covered aspects of arthritis self-management, including one or more of the following: education about pathology; how to manage symptoms such as pain, stiffness, fatigue, depression and stress; nutrition;

weight management; joint protection; active coping; relaxation; increasing physical activity and exercise; accessing community resources and social networks; energy saving strategies; and effective communication. Additional strategies utilised to enhance adoption of self-management included goal setting, positive reinforcement, group discussion and problem solving, a personal contract, self-monitoring via a diary, and feedback.

Two trials included an additional exercise component to the arthritis self-management programme. Yip et al promoted an exercise action plan that included stretches, walking and tai-chi types of movement (fluid, gentle, relaxed and slow-tempo) (Yip 2007). A pedometer was also given to participants for three days to act as positive reinforcement for walking. Talbot et al supplemented an arthritis self-management programme with a walking programme, in which participants used a pedometer to monitor their daily step count (Talbot 2003). They were instructed to increase their baseline step count by 10% every four weeks.

(See Table 4 for list of RCTs)

Interventions based on cognitive and/or behavioural principles

Seven trials explored the effectiveness of interventions based on cognitive and/or behavioural principles. Various professionals including physiotherapists, physicians, psychologists, psychiatrists, and counsellors delivered the interventions. Strategies included one or more of the following: education (including a broad range of topics such as stress management, depression, pain, ergonomics and anatomy and physiology), behavioural graded activity (increasing activity levels in a time contingent manner), goal setting, skills acquisition (including physical skills such as exercise, workplace adjustment and relaxation techniques, and cognitive skills such as active coping, self-efficacy, communication, assertion skills, and self-responsibility), application of skills into daily activities, problem solving, and self-monitoring.

(See Table 5 for list of RCTs)

Description of outcomes

Exercise adherence

In total, 25 of the trials (59%) used one measure of adherence, 12 trials used two measures and five trials had three or more measures. There was considerable heterogeneity in the types of measure employed, but they could be broadly grouped as: continuous, dichotomous/categorical, attendance, and exercise performance accuracy. Continuous measures of exercise adherence were used in 25 studies. These included the number and duration of exercise sessions completed, the total minutes spent in physical activity and daily step count completed over a pre-determined time period (for example, in the past week, month, or six months). Eleven studies included dichotomous/categorical measures of exercise adherence. These included achievement of a pre-determined level of physical activity, or set number of exercise sessions (Mikesky 2006), change in overall activity level (McCarthy 2004), and self-rating of whether or not participants had completed home exercises as often as they had been prescribed (Yip 2007).

Continuous and dichotomous/categorical adherence data were mostly self-reported by study participants, including through use of exercise diaries, Likert scales, and open-ended questions in interviews or questionnaires. Three trials used specific physical activity questionnaires to measure change in participants' overall physical activity levels including the Physical Activity Scale for the Elderly (PASE) (Petrella 2000) and the Short QUestionnaire to ASsess Health enhancing physical activity (SQUASH) (Bernaards 2007; Veenhof 2006). One study included two objective measures of physical activity: an accelerometer, measuring total counts of physical activity per day (expressed as total vector magnitude); and a pedometer, measuring daily step count. However, participants were still required to log their total daily step count, measured by the pedometer, in a diary (Talbot 2003). Although one other study used a pedometer to promote walking, it was not used as a measure of exercise adherence (Yip 2007).

Attendance at exercise sessions was commonly used as a measure of adherence (13 studies). The methods for calculating attendance varied between studies and included: dividing the number of participants that completed the treatment by the total number of participants who commenced treatment (Huang 2003; Huang 2005); calculating the total number of participants that attended a set number of treatment sessions, although the rationale for the number set was not stated (Hurley 2007); calculating the mean number of prescribed exercise sessions attended (Mikesky 2006); dividing the number of exercise sessions completed by the total number prescribed (although some of these sessions were completed at home, this was still classed as attendance) (Ettinger 1997). One study reported measuring attendance but did not elaborate on how this was done (Foley 2003). Attendance was mostly self-reported or logged in a class register; however, one study used electronic monitoring whereby participants checked into the class by swiping an electronic membership card through a card reader (Mikesky 2006).

Finally, four studies used the accuracy of exercises performed to rate adherence (Friedrich 1996; Harkapaa 1990; Luszczynska 2006; Schoo 2005). Three of these asked the treating clinician to rate the patient's performance of exercise technique (Friedrich 1996; Harkapaa 1990; Schoo 2005). None of these trials used this as their only measure of exercise adherence; frequency of exercise was also noted. Luszczynska 2006 used a subjective measure of exercise performance accuracy as well as frequency of exercise. In this trial, participants were asked at follow up whether they recognised pictures or descriptions of two of the recommended exercises and how often they had performed them.

Clinical outcome measures

A wide variety of clinical outcome measures were utilised in the included studies, such as previously validated tools (for example the Pain Disability Index, the Roland and Morris Disability Questionnaire, and the Short Form 12 Health Survey), visual analogue scales, Likert scales, open-ended questions and diaries. In total 36 studies measured pain, 30 studies measured function and 11 studies measured quality of life. Three studies did not include any clinical outcome measures (Luszczynska 2006; Nour 2006; Schoo 2005).

See Characteristics of included studies for the adherence and clinical measures used by each trial.

Risk of bias in included studies

We have reported the full quality assessment for each included study in Table 6. The Delphi quality assessment scores ranged from two to eight, with an overall average score of five. A methodological quality score of five is considered moderate quality according to our predefined criteria. The majority of the included studies (n = 29) were moderate methodological quality, with six poor quality and seven high quality trials.

None of the 42 included trials were able to blind the care providers, as it would not be possible to do this for these types of interventions. In the trial by Koumantakis et al, the participants were told that the interventions were "two exercise regimens for trunk muscles" and were not aware of the theoretical bases behind them (Koumantakis 2005). This was the only trial that attempted to blind the participants to the differences in the intervention they received. Sixteen of the trials had a blinded outcome assessment for the primary outcomes measured. However, all of the trials had at least one self-reported, or care provider-rated adherence measure; we therefore did not consider them as blinded for this outcome as the participants and care providers were aware of the intervention received.

The randomisation process was generally not well reported. All but one of the trials (Cohen 1983) stated that the trial was randomised, but the randomisation process itself was often not described. There was not enough information in 24 (57%) of the trials to judge if allocation was adequately concealed.

Luszcyzynska et al failed to state how many of the 66 people recruited to the trial were allocated to the two groups (Luszczynska 2006). As we were not able to conduct a statistical analysis in this review, this was not essential data, and we included this trial in the review.

As well as the items in the Delphi list, we also looked at the proportion of withdrawals from each of the trials. Eight (19%) trials reported loss to follow up of 30% or more (Asenlof 2005; Bernaards 2007; Cohen 1983; Hughes 2004; Koumantakis 2005; Mikesky 2006; Song 2003; Yip 2007). Song et al reported 41% of the participants were missing at the three-month follow up, with no statistically significant difference in those lost between the two groups (Song 2003). In four of the trials there was a statistically significant difference in withdrawal rates between groups (Fries 1997; Hughes 2004; Mikesky 2006; Yip 2007). Mikesky et al found more people in the strengthening exercise group dropped out than in the range of movement exercise group (Mikesky 2006). In the trials by Yip et al (Yip 2007) and Hughes et al (Hughes 2004) more of the participants in the comparison or control groups were lost to follow up than in the intervention groups. However, more people in the intervention group (an arthritis self-management programme) than in the control group (12-month waiting list) were lost to follow up at the end of the trial by Fries et al, which had an overall drop out rate of 26% (Fries 1997).

Twenty-five trials stated that an intention-to-treat (ITT) analysis was carried out, or we judged them to have done so. Three of these trials reported complete follow up of participants, and we counted these as having used an ITT analysis (Friedrich 1996; Halbert 2001; Mangione 1999). Nineteen trials did not carry out an ITT analysis, or the data were not available. Four of these trials (Cohen 1983; Hughes 2004; Mikesky 2006; Song 2003) also reported more than 30% loss to follow up.

Effects of interventions

Overall only 18 of the 42 trials indicated that the intervention improved adherence to exercise or physical activity. Results varied widely for similar interventions, populations and outcome measures.

Type of exercise therapy or physical activity

Seventeen out of 42 trials evaluated different types of exercise therapy or physical activity. Only two of these (Fransen 2007; Ylinen 2003) found a difference between types for any of the adherence outcomes measured. Fransen et al compared hydrotherapy with tai-chi in 152 people with knee osteoarthritis and found that attendance was higher in the hydrotherapy group sessions than in the tai-chi group (Fransen 2007). Although this appears to favour water-based exercise, another study compared water-based exercise to land-based exercise, and found no significant difference in exercise adherence between groups (Minor 1989). Ylinen et al found in a trial of 180 female office workers with neck pain that those who received endurance neck training completed significantly more training sessions at 12 months, as reported in their exercise diaries, than the group who had neck strengthening and stabilisation exercise training (Ylinen 2003). However, even though the difference in average number of training sessions per week was statistically significant, the actual difference was only 0.3 times a week (2.0 times and 1.7 times), which does not seem to be a clinically meaningful difference. None of the other types of exercise showed statistically significant differences with the interventions to which they were compared. For details of the different types of exercises and the comparisons in each of these trials see Table 1.

Summary

- **Exercise type does not appear to be an important factor in order to improve exercise adherence. (GRADE: Moderate (inconsistent interventions (-1)); Silver)**
- **Evidence for water-based exercise is conflicting (GRADE: Low (moderate quality (-1) and inconsistent results (-1)); Silver)**

Delivery of exercise

Six trials evaluated the effectiveness of different modes of delivery of exercise interventions. Of these, five had a positive effect on adherence outcomes. Friedrich et al compared supervised group exercise with un-supervised exercise in the form of exercise brochures in 87 people with neck or back pain (72% reported chronic pain) (Friedrich 1996). The authors found that weekly training frequency was significantly higher for the supervised group than the group that received a brochure. McCarthy et al compared the effect on adherence of supplementing a home exercise programme with a class-based exercise programme, versus home exercise alone, in a sample of 214 patients with knee osteoarthritis (McCarthy 2004). At six and 12 months follow up, participants rated their physical activity levels over the previous six months. Although similar proportions reported no change in each treatment group, a greater proportion reported increased activity in the class group and correspondingly a smaller proportion reported reduced activity. At six months and 12 months, the ordinal logistic model suggested that the class-based group described greater physical activity levels. However, there was no significant difference at six and 12 months in participants' report of how many times, and for what duration, they had performed the home exercises in the past week. Hurley et al (n = 418) found that attendance at exercise sessions for people with chronic knee pain was significantly higher for individual rehabilitation than group rehabilitation (Hurley 2007). The reason for this was that individual sessions could be arranged at more convenient times and missed sessions could be rearranged, whereas group sessions were scheduled at relatively inflexible times, and missed sessions could not be rearranged.

Härkäpaa et al showed outpatient rehabilitation and refresher sessions were more effective at improving the accuracy of exercise performance than written and oral advice on back exercises and ergonomics in 476 blue-collar workers and farmers with back pain (Harkapaa 1990). However, this intervention was not significantly better than advice for increasing the frequency of exercise. In the trial by Schoo et al, the performance accuracy of exercises in 115 people with hip or knee osteoarthritis was also found to be better using face-to-face exercise instruction reinforced with a brochure and either audiotape or videotape compared to the same instruction with a brochure only (Schoo 2005). Over eight weeks' follow up, the addition of instruction on audiotape and videotape did not increase the frequency of exercise compared to the brochure alone.

Taimela et al compared an exercise programme including eye fixation exercises to a home exercise programme plus lectures or lectures plus a recommendation to exercise in a trial of 76 people with chronic low back pain (Taimela 2000). They found no differences in exercise adherence over 12 months between these different modes of delivery of exercise.

For details of the different methods of delivering exercises and the comparisons in each of these trials, see Table 2.

Summary

- **Supervised exercise is more effective for improving weekly training frequency than unsupervised exercise. (GRADE: Moderate (moderate quality (-1)); Silver)**
- **Individual exercise is more effective than group exercise for improving attendance at exercise classes. (GRADE: Moderate (moderate quality (-1)); Silver)**
- **Supplementing a home exercise programme with group exercise may increase overall physical activity levels. (GRADE: Moderate (moderate quality (-1)); Silver)**
- **Performance accuracy is improved by refresher sessions or by providing audiotapes or videotapes of exercises. (GRADE: Low (low quality (-2)); Silver)**

Exercise combined with a specific 'adherence' component

The interventions in these trials varied considerably. Three out of the four trials that included a specific adherence-enhancing component with an exercise programme showed that they were more effective at increasing frequency or duration of exercise per week than an exercise package or advice to exercise alone. Friedrich et al compared a combined physiotherapy exercise and motivation package with standard physiotherapy exercise alone in 93 people with chronic low back pain (Friedrich 1998). Those who had the additional motivation programme were more likely to attend the exercise classes and to be exercising more frequently at 12 months than those who had the exercise programme alone. A small trial (66 people) by Luszczynska et al found that reinforcement of exercise therapy by a consultant physiotherapist was better than verbal and written education alone for increasing reported frequency of exercises after one month in people with spondylosis (Luszczynska 2006). Hughes et al, who compared an adherence-focused home exercise programme following facility-based exercise with an exercise advice booklet, found the mean number of minutes exercised per week improved significantly more for those in the adherence-focused intervention (Hughes 2004).

The trial by Basler et al did not show any difference in average duration of physical activity at six months between either physiotherapy combined with transtheoretical model based counselling, or physiotherapy plus sham ultrasound (Basler 2007).

For details of the trials of specific exercise adherence enhancing components and the comparisons in each of these trials see Table 3.

Summary

- **Therapeutic programmes that specifically address exercise adherence are effective in improving the frequency/duration of exercise, and attendance at sessions. (GRADE: Moderate (moderate quality (-1)); Silver)**
- **The addition of transtheoretical model based counselling to physiotherapy is not more effective than physiotherapy and a sham intervention (GRADE: High (high quality); Silver)**

Self-management programmes (SMP)

Six of the eight trials that evaluated self-management programmes showed a positive effect on exercise adherence. Barlow et al randomised 544 volunteers with arthritis to group Arthritis SMP (ASMP) or a waiting list control group (Barlow 2000). After four months, significantly more people receiving ASMP were doing flexibility and strengthening exercises than those in the control group. Fries et al found, in 1099 people with arthritis, that individualised postal SMP was more effective for increasing the frequency of exercise than a waiting list control group over six months (Fries 1997). Lorig et al also found an increased frequency in exercise with a lay-led SMP compared to a no-intervention control group after four months in 190 people with arthritis (Lorig 1985). Nour et al compared a SMP that included a cognitive behavioural approach and home visits to a waiting list control group in 113 people with arthritis (Nour 2006). The trial showed a significant difference in favour of the combined treatment package in change in overall exercise frequency and in the change in frequency of stretching exercises, but not for change in strengthening exercises or walking frequency over three months. In the trial by Yip et al, 182 people were randomised to either a SMP that included activity goals and a pedometer or a control group that received routine treatment from orthopaedic doctors or outpatient clinics (Yip 2007). The SMP group had a significantly higher mean change in light exercise than the usual care group at six months' follow up. Talbot et al found in 34 people with osteoarthritis that the addition of a walking programme to a SMP significantly increased daily step counts measured on a pedometer compared to the SMP alone over six months (Talbot 2003). However, there was no significant difference between groups in the frequency and intensity of physical activity measured by accelerometry.

The trials by Blixen et al (Blixen 2004) and Ersek et al (Ersek 2004) showed no significant differences between the groups for the adherence outcomes measured. See Table 4 for details of the interventions and the comparison groups.

Summary

- **Self-management programmes improve exercise frequency compared to waiting list or no-intervention control groups. (GRADE: Moderate (moderate quality (-1)); Silver)**

Interventions based on cognitive and/or behavioural principles

Two trials showed a positive effect on adherence measures by including interventions based on cognitive and/or behavioural principles. Soderlund et al compared a physiotherapy programme that included cognitive behavioural therapy (CBT) with usual physiotherapy in 33 people with whiplash-associated disorder (Soderlund 2001). People who had the additional CBT programme were more likely to say that they had applied what they had learnt in the physiotherapy sessions than those in the usual physiotherapy group. In the trial by Veenhof et al, 200 people with hip or knee osteoarthritis were allocated to behavioural graded activity or usual care (treated according to Dutch physiotherapy guidelines for patients with hip or knee OA) (Veenhof 2006). Significantly more of the people in the graded activity group reported adhering to their home exercise programme than those in the usual care group at nine months' follow-up.

Five trials (Asenlof 2005; Bernaards 2007; Cohen 1983; Jensen 2001; Smeets 2006) did not find any significant differences between the interventions compared. See Table 5 for details of interventions and the comparison groups.

Summary

- **Graded activity is effective in improving adherence to a home exercise programme. (GRADE: Moderate (moderate quality (-1)); Silver)**
- **The addition of interventions based on CBT to physiotherapy programmes may be effective for people with whiplash-associated disorder. (GRADE: Moderate (moderate quality (-1)); Silver)**
- **Evidence suggests that adding CBT-based approaches to physiotherapy programmes is not effective in improving exercise adherence for other chronic musculoskeletal conditions. (GRADE: Moderate (moderate quality (-1)); Silver)**

Subgroups

When we looked at different subgroups of trial participants, for example those with chronic pain at different sites, or trials, for example trials with higher methodological quality, there was no indication of different effects for different subgroups.

Adverse events

Eleven studies reported data on exercise-related adverse events (Ettinger 1997; Fransen 2007; Hagberg 2000; Hurley 2007; McCarthy 2004; Mikesky 2006; Minor 1989; Sherman 2005; Smeets 2006; Taimela 2000; Veenhof 2006); most commonly this was an increase in pain as a consequence of exercise (n = 8). Smeets et al reported that one patient with increased pain developed a herniated disc with neurological deficits three days after a training session, and this required neurosurgical intervention (Smeets 2006). In another trial, four participants fell, one of which resulted in a fracture, and another participant dropped a dumbbell on her foot that also resulted in a fracture (Ettinger 1997). In the study by McCarthy et al, one participant did not complete a home exercise as prescribed and developed an inguinal hernia that needed surgical repair (McCarthy 2004). Other, less serious adverse events included dizziness (Taimela 2000), dyspepsia and fatigue (Minor 1989), migraine and back strain (Sherman 2005).

Four of these trials (Fransen 2007; Hurley 2007; McCarthy 2004; Veenhof 2006) showed a positive effect on adherence measures. However, the adverse events reported were not linked in the trials to any differences in adherence to exercise. This may have been due to the small number of adverse events reported.

Clinical outcomes

We explored whether the interventions that improved adherence also demonstrated improvement on the primary clinical outcomes. Of the 18 trials that showed improved adherence to exercise, only eight also showed significant improvements in at least one clinical outcome.

One trial showed a significant difference in exercise adherence between two different types of exercise training programmes, but no difference in clinical outcomes (Ylinen 2003). In another trial that compared different types of exercise, significant differences in adherence measures did not correspond with a significant difference in clinical outcomes (Fransen 2007).

For the trials evaluating different modes of delivering exercise programmes, three of the five trials that demonstrated statistically significant results for exercise adherence also had significant differences between the intervention and control groups in pain or function measures (Friedrich 1996; Harkapaa 1990; McCarthy 2004). Scores on quality of life measures were not significantly different between the groups (Hurley 2007; McCarthy 2004). The trial by Schoo et al did not measure clinical outcomes (Schoo 2005).

Within the trials exploring the addition of a specific 'adherence' component to an exercise programme, Friedrich et al found statistically significant differences in pain and function between the group that received the motivation and exercise programme and the standard physiotherapy control group corresponding to the differences seen in exercise adherence (Friedrich 1998). Hughes et al also showed significant differences in exercise adherence between the intervention and the control group and found a significant difference in pain at six months, but not at any other time point, or in function outcome measures (Hughes 2004). The trial by Luszczynska et al did not report clinical outcomes (Luszczynska 2006).

There was a statistically significant difference in pain reduction between groups in three of the six trials evaluating self-management programmes that also had improvements in exercise adherence (Fries 1997; Lorig 1985; Yip 2007). However, Fries et al showed a significant difference between groups in function and Lorig et al did not find a significant difference for this outcome (Fries 1997; Lorig 1985). The trial by Nour et al did not report clinical outcomes (Nour 2006).

The two trials of behavioural interventions reporting significant differences on adherence did not show significant differences between groups for pain or function measures (Soderlund 2001; Veenhof 2006).

Summary

- **There is conflicting evidence whether interventions that significantly improve adherence also significantly improve clinical outcome measures in comparison to a control/ comparison group (GRADE: Moderate (inconsistent evidence (-1)); Silver)**

DISCUSSION

Summary of main results

In total, only 18 of the 42 RCTs within the review showed that their interventions successfully enhanced adherence to exercise or physical activity in people with chronic musculoskeletal pain. This may reflect the fact that although all studies targeted exercise adherence in some way, it was commonly not a primary outcome or focus, thus studies may have been insufficiently powered to detect differences in adherence between groups. This, coupled with the large number of studies that were excluded from the review due to lack of targeted exercise adherence, or measurement of exercise adherence, highlights the limited attention that adherence to exercise has received to date within the field of chronic musculoskeletal pain.

The evidence within this systematic review suggests that the type of exercise prescribed does not influence levels of exercise adherence; however, the way in which exercise is delivered may have an effect. For example, providing supervised exercise and follow up to reinforce exercise behaviour, in addition to supplementing face-to-face instruction with other material, may all positively influence levels of exercise adherence. Incorporating specific adherence enhancing strategies within an exercise programme, including education and behavioural techniques such as positive rein-

forcement, goal setting, and use of an exercise contract, may be beneficial in increasing exercise adherence for people with chronic musculoskeletal pain. This is highlighted by the positive effect of interventions specifically targeting adherence in three of the four trials evaluating these interventions in our review (Friedrich 1998; Hughes 2004; Luszczynska 2006).

There was moderate evidence to suggest that self-management programmes and the inclusion of interventions based on cognitive and/or behavioural principles could also help some groups of people improve exercise adherence. However, due to the complex interventions employed, and the wide variation in content of interventions between studies, with some including adherence enhancing strategies and some not, it is difficult to determine the specific component(s) of interventions that improved adherence. In the trial by Talbot et al, a self-management programme plus a pedometer-driven walking programme was compared to a self-management programme alone, making it possible to attribute the improvements seen in adherence in the intervention group to the pedometer (Talbot 2003). The trial by Song et al also used a pedometer and found improvements in the intervention group; however, as there were multiple strategies within the intervention package, and as each was not specifically tested against a control, it is not possible to attribute the improvement in adherence directly to the pedometer (Song 2003).

Within the review, three studies that showed a significant improvement in adherence between groups did not report the effect of the interventions on clinical outcomes such as pain and function (Luszczynska 2006; Nour 2006; Schoo 2005). Taking into account both clinical and adherence outcomes, is important to fully establish the overall effectiveness of an intervention. In interventions that enhanced exercise adherence, some also showed significant improvements in clinical outcomes, but this was not a consistent finding. Given the variation in clinical outcome measures used and the multiple influences on outcome in the included trials, we were unable to draw any conclusions about the association between improving exercise adherence and clinical outcomes.

Overall completeness and applicability of evidence

Although this review provides evidence that adherence to exercise and physical activity for chronic musculoskeletal pain can be enhanced, caution is required when interpreting the results as evidence on exercise adherence is indirect, and comes from observed effects that are heterogeneous and inconsistent. The accuracy of measurement of exercise adherence, quality of some studies, and poor reporting must also be considered.

There was considerable variation in the intervention programmes delivered in the included trials. Even where one element was similar, it was packaged with different therapies, administered by different providers, and compared with different control groups. Studies were broadly grouped into those exploring the effect of type of exercise, the delivery of exercise, exercise combined with an 'adherence' component, self-management programmes, and interventions based on cognitive or behavioural principles, or both, on exercise adherence. However, there was overlap and inconsistencies in the content of study interventions between groups, meaning that it was difficult to synthesise the results and make meaningful comparisons between studies. Whilst there is some inevitable overlap between the categories used, other approaches to grouping the studies for purposes of description also lead to similar overlap, and lead to the same overall conclusions about the effectiveness of different interventions. In addition, within interventions that successfully enhanced exercise adherence, the large number of strategies adopted, and comparisons with very different control interventions made it impossible to identify the specific component that targeted exercise adherence within the intervention package.

As authors of this review, our greatest challenges were the decisions on how to define adherence to exercise and whether the different measures used in the literature were really measuring all the important components of adherence. Judgement of the accuracy of exercise performance by a health professional may not reflect how often exercise is being completed by the patient at home. Although patient attendance at exercise sessions gives some indication of adherence (Haynes 1980), it does not measure the amount of exercise behaviour completed, and once the course of treatment has been completed, it cannot be used to determine long-term adherence to an exercise programme. There was no consistency in the measures of exercise adherence, with a wide variety of continuous and dichotomous/categorical measures used, which may not capture data on all domains of exercise activity. For example, measurement of the number of times per week an individual engages in exercise fails to assess other domains such as intensity or duration of exercise, and thus this approach fails to provide clear insight into overall activity or exercise levels (Matthews 2002; Melanson 1996). Mostly, the measures and methods we found in the included trials were indirect and self-reported, which could be prone to recall and social desirability biases (Matthews 2002; Sallis 2000). An objective measure was used in only one trial (Talbot 2003), which measured physical activity with accelerometers and pedometers. Use of motion sensors, such as accelerometers, reduces the likelihood of biases from recall and other sources in clinical trials (Matthews 2005), although still relies on the participant adhering to the request to wear them, and in some instances record daily step count. As no single measure of exercise adherence is superior, it is suggested that using two or more methods might allow strengths of one method to help compensate for weaknesses of the other (Treuth 2002). Within our systematic review, a number of studies that showed significant improvements in exercise adherence using one measure included a second measure that failed to show differences in adherence between groups (for example McCarthy 2004; Schoo 2005). Therefore questions remain about the effectiveness of these interventions in improving overall exercise and physical activity levels and about the responsiveness of different adherence

measures. Finally, most of the included trials measured adherence in the short term only. Therefore, it is not known whether the measures can be used effectively to assess long-term adherence to physical activity.

Quality of the evidence

The overall quality of the included trials was moderate. A number of the trials lost a large proportion of participants during follow up and many of the trials were small. Large numbers of people withdrawing from the trials may also be an indicator of poor acceptability of the interventions, and may imply poor adherence to exercise in the long term. Within this review we did not use drop-out rate as an indicator of exercise adherence, as there could be many unexplained reasons for withdrawal from a study that are not directly related to adherence to exercise. There was a lack of long-term follow up in the trials; we found a mean follow up of less than nine months. Long-term follow up is important in order to fully evaluate interventions that aim to alter exercise or physical activity behaviour for chronic musculoskeletal conditions. Many studies in the literature have shown short-term benefits while the intervention is being administered that do not continue when contact with the clinician ceases (Marks 2005).

The quality of the reporting of the trials was generally poor. In particular there was often insufficient data on exercise adherence to be able to consistently extract this information. Trials frequently reported a non-significant difference between groups in adherence to the exercises, but failed to provide the supporting summary data. We found many studies in the literature search that evaluated exercise and self-management programmes without reporting any adherence measures. It is impossible to know if this is because these were not measured at all, or if they were left out of the published reports because the results were not significant. If it is the latter, then this could have added to the evidence we have summarised in this review. Poor reporting of adherence also creates difficulties searching for this literature. As a secondary outcome, particularly if no difference is shown between the intervention and control groups, exercise adherence may not appear in the abstract or as a key word in the article. Where this is the case the full text of the papers have to be searched, which can substantially increase the number of papers that have to be obtained and filtered before they can be excluded from the review.

Potential biases in the review process

We set the inclusion criteria as trials that had a clear aim to improve exercise adherence, either as an overall study aim, or as a specific aim of an intervention. This meant that we would have excluded trials that did not make this statement in reporting the trial, even if exercise adherence was measured, from the review. This review will have been affected by publication and selective reporting bias and missed any trials that evaluated adherence and did not report the results in the published paper.

We assessed quality of the trials only on the information published in the report. We did contact authors if there was any doubt about whether to include a trial in the review or not, for example to check the proportion of people with arthritis that had osteoarthritis, or that the proportion of participants with chronic condition was 50% or more of the sample.

In spite of some high-quality trials, none of the evidence could be classified using the grading system in *Evidence-based Rheumatology* (Tugwell 2004) as 'platinum' or 'gold'. All the evidence in the review was given a grade of 'silver'. This was mainly because participants or care providers could not be blind to the interventions in the included trials and allocation concealment was not adequately described. This grading system is not sensitive enough to discriminate between trials in systematic reviews of non-pharmacological trials where it is not possible to use blinding. The Delphi quality assessment tool that we used also included items on blinding of trial participants and care providers, which meant that trials of exercise interventions could not score more than seven out of a possible nine (Verhagen 1998). Including the GRADE system in this review meant that we had a better understanding of the strength of the evidence (GRADE 2004) and could arrange the included studies in a hierarchy. However, as GRADE was linked to the limited range of Delphi quality scores, this restricted the grading available. Only one of the evidence summary statements gained a 'high' grade.

Agreements and disagreements with other studies or reviews

A recent review of systematic reviews exploring the effectiveness of adherence interventions to medical treatment (including medication, diet, lifestyle changes or appointment keeping) for a diagnosed medical condition included 38 systematic reviews, 1373 primary studies and 266,988 patients. None of the included reviews focused on chronic musculoskeletal pain, although reviews concerning other chronic conditions, such as cardiovascular disease and diabetes were common (van Dulmen 2007). Again this highlights the lack of attention that exercise adherence in chronic musculoskeletal pain has received and underlines the need for future studies to address and measure adherence to therapeutic exercise in this patient population.

We found that the delivery of exercise can influence exercise adherence. A recent Cochrane review by Foster et al which explored the effectiveness of interventions for promoting physical activity in apparently healthy adults supports this finding (Foster 2005). They concluded that interventions that provide ongoing support might be more effective in encouraging the uptake of physical activity, although they were unable to determine the association between the degree of supervision and changes in physical activity behaviour. Although supplementing a home-based exercise pro-

gramme with group classes may increase overall activity levels, attendance at such group sessions may be limited due to inconvenient times of such sessions, and the inability to reschedule missed sessions (Hurley 2007).

Related literature also strengthens the finding of this review that combining a specific 'adherence' component to exercise increases exercise behaviour. In a systematic review, van Dulmen et al found that simple behavioural strategies, such as reminders, feedback, support and rewards not only enhanced adherence to medication, but other therapeutic regimens as well (van Dulmen 2007). A meta-analysis completed by Roter et al also supports the usefulness of educational, behavioural and affective (appealing to feelings, emotions or social relationships and social supports) interventions in improving patient adherence to therapeutic recommendations (Roter 1998). Overall they found that programmes with a combined educational and behavioural focus were generally more effective than single-focus interventions. Although based on very few studies, interventions that included all three educational, behavioural and affective components had larger effects. Such comparisons were not possible within this review due to the heterogeneity of study design, interventions and adherence measures used.

In support of the use of a pedometer in optimising exercise adherence, a meta-analysis by Bravata et al, including data from eight RCTs and 18 observational studies, evaluated the association between pedometer use and physical activity among adults in outpatient settings (Bravata 2007). The results showed that pedometer users significantly increased their daily step count compared to control participants. When data from all studies were combined, pedometer use increased physical activity by 26.9% over baseline, and also significantly decreased body mass index and blood pressure. In addition, Bravata et al found that setting a target number of steps as a goal and using a step diary served as key motivational factors for increasing physical activity, supporting the findings from this systematic review and others, that relatively simple adherence enhancing strategies can be effective in improving adherence to medical regimens, including exercise (Bravata 2007).

Conclusion

In total, we included 42 trials in the review, mostly involving patients with knee osteoarthritis and spinal pain and with relatively short-term follow up. Of these, 18 trials showed positive effects on exercise adherence, suggesting that exercise and physical activity behaviour in patients with chronic musculoskeletal pain can be enhanced. Exercise type does not appear to be an important factor in improving exercise adherence. The most promising strategies are those that specifically address exercise adherence, that include supervised exercise, individualised exercise, refresher or follow-up sessions, the provision of supplementary materials such as audiotapes or videotapes of exercises, and that are based on graded activity, include self-management programmes and cognitive behavioural techniques. However, inconsistent effects from study to study and the large variation in current methods of improving adherence to exercise and measuring exercise adherence, make it impossible to draw firm conclusions about the best way to optimise adherence to exercise for chronic musculoskeletal pain. High priority should be given to addressing and measuring exercise and physical activity adherence in future clinical trials.

AUTHORS' CONCLUSIONS

Implications for practice

- The type of exercise prescribed does not appear to influence levels of exercise adherence. Patient preference should therefore be considered in an attempt to increase motivation to initiate and maintain an exercise programme

- Including simple educational and behavioural strategies, such as providing feedback or using an exercise contract, as part of routine delivery of exercise for chronic musculoskeletal pain may enhance adherence

- Providing supervised exercise, follow up to reinforce exercise behaviour, and supplementing face-to-face instruction with other material all may have a positive influence on levels of exercise adherence

- Although supplementing home exercise with a group exercise programme may improve overall physical activity levels, attendance at group sessions may be limited if session times are inconvenient, and missed sessions cannot be rescheduled. The type of exercise setting should therefore again be directed by patient preference

Implications for research

- Evidence for the long-term effectiveness of interventions to improve exercise adherence in this population is urgently required

- There is a need for high-quality, sufficiently powered RCTs that include long-term follow up and explicitly address exercise adherence as a primary aim

- A standard validated measure of exercise adherence that is responsive to change should be used consistently in future studies with chronic musculoskeletal pain patients

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REFERENCES

References to studies included in this review

Asenlof 2005 *{published data only}*

Asenlof P, Denison E, Lindberg P. Individually tailored treatment targeting activity, motor behavior, and cognition reduces pain-related disability: a randomized controlled trial in patients with musculoskeletal pain. *The Journal of Pain: Official journal of the American Pain Society* 2005;**6**(9):588–603. [PUBMED: 16139778]

Barlow 2000 *{published data only}*

Barlow JH, Turner AP, Wright CC. A randomized controlled study of the Arthritis Self-Management Programme in the UK. *Health education research* 2000;**15**(6):665–80. [PUBMED: 11142075]

Basler 2007 *{published data only}*

Basler HD, Bertalanffy H, Quint S, Wilke A, Wolf U. TTM-based counselling in physiotherapy does not contribute to an increase of adherence to activity recommendations in older adults with chronic low back pain--a randomised controlled trial. *European Journal of Pain* 2007;**11**(1):31–7. [PUBMED: 16448828]

Bernaards 2007 *{published data only}*

Bernaards CM, Ariens GA, Hildebrandt VH. The (cost-)effectiveness of a lifestyle physical activity intervention in addition to a work style intervention on the recovery from neck and upper limb symptoms in computer workers. *BMC Musculoskeletal Disorders* 2006;**7**:80. [PUBMED: 17062141]

* Bernaards CM, Ariens GA, Knol DL, Hildebrandt VH. The effectiveness of a work style intervention and a lifestyle physical activity intervention on the recovery from neck and upper limb symptoms in computer workers. *Pain* 2007;**132**(1-2):142–53. [PUBMED: 17768009]

Blixen 2004 *{published data only}*

Blixen CE, Bramstedt KA, Hammel JP, Tilley BC. A pilot study of health education via a nurse-run telephone self-management programme for elderly people with osteoarthritis. *Journal of Telemedicine and Telecare* 2004;**10**(1):44–9. [PUBMED: 15006216]

Carr 2005 *{published data only}*

Carr JL, Klaber Moffett JA, Howarth E, Richmond SJ, Torgerson DJ, Jackson DA, et al.A randomized trial comparing a group exercise programme for back pain patients with individual physiotherapy in a severely deprived area. *Disability and Rehabilitation* 2005;**27**(16):929–37. [PUBMED: 16096246]

Cohen 1983 *{published data only}*

Cohen MJ, Heinrich RL, Naliboff BD, Collins GA, Bonebakker AD. Group outpatient physical and behavioral therapy for chronic low back pain. *Journal of Clinical Psychology* 1983;**39**(3):326–33. [PUBMED: 6223946]

Heinrich RL, Cohen MJ, Naliboff BD, Collins GA, Bonebakker AD. Comparing physical and behavior therapy for chronic low back pain on physical abilities, psychological distress, and patients' perceptions. *Journal of Behavioral Medicine* 1985;**8**(1):61–78. [PUBMED: 3156999]

Ersek 2004 *{published data only}*

Ersek M, Turner JA, Cain KC, Kemp CA. Chronic pain self-management for older adults: a randomized controlled trial [ISRCTN11899548]. *BMC Geriatrics* 2004;**4**:7. [PUBMED: 15285783]

Ersek M, Turner JA, Cain KC, Kemp CA. Results of a randomized controlled trial to examine the efficacy of a chronic pain self-management group for older adults [ISRCTN11899548]. *Pain* 2008;**138**(1):29–40. [PUBMED: 18086516]

Ettinger 1997 *{published data only}*

Ettinger WH Jr, 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**(1):25–31. [PUBMED: 8980206]

Messier SP, Royer TD, Craven TE, O'Toole ML, Burns R, Ettinger WH Jr. Long-term exercise and its effect on balance in older, osteoarthritic adults: results from the Fitness, Arthritis, and Seniors Trial (FAST). *Journal of the American Geriatrics Society* 2000;**48**(2):131–8. [PUBMED: 10682941]

Rejeski WJ, Brawley LR, Ettinger W, Morgan T, Thompson C. Compliance to exercise therapy in older participants with knee osteoarthritis: implications for treating disability. *Medicine and Science in Sports and Exercise* 1997;**29**(8):977–85. [PUBMED: 9268953]

Rejeski WJ, Ettinger WH Jr, Martin K, Morgan T. Treating disability in knee osteoarthritis with exercise therapy: a central role for self-efficacy and pain. *Arthritis Care and Research: The Official Journal of the Arthritis Health Professions Association* 1998;**11**(2):94–101. [PUBMED: 9668732]

Ferreira 2007 *{published data only}*

Ferreira ML, Ferreira PH, Latimer J, Herbert RD, Hodges PW, Jennings MD, et al.Comparison of general exercise, motor control exercise and spinal manipulative therapy for chronic low back pain: a randomized trial. *Pain* 2007;**131**(1-2):31–7. [PUBMED: 17250965]

Fransen 2007 *{published data only}*

Fransen M, Nairn L, Winstanley J, Lam P, Edmonds J. Physical activity for osteoarthritis management: a

randomized controlled clinical trial evaluating hydrotherapy or Tai Chi classes. *Arthritis and Rheumatism* 2007;**57**(3): 407–14. [PUBMED: 17443749]

Friedrich 1996 ***{published and unpublished data}***
Friedrich M, Cermak T, Maderbacher P. The effect of brochure use versus therapist teaching on patients performing therapeutic exercise and on changes in impairment status. *Physical Therapy* 1996;**76**(10):1082–8. [PUBMED: 8863761]

Friedrich 1998 ***{published data only}***
Friedrich M, Gittler G, Halberstadt Y, Cermak T, Heiller I. Combined exercise and motivation program: effect on the compliance and level of disability of patients with chronic low back pain: a randomized controlled trial. *Archives of Physical Medicine and Rehabilitation* 1998;**79**(5):475–87. [PUBMED: 9596385]

Fries 1997 ***{published and unpublished data}***
Fries JF, Carey C, McShane DJ. Patient education in arthritis: randomized controlled trial of a mail-delivered program. *The Journal of Rheumatology* 1997;**24**(7): 1378–83. [PUBMED: 9228140]

Halbert 2001 ***{published data only}***
Halbert J, Crotty M, Weller D, Ahern M, Silagy C. Primary care-based physical activity programs: effectiveness in sedentary older patients with osteoarthritis symptoms. *Arthritis and Rheumatism* 2001;**45**(3):228–34. [PUBMED: 11409662]

Harkapaa 1990 ***{published data only}***
Harkapaa K, Mellin G, Jarvikoski A, Hurri H. A controlled study on the outcome of inpatient and outpatient treatment of low back pain. Part III. Long-term follow-up of pain, disability, and compliance. *Scandinavian Journal of Rehabilitation Medicine* 1990;**22**(4):181–8. [PUBMED: 2148221]

Huang 2003 ***{published data only}***
Huang MH, Lin YS, Yang RC, Lee CL. A comparison of various therapeutic exercises on the functional status of patients with knee osteoarthritis. *Seminars in Arthritis and Rheumatism* 2003;**32**(6):398–406. [PUBMED: 12833248]

Huang 2005 ***{published data only}***
Huang MH, Lin YS, Lee CL, Yang RC. Use of ultrasound to increase effectiveness of isokinetic exercise for knee osteoarthritis. *Archives of Physical Medicine and Rehabilitation* 2005;**86**(8):1545–51. [PUBMED: 16084806]

Hughes 2004 ***{published data only}***
Hughes SL, Seymour RB, Campbell R, Pollak N, Huber G, Sharma L. Impact of the fit and strong intervention on older adults with osteoarthritis. *The Gerontologist* 2004;**44** (2):217–28. [PUBMED: 15075418]
Hughes SL, Seymour RB, Campbell RT, Huber G, Pollak N, Sharma L, et al.Long-term impact of Fit and Strong! on older adults with osteoarthritis. *The Gerontologist* 2006;**46** (6):801–14. [PUBMED: 17169935]

Hurley 2007 ***{published data only}***
Hurley MV, Walsh NE, Mitchell HL, Pimm TJ, Patel A, Williamson E, et al.Clinical effectiveness of a rehabilitation program integrating exercise, self-management, and active coping strategies for chronic knee pain: a cluster randomized trial. *Arthritis and Rheumatism* 2007;**57**(7): 1211–9. [PUBMED: 17907147]

Jensen 2001 ***{published data only}***
Jensen IB, Bergstrom G, Ljungquist T, Bodin L. A 3-year follow-up of a multidisciplinary rehabilitation programme for back and neck pain. *Pain* 2005;**115**(3):273–83. [PUBMED: 15911154]
Jensen IB, Bergstrom G, Ljungquist T, Bodin L, Nygren AL. A randomized controlled component analysis of a behavioral medicine rehabilitation program for chronic spinal pain: are the effects dependent on gender?. *Pain* 2001;**91**(1-2):65–78. [PUBMED: 11240079]
Jensen IB, Bodin L. Multimodal cognitive-behavioural treatment for workers with chronic spinal pain: a matched cohort study with an 18-month follow-up. *Pain* 1998;**76** (1-2):35–44. [PUBMED: 9696457]

Koumantakis 2005 ***{published data only}***
Koumantakis GA, Watson PJ, Oldham JA. Supplementation of general endurance exercise with stabilisation training versus general exercise only. Physiological and functional outcomes of a randomised controlled trial of patients with recurrent low back pain. *Clinical Biomechanics* 2005;**20**(5): 474–82. [PUBMED: 15836934]
Koumantakis GA, Watson PJ, Oldham JA. Trunk muscle stabilization training plus general exercise versus general exercise only: randomized controlled trial of patients with recurrent low back pain. *Physical Therapy* 2005;**85**(3): 209–25. [PUBMED: 15733046]

Lorig 1985 ***{published data only}***
Lorig K, Lubeck D, Kraines RG, Seleznick M, Holman HR. Outcomes of self-help education for patients with arthritis. *Arthritis and Rheumatism* 1985;**28**(6):680–5. [PUBMED: 4004977]

Luszczynska 2006 ***{published data only}***
Luszczynska A, Gregajtys A, Abraham C. Effects of a self-efficacy intervention on initiation of recommended exercises in patients with spondylosis. *Journal of Aging and Physical Activity* 2006;**15**:26–40.

Mangione 1999 ***{published data only}***
Mangione KK, McCully K, Gloviak A, Lefebvre I, Hofmann M, Craik R. The effects of high-intensity and low-intensity cycle ergometry in older adults with knee osteoarthritis. *The Journals of Gerontology. Series A: Biological sciences and medical sciences* 1999;**54**(4):M184–90. [PUBMED: 10219009]

McCarthy 2004 ***{published data only}***
McCarthy CJ, Mills PM, Pullen R, Richardson G, Hawkins N, Roberts CR, et al.Supplementation of a home-based exercise programme with a class-based programme for people with osteoarthritis of the knees: a randomised controlled trial and health economic analysis. *Health*

Technology Assessment 2004;**8**(46):iii-iv, 1-61. [PUBMED: 15527668]

McCarthy CJ, Mills PM, Pullen R, Roberts C, Silman A, Oldham JA. Supplementing a home exercise programme with a class-based exercise programme is more effective than home exercise alone in the treatment of knee osteoarthritis. *Rheumatology* 2004;**43**(7):880–6. [PUBMED: 15113993]

Mikesky 2006 ***{published data only}***

Mikesky AE, Mazzuca SA, Brandt KD, Perkins SM, Damush T, Lane KA. Effects of strength training on the incidence and progression of knee osteoarthritis. *Arthritis and Rheumatism* 2006;**55**(5):690–9. [PUBMED: 17013851]

Minor 1989 ***{published data only}***

Minor MA, Brown JD. Exercise maintenance of persons with arthritis after participation in a class experience. *Health Education Quarterly* 1993;**20**(1):83–95. [PUBMED: 8444627]

Minor MA, Hewett JE, Webel RR, Anderson SK, Kay DR. Efficacy of physical conditioning exercise in patients with rheumatoid arthritis and osteoarthritis. *Arthritis and Rheumatism* 1989;**32**(11):1396–405. [PUBMED: 2818656]

Minor MA, Reid JC, Griffin JZ, Pittman CB, Patrick TB, Cutts JH 3rd. Development and validation of an exercise performance support system for people with lower extremity impairment. *Arthritis care and Research: The Official Journal of the Arthritis Health Professions Association* 1998;**11**(1): 3–8. [PUBMED: 9534488]

Nour 2006 ***{published data only}***

Nour K, Laforest S, Gauvin L, Gignac M. Behavior change following a self-management intervention for housebound older adults with arthritis: an experimental study. *The International Journal of Behavioral Nutrition and Physical Activity* 2006;**3**:12. [PUBMED: 16734904]

Petrella 2000 ***{published data only}***

Petrella RJ, Bartha C. Home based exercise therapy for older patients with knee osteoarthritis: a randomized clinical trial. *The Journal of Rheumatology* 2000;**27**(9):2215–21. [PUBMED: 10990236]

Schoo 2005 ***{published data only}***

Schoo AMM, Morris ME, Bui QM. The effects of mode of exercise instruction on compliance with a home exercise program in older adults with osteoarthritis. *Physiotherapy* 2005;**91**:79–86.

Sherman 2005 ***{published data only}***

Sherman KJ, Cherkin DC, Erro J, Miglioretti DL, Deyo RA. Comparing yoga, exercise, and a self-care book for chronic low back pain: a randomized, controlled trial. *Annals of Internal Medicine* 2005;**143**(12):849–56. [PUBMED: 16365466]

Smeets 2006 ***{published data only}***

Smeets RJ, Vlaeyen JW, Hidding A, Kester AD, van der Heijden GJ, van Geel AC, et al.Active rehabilitation for chronic low back pain: cognitive-behavioral, physical, or both? First direct post-treatment results from a randomized controlled trial [ISRCTN22714229]. *BMC Musculoskeletal Disorders* 2006;**7**:5. [PUBMED: 16426449]

Smeets RJ, Vlaeyen JW, Kester AD, Knottnerus JA. Reduction of pain catastrophizing mediates the outcome of both physical and cognitive-behavioral treatment in chronic low back pain. *The Journal of Pain: Official Journal of the American Pain Society* 2006;**7**(4):261–71. [PUBMED: 16618470]

Soderlund 2001 ***{published data only}***

Soderlund A, Lindberg P. Cognitive behavioural components in physiotherapy management of chronic whiplash associated disorders (WAD) - a randomised group study. *Physiotherapy Theory and Practice* 2001;**17**:229–238.

Song 2003 ***{published data only}***

Song R, Lee EO, Lam P, Bae SC. Effects of a Sun-style Tai Chi exercise on arthritic symptoms, motivation and the performance of health behaviors in women with osteoarthritis. *Taehan Kanho Hakhoe chi* 2007;**37**(2): 249–56. [PUBMED: 17435410]

* Song R, Lee EO, Lam P, Bae SC. Effects of tai chi exercise on pain, balance, muscle strength, and perceived difficulties in physical functioning in older women with osteoarthritis: a randomized clinical trial. *The Journal of Rheumatology* 2003;**30**(9):2039–44. [PUBMED: 12966613]

Soukup 1999 ***{published data only}***

Soukup MG, Glomsrod B, Lonn JH, Bo K, Larsen S. The effect of a Mensendieck exercise program as secondary prophylaxis for recurrent low back pain. A randomized, controlled trial with 12-month follow-up. *Spine* 1999;**24** (15):1585-91; discussion 1592. [PUBMED: 10457579]

Soukup MG, Lonn J, Glomsrod B, Bo K, Larsen S. Exercises and education as secondary prevention for recurrent low back pain. *Physiotherapy Research International: The Journal for Researchers and Clinicians in Physical Therapy* 2001;**6**(1): 27–39. [PUBMED: 11379254]

Taimela 2000 ***{published data only}***

Taimela S, Takala EP, Asklof T, Seppala K, Parviainen S. Active treatment of chronic neck pain: a prospective randomized intervention. *Spine* 2000;**25**(8):1021–7. [PUBMED: 10767816]

Talbot 2003 ***{published data only}***

Talbot LA, Gaines JM, Huynh TN, Metter EJ. A home-based pedometer-driven walking program to increase physical activity in older adults with osteoarthritis of the knee: a preliminary study. *Journal of the American Geriatrics Society* 2003;**51**(3):387–92. [PUBMED: 12588583]

Veenhof 2006 ***{published data only}***

Veenhof C, Koke AJ, Dekker J, Oostendorp RA, Bijlsma JW, van Tulder MW, et al.Effectiveness of behavioral graded activity in patients with osteoarthritis of the hip and/or knee: A randomized clinical trial. *Arthritis and Rheumatism* 2006;**55**(6):925–34. [PUBMED: 17139639]

Viljanen 2003 ***{published data only}***

Viljanen M, Malmivaara A, Uitti J, Rinne M, Palmroos P, Laippala P. Effectiveness of dynamic muscle training, relaxation training, or ordinary activity for chronic neck

pain: randomised controlled trial. *BMJ (Clinical research ed.)* 2003;**327**(7413):475. [PUBMED: 12946968]

Yip 2007 *{published data only}*

Yip YB, Sit JW, Fung KK, Wong DY, Chong SY, Chung LH, et al.Effects of a self-management arthritis programme with an added exercise component for osteoarthritic knee: randomized controlled trial. *Journal of Advanced Nursing* 2007;**59**(1):20–8. [PUBMED: 17559610]

Yip YB, Sit JW, Fung KK, Wong DY, Chong SY, Chung LH, et al.Impact of an Arthritis Self-Management Programme with an added exercise component for osteoarthritic knee sufferers on improving pain, functional outcomes, and use of health care services: An experimental study. *Patient Education and Counseling* 2007;**65**(1):113–21. [PUBMED: 17010554]

Ylinen 2003 *{published data only}*

Ylinen J, Takala EP, Nykanen M, Hakkinen A, Malkia E, Pohjolainen T, et al.Active neck muscle training in the treatment of chronic neck pain in women: a randomized controlled trial. *JAMA* 2003;**289**(19): 2509–16. [PUBMED: 12759322]

References to studies excluded from this review

Berwick 1989 *{published and unpublished data}*

Berwick DM, Budman S, Feldstein M. No clinical effect of back schools in an HMO. A randomized prospective trial. *Spine* 1989;**14**(3):338–44. [PUBMED: 2523581]

Descarreaux 2002 *{published and unpublished data}*

Descarreaux M, Normand MC, Laurencelle L, Dugas C. Evaluation of a specific home exercise program for low back pain. *Journal of Manipulative and Physiological Therapeutics* 2002;**25**(8):497–503. [PUBMED: 12381971]

Dziedzic 2005 *{published and unpublished data}*

Dziedzic K, Hill J, Lewis M, Sim J, Daniels J, Hay EM. Effectiveness of manual therapy or pulsed shortwave diathermy in addition to advice and exercise for neck disorders: a pragmatic randomized controlled trial in physical therapy clinics. *Arthritis and Rheumatism* 2005;**53** (2):214–22. [PUBMED: 15818640]

Ferrell 1997 *{published data only}*

Ferrell BA, Josephson KR, Pollan AM, Loy S, Ferrell BR. A randomized trial of walking versus physical methods for chronic pain management. *Aging (Milan, Italy)* 1997;**9**(1-2):99–105. [PUBMED: 9177592]

Foley 2003 *{published data only}*

Foley A, Halbert J, Hewitt T, Crotty M. Does hydrotherapy improve strength and physical function in patients with osteoarthritis--a randomised controlled trial comparing a gym based and a hydrotherapy based strengthening programme. *Annals of the Rheumatic Diseases* 2003;**62**(12): 1162–7. [PUBMED: 14644853]

Goeppinger 2007 *{published data only}*

Goeppinger J, Armstrong B, Schwartz T, Ensley D, Brady TJ. Self-management education for persons with arthritis: managing comorbidity and eliminating health disparities. *Arthritis and Rheumatism* 2007;**57**(6):1081–8. [PUBMED: 17665471]

Hagberg 2000 *{published data only}*

Hagberg M, Harms-Ringdahl K, Nisell R, Hjelm EW. Rehabilitation of neck-shoulder pain in women industrial workers: a randomized trial comparing isometric shoulder endurance training with isometric shoulder strength training. *Archives of Physical Medicine and Rehabilitation* 2000;**81**(8):1051–8. [PUBMED: 10943754]

Helmhout 2004 *{published data only}*

Helmhout PH, Harts CC, Staal JB, Candel MJ, de Bie RA. Comparison of a high-intensity and a low-intensity lumbar extensor training program as minimal intervention treatment in low back pain: a randomized trial. *European Spine Journal: official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society* 2004; **13**(6):537–47. [PUBMED: 15095072]

Hibbard 2007 *{published data only}*

Hibbard JH, Mahoney ER, Stock R, Tusler M. Do increases in patient activation result in improved self-management behaviors?. *Health Services Research* 2007;**42**(4):1443–63. [PUBMED: 17610432]

Kamwendo 1991 *{published data only}*

Kamwendo K, Linton SJ. A controlled study of the effect of neck school in medical secretaries. *Scandinavian Journal of Rehabilitation Medicine* 1991;**23**(3):143–52. [PUBMED: 1962157]

Lewis 2005 *{published data only}*

Lewis JS, Hewitt JS, Billington L, Cole S, Byng J, Karayiannis S. A randomized clinical trial comparing two physiotherapy interventions for chronic low back pain. *Spine* 2005;**30**(7):711–21. [PUBMED: 15803071]

Ljunggren 1997 *{published and unpublished data}*

Ljunggren AE, Weber H, Kogstad O, Thom E, Kirkesola G. Effect of exercise on sick leave due to low back pain. A randomized, comparative, long-term study. *Spine* 1997;**22** (14):1610-6; discussion 1617. [PUBMED: 9253097]

Long 2004 *{published and unpublished data}*

Long A, Donelson R, Fung T. Does it matter which exercise? A randomized control trial of exercise for low back pain. *Spine* 2004;**29**(23):2593–602. [PUBMED: 15564907]

Martire 2003 *{published data only}*

Martire LM, Schulz R, Keefe FJ, Starz TW, Osial TA Jr, Dew MA, et al.Feasibility of a dyadic intervention for management of osteoarthritis: a pilot study with older patients and their spousal caregivers. *Aging & Mental Health* 2003;**7**(1):53–60. [PUBMED: 12554315]

Messier 2000 *{published data only}*

Messier SP, Loeser RF, Mitchell MN, Valle G, Morgan TP, Rejeski WJ, et al.Exercise and weight loss in obese older adults with knee osteoarthritis: a preliminary study. *Journal of the American Geriatrics Society* 2000;**48**(9):1062–72. [PUBMED: 10983905]

Messier 2004 *{published data only}*
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 and Rheumatism* 2004;**50**(5):1501–10. [PUBMED: 15146420]

Miller 2004 *{published data only}*
Miller JS, Stanley I, Moore K. Videotaped exercise instruction: a randomised controlled trial in musculoskeletal physiotherapy. *Physiotherapy Theory and Practice* 2004;**20**: 145–154.

Pariser 2005 *{published and unpublished data}*
Pariser D, O'Hanlon A. Effects of telephone intervention on arthritis self-efficacy, depression, pain, and fatigue in older adults with arthritis. *Journal of Geriatric Physical Therapy (2001)* 2005;**28**(3):67–73. [PUBMED: 16386168]

Peloquin 1999 *{published data only}*
Peloquin L, Bravo G, Gauthier P, Lacombe G, Billiard JS. Effects of a cross-training exercise program in persons with osteoarthrtitis of the knee. A randomized controlled trial. *Journal of Clinical Rheumatology* 1999;**5**(3):126–136.

Ravaud 2004 *{published data only}*
Ravaud P, Giraudeau B, Logeart I, Larguier JS, Rolland D, Treves R, et al.Management of osteoarthritis (OA) with an unsupervised home based exercise programme and/or patient administered assessment tools. A cluster randomised controlled trial with a 2x2 factorial design. *Annals of the Rheumatic Diseases* 2004;**63**(6):703–8. [PUBMED: 15140778]

Reilly 1989 *{published data only}*
Reilly K, Lovejoy B, Williams R, Roth H. Differences between a supervised and independent strength and conditioning program with chronic low back syndromes. *Journal of Occupational Medicine: official publication of the Industrial Medical Association* 1989;**31**(6):547–50. [PUBMED: 2525182]

Simeoni 1995 *{published data only}*
Simeoni E, Bauman A, Stenmark J, O'Brien J. Evaluation of a community arthritis program in Australia: dissemination of a developed program. *Arthritis Care and Research: the official journal of the Arthritis Health Professions Association* 1995;**8**(2):102–7. [PUBMED: 7794983]

Suomi 2003 *{published data only}*
Suomi R, Collier D. Effects of arthritis exercise programs on functional fitness and perceived activities of daily living measures in older adults with arthritis. *Archives of Physical Medicine and Rehabilitation* 2003;**84**(11):1589–94. [PUBMED: 14639556]

Thomas 2002 *{published and unpublished data}*
Thomas KS, Muir KR, Doherty M, Jones AC, O'Reilly SC, Bassey EJ. Home based exercise programme for knee pain and knee osteoarthritis: randomised controlled trial. BMJ (Clinical research ed.) 2002; Vol. 325, issue 7367:752. [PUBMED: 12364304]

UKBeam 2004 *{published and unpublished data}*
UK Beam Trial Team. United Kingdom back pain exercise and manipulation (UK BEAM) randomised trial: effectiveness of physical treatments for back pain in primary care. *BMJ (Clinical research ed.)* 2004;**329**(7479):1377. [PUBMED: 15556955]

van Baar 1998 *{published data only}*
van Baar ME, Dekker J, Oostendorp RA, Bijl D, Voorn TB, Lemmens JA, et al.The effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: a randomized clinical trial. *The Journal of Rheumatology* 1998;**25**(12): 2432–9. [PUBMED: 9858441]

Additional references

Abenhaim 2000
Abenhaim L, Rossignol M, Valat JP, Nordin M, Avouac B, Blotman F, et al.The role of activity in the therapeutic management of back pain. Report of the International Paris Task Force on Back Pain. *Spine* 2000;**25**(4 Suppl):1S–33S.

Adams 2002
Adams MA, Bogduk N, Burton K, Dolan P. Epidemiology of low back trouble. *The biomechanics of back pain*. London: Churchill Livingstone, 2002.

Altman 1998
Altman RD, Lozada CJ. Practice guidelines in the management of osteoarthritis. *Osteoarthritis & Cartilage* 1998;**6**:22–4.

Andersson 1999
Andersson GB. Epidemiological features of chronic low-back pain. *Lancet* 1999;**354**:581–5.

Anon 2001
Anonymous. Philadelphia Panel evidence-based clinical practice guidelines on selected rehabilitation interventions for low back pain. *Physical Therapy* 2001;**81**:1641–74.

ARMA 2004
Arthritis, Musculoskeletal Alliance. *Standards of care for people with osteoarthritis*. Arthritis and Musculoskeletal Alliance, 2004.

ASA Taskforce 1997
American Society of Anesthesiologists Task Force. Practice guidelines for chronic pain management. A report by the American Society of Anesthesiologists Task Force on Pain Management, Chronic Pain Section. *Anesthesiology* 1997;**6**: 22–4.

Bravata 2007
Bravata DM, Smith-Spangler C, Sundaram V, Gienger AL, Lin N, Lewis R, et al.Using pedometers to increase physical activity and improve health: a systematic review. *JAMA* 2007;**298**(19):2296–304. [PUBMED: 18029834]

Brawley 2000
Brawley LR, Culos-Reed SN. Studying Adherence to Therapeutic Regimens: Overview, Theories, Recommendations. *Controlled Clinical Trials* 2000;**21**: 156s–163s.

Breivik 2006
Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. *European Journal of Pain* 2006;**10** (4):287–333.

COST B13 2004
COST B13 Working Group. European guidelines for the management of chronic non-specific low back pain. http://www.backpaineurope.org/web/files/WG2_Guidelines.pdf 2004 (accessed 05/07/2005).

Creamer 1998
Creamer P, Flores R, Hochberg MC. Management of osteoarthritis in older adults. *Clinics in Geriatric Medicine* 1998;**14**:435–54.

CSAG 2000
Clinical Standards Advisory Group. *Services for patients with pain*. London: Department of Health, 2000.

Elliott 1999
Elliott AM, Smith BH, Penny KI, Smith WC, Chambers WA. The epidemiology of chronic pain in the community. *Lancet* 1999;**352**:1248–52.

Foster 2005
Foster C, Hillsdon M, Thorogood M. Interventions for promoting physical activity. *Cochrane Database of Systematic Reviews* 2005, Issue 1. [DOI: 10.1002/14651858.CD003180.pub2.]

GRADE 2004
GRADE Working group. Grading quality of evidence and strength of recommendations. *BMJ* 2004;**328**:1490.

Guccione 1994
Guccione AA, Felson DT, Anderson JJ, Anthony JM, Zhang Y, Wilson PW, et al.The effects of specific medical conditions on the functional limitations of elders in the Framingham study. *American Journal of Public Health* 1994; **84**:351–8.

Hayden 2005a
Hayden JA, van Tulder MW, Malmivaara AV, Koes BW. Meta-analysis: exercise therapy for nonspecific low back pain. *Annals of Internal Medicine* 2005;**142**:765–75.

Hayden 2005b
Hayden JA, van Tulder MW, Tomlinson G. Systematic review: strategies for using exercise therapy to improve outcomes in chronic low back pain. *Annals of Internal Medicine* 2005;**142**:776–85.

Haynes 1980
Haynes RB, Sackett DL, Taylor DW. How to detect and manage low patient compliance in chronic illness. *Geriatrics* 1980;**35**(1):91-3, 96-7. [PUBMED: 7350072]

Haynes 2008
Haynes RB, Ackloo E, Sahota N, McDonald HP. Interventions for enhancing medication adherence. *Cochrane Database of Systematic Reviews* 2008, Issue 2.[Art. No.: CD000011. DOI: 10.1002/14651858.CD000011.pub3]

Holtzman 2004
Holtzman J, Schmitz K, Babes G, Kane RL, Duval S, Wilt TJ, et al.*Effectiveness of behavioral interventions to modify physical activity behaviors in general populations and cancer patients and survivors. Summary, Evidence Report/Technology Assessment No. 102*. Rockville, MD: Agency for Healthcare Research and Quality, June 2004.

IASP 1986
International Association for the Study of Pain. Classification of chronic pain. Descriptions of chronic pain syndromes and definitions of pain terms. *Pain* 1986;**Suppl 3**:S1–S225.

Jordan 2003
Jordan KM, Arden NK, Doherty M, Bannwarth B, Bijlsma JW, Dieppe P, et al.EULAR Recommendations 2003: an evidence based approach to the management of knee osteoarthritis: Report of a Task Force of the Standing Committee for International Clinical Studies Including Therapeutic Trials (ESCISIT). *Annals of Rheumatic Diseases* 2003;**62**:1145–55.

Lane 1997
Lane NE, Thompson JM. Management of osteoarthritis in the primary-care setting: an evidence-based approach to treatment. *American Journal of Medicine* 1997;**103**(6A): 25S–30S.

Lorig 1980
Lorig K, Fries JF. *The Arthritis Helpbook*. Reading, Massachusetts: Addison-Wesley, 1980.

Maniadakis 2000
Maniadakis N, Gray A. The economic burden of back pain in the UK. *Pain* 2000;**84**:95–103.

Marks 2005
Marks R, Allegrante JP. Chronic osteoarthritis and adherence to exercise: a review of the literature. *Journal of Aging and Physical Activity* 2005;**13**(4):434–60. [PUBMED: 16301755]

Matthews 2002
Matthews CE. Use of self-report instruments to assess physical activity. In: Welk GJ editor(s). *Physical activity assessments for health related research*. Champaign, Illinois: Human Kinetics Publishers, 2002.

Matthews 2005
Matthews CE. Calibration of accelerometer output for adults. *Medicine and Science in Sports and Exercise* 2005;**37** (11s):s512–s522.

McCormack 1995
McCormack A, Fleming D, Charlton J. *Morbidity statistics from general practice. Fourth national study 1991-1992. Series MB5, no. 3*. London: HMSO, 1995.

Meichenbaum 1987
Meichenbaum D, Turk DC. *Facilitating treatment adherence: a practitioner's guidebook*. New York: Plenum press, 1987.

Melanson 1996
Melanson EL Jr, Freedson PS. Physical activity assessment: a review of methods. *Critical Reviews in Food Science and Nutrition* 1996;**36**(5):385–96. [PUBMED: 8725670]

NICE 2008
National Collaborating Centre for Chronic Conditions. *Osteoarthritis: national clinical guideline for care and management in adults*. London: Royal College of Physicians, 2008.

NICE 2009
Savigny P, Kuntze S, Watson P, Underwood M, Ritchie G, Cotterell M, et al.Low Back Pain: early management of persistent non-specific low back pain. *Low back pain: early management of persistent non-specific low back pain*. London: National Collaborating Centre for Primary Care and Royal College of General Practitioners, May 2009.

Pencharz 2002
Pencharz JN, Grigoriadis E, Jansz GF, Bombardier C. A critical appraisal of clinical practice guidelines for the treatment of lower-limb osteoarthritis. *Arthritis Research* 2002;**4**:36–43.

Roddy 2005a
Roddy E, Zhang W, Doherty M, Arden NK, Barlow J, Birrell F, et al.Evidence-based recommendations for the role of exercise in the management of osteoarthritis of the hip or knee--the MOVE consensus. *Rheumatology* 2005;**44**(1): 67–73.

Roddy 2005b
Roddy E, Zhang W, Doherty M. Aerobic walking or strengthening exercise for osteoarthritis of the knee? A systematic review. *Annals of the Rheumatic Diseases* 2005; **64**:544–8.

Roter 1998
Roter DL, Hall JA, Merisca R, Nordstrom B, Cretin D, Svarstad B. Effectiveness of interventions to improve patient compliance: a meta-analysis. *Medical Care* 1998;**36**: 1138–61.

Sallis 2000
Sallis JF, Saelens BE. Assessment of physical activity by self-report: status, limitations, and future directions. *Research Quarterly for Exercise and Sport* 2000;**71**(2 Suppl):S1–14. [PUBMED: 10925819]

Schroeder 2004
Schroeder K, Fahey T, Ebrahim S. Interventions for improving adherence to treatment in patients with high blood pressure in ambulatory settings. *Cochrane Database of Systematic Reviews* 2004, Issue 3. [DOI: 10.1002/ 14651858.CD004804]

Scott 1998
Scott DL, Shipley M, Dawson A, Edwards S, Symmons DP, Woolf AD. The clinical management of rheumatoid arthritis and osteoarthritis: strategies for improving clinical effectiveness. *British Journal of Rheumatology* 1998;**37**: 546–54.

Thomas 2004
Thomas E, Peat G, Harris L, Wilkie R, Croft PR. The prevalence of pain and pain interference in a general population of older adults: cross-sectional findings from the North Staffordshire Osteoarthritis Project (NorStOP). *Pain* 2004;**110**:361–8.

Treuth 2002
Treuth MS. Applying multiple methods to improve the accuracy of activity assessments. In: Welk GJ editor (s). *Physical activity assessments for health related research*. Champaign, Illinois: Human Kinetics Publishers, 2002.

Tugwell 2004
Tugwell P, Shea B, Boers M, Brooks P, Simon L, Strand V, et al (editors). *Evidence-based Rheumatology*. London: BMJ Books, 2004.

van Baar 1999
van Baar ME, Assendelft WJ, Dekker J, Oostendorp RA, Bijlsma JW. Effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: a systematic review of randomized clinical trials. *Arthritis & Rheumatism* 1999;**42**: 1361–9.

van Dulmen 2007
van Dulmen S, Sluijs E, van Dijk L, de Ridder D, Heerdink R, Bensing J. Patient adherence to medical treatment: a review of reviews. *BMC Health Services Research* 2007;**7**:55. [PUBMED: 17439645]

van Gool 2005
van Gool CH, Penninx BW, Kempen GI, Rejeski WJ, Miller GD, Van Eijk JT, et al.Effects of exercise adherence on physical function among overweight older adults with knee osteoarthritis. *Arthritis & Rheumatism* 2005;**53**:24–32.

van Tulder 2000
van Tulder M, Malmivaara A, Esmail R, Koes B. Exercise therapy for low back pain: a systematic review within the framework of the Cochrane Collaboration Back Review Group. *Spine* 2000;**25**:2784–96.

Verhagen 1998
Verhagen AP, de Vet HCW, de Bie RA, Kessels AGH, Boers M, Bouter LM, et al.The Delphi List: A criteria list for quality assessment of randomised clinical trials for conducting systematic reviews developed by Delphi consensus. *Journal of Clinical Epidemiology* 1998;**51**(12): 1235–41.

Vermeire 2005
Vermeire E, Wens J, Van Royen P, Biot Y, Hearnshaw H, Lindenmeyer A. Interventions for improving adherence to treatment recommendations in people with type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews* 2005;**18** (2):CD003638. [PUBMED: 15846672]

Waddell 1999
Waddell G, McIntosh A, Hutchinson A, Feder G, Lewis M. *Low back pain evidence review*. London: Royal College of General Practitioners, 1999.

White 1999
White KP, Harth M. The occurrence and impact of generalized pain. *Bailliere's Best Practice & Research. Clinical Rheumatology* 1999;**13**:379–89.

WHO 2003
World Health Organization. *Adherence to long-term therapies: evidence for action*. WHO LIbrary, 2003.

* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Asenlof 2005

Methods	RCT. Quality score: 5 (No blinding, unknown concealment)
Participants	Chronic musculoskeletal pain (majority LBP), patients 18 - 65 yrs, Sweden, n = 122
Interventions	I: Individually tailored behavioural medicine treatment. Goal identification & assessment; self-monitoring using a diary; individual functional behavioural analysis; basic & applied skills acquisition for achieving goals; generalisation; maintenance & relapse prevention. n = 57. C: Physiotherapy exercise. Structured physical exercise individually adapted with regard to physical impairment and physical fitness. n = 65. Treatment duration: 3 months.
Outcomes	Adherence: Yes/no to completing regular physical activity (3 months only). Pain: Pain intensity and pain control (VAS, 0-10). Function: PDI.
Notes	Follow up: Baseline, post treatment, 3 months. Loss to follow up: 34% (I: 33%, C: 34%) NSD

Barlow 2000

Methods	RCT. Quality score: 6 (No blinding)
Participants	OA/RA, volunteers 18 + yrs, UK, n = 544.
Interventions	I: Group ASMP. Weekly 2 hour sessions delivered by pairs of lay leaders. Supported by a manual. Self-management principles, exercise, cognitive symptom management, dealing with depression, nutrition, communication with family and health professionals and goal setting. 10 participants per session. n = 311. C: Waiting list. 4 months then ASMP. n=233. Treatment duration: 6 weeks.
Outcomes	Adherence: Number doing exercises (cycling, walking, swimming, relaxation, flexibility, strengthening) at follow up - change in exercise performed in past week (yes/no response). Pain: ASE (pain - 5 items, 0-10). Function: Modified HAQ (physical function scale). QoL: EQ-5D (sub-sample only).

Barlow 2000 (*Continued*)

Notes	Follow-up: baseline, 4 months. Loss to follow up: 22% (I: 25%, C: 19%) NSD

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Basler 2007

Methods	RCT. Quality score: 7 (No participants or care provider blinding)
Participants	Chronic LBP due to osteoporosis or degenerative spine disorder, patients 65 + yrs, Germany, n = 170
Interventions	I: Physiotherapy plus counselling. Standardised physiotherapy treatment manual, including stretching exercise, tailored strength, endurance, flexibility & coordination training. Homework, emphasis on ADLs with written information. Transtheoretical model-based counselling by physiotherapist aimed at increasing self-efficacy & positively influence decisional balance, enhance commitment, self-reinforcement & reinforce desired behaviour. n = 86. C: Physiotherapy plus placebo ultrasound. Physiotherapy same as intervention group. Placebo ultrasound using an inactive device. n = 84. Treatment duration: 5 weeks including 10 sessions (20 minutes of physiotherapy and 10 minutes of counselling or placebo ultrasound)
Outcomes	Adherence: Average duration of physical activity. Function: Hannover Functional Disability Scale.
Notes	Follow up: baseline, 6-7 weeks, 6 months. Loss to follow up: 6 months 11% (I: 15%, C: 6%) NSD

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Bernaards 2007

Methods	RCT. Quality score: 6 (No blinding).
Participants	Chronic or recurrent pain, stiffness or tingles in neck, shoulders, arms, wrists and/or hands, computer workers, adults, Netherlands, n = 466

Bernaards 2007 (*Continued*)

Interventions	I1: Work style (WS) group. Focus on changing body posture, workplace adjustment, breaks & coping with high work demands. n = 152. I2: Work Style & Physical Activity group. Encouraged engagement in moderate or heavy intensity physical activity plus work style change (I1). n = 156. C: Usual Care. No meetings. n = 158. Treatment duration: 4 large group meetings (max 10) of 1 hr for I1 & 1.5 hrs for I2 & 2 small group meetings (max 3) of 30 mins for I1 & 45 mins for I2 over 6 months
Outcomes	Adherence: SQUASH. Pain: Current, average or worst pain (VAS, 0-10). Function: Disability at work (0-10)
Notes	Follow up: baseline, 6, 12 months. Loss to follow up: 12 months 32% (I1: 25%, I2: 31%, C: 36%) NSD

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Blixen 2004

Methods	Pilot RCT. Quality score: 5 (No participant or care provider blinding, unknown concealment, no ITT)
Participants	OA, patients, 60 + yrs, USA, n = 32.
Interventions	I: Telephone health education strategy. 6 weekly mailings of OA self-management modules (adapted from The Arthritis Help book). Modules covered: 1) pathology; 2) OA medications; 3) interrelationship between emotional and physical components of pain, & importance of relaxation techniques; 4) depression; 5) importance of regular exercise; 6) weight management. Received relaxation audiotape. Reinforced by 6-weekly 45-min telephone educational support sessions, conducted by advanced practice nurse, who also answered questions, helped set goals, and learn new skills. n = 16. C: Usual Rheumatologist care. n = 16. Treatment duration: 6 weeks.
Outcomes	Adherence: Type of exercise. Frequency of exercise. (Open questions). Pain: AIMS-2. Function: AIMS-2. QoL: Modified QOLS.
Notes	Follow-up: Baseline, 3, 6 months. Loss to follow up: 6% (I: 6%, C: 6%) NSD.

Carr 2005

Methods	RCT. Quality score: 5 (No blinding, no ITT).
Participants	LBP, patients, adults, UK, n = 237.
Interventions	I1: Back to fitness programme. 8 classes (1 hr each) led by a physiotherapist, aimed at increasing activity gradually over a 4-week period. Included low impact aerobics, strengthening, stretches for main muscle groups, relaxation. Cognitive behavioural approach underpinned messages given. n = 118. I2: Individual physiotherapy. Treatment at the discretion of the physiotherapist and included one, or a combination of: McKenzie exercises, strength exercises, stretches, spinal stabilisation exercise, other exercises, manipulation, mobilisation, traction, short wave diathermy, ultrasound (5%), interferential, TENS (6%), other (including likon, massage, heat, advice/education). n = 119. Treatment duration: I1: 4 weeks.
Outcomes	Adherence: Attendance at 5+ sessions. Pain: Pain self-efficacy scale. Function: RMDQ. QoL: EQ-5D. SF-12.
Notes	Follow-up: Baseline, 3, 12 months. Loss to follow up: 24% (I: 22%, C: 26%) NSD.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Cohen 1983

Methods	Quasi-randomised trial. Quality score: 2 (Unknown randomisation, unknown concealment, no blinding, no variability of estimates, unknown ITT)
Participants	LBP, patients, 20 - 62 yrs, USA, n = 36.
Interventions	I1: Behavioural therapy. Attempted to increase knowledge and understanding of pain, encourage self-responsibility for pain management, teach skills such as relaxation and guided imagery, goal setting, activity management, problem solving and assertiveness training. Conducted by psychologist and psychiatrist. n = 16. I2: Physiotherapy. Included instruction in acute and chronic pain control strategies, relation training, exercise, pool therapy and proper use of body mechanics conducted by physiotherapist and student assistant. n = 21. Treatment duration: 10 weeks.
Outcomes	Adherence: Time spent in daily activities. Pain: Pain diary. Function: Self-reported functional limitations.
Notes	Follow-up: Baseline, post treatment. Loss to follow up: 33% (I1: 19%, I2: 43%) NSD

Ersek 2004

Methods	RCT. Quality score: 6 (No participant or care provider blinding, unknown concealment)
Participants	OA, volunteers, 60 + yrs, USA, n = 45.
Interventions	I: Group ASMP. Took place at the retirement facilities. Topics were the same as the booklet plus relaxation training and regular relaxation exercises, and practice of pain management skills. Major focus was individualised pain management goals e.g. increasing physical activity. Supported with written syllabus. Led by a health professional with doctoral level experience. Group size ranged from 3 to 8 people. n = 22. C: Educational booklet. Subjects received a booklet prepared by investigators, with information on definitions and types of chronic pain, gate-control theory, pharmacologic and non-pharmacologic therapies for pain, decision-making about therapies, communication with health providers, chronic pain resources. n = 23. Treatment duration: 8 weeks.
Outcomes	Adherence: Proportion completing strength or balance exercise, stretching, or aerobic exercise at least once per week. Pain: Chronic Pain Grade. Function: SF-36 (physical function subscale). QoL: SF-36 (physical role function subscale).
Notes	Follow-up: Baseline, post treatment, 3 months after treatment. Loss to follow up: 13% (I: 14%, C: 13%) NSD

Ettinger 1997

Methods	RCT. Quality score: 7 (No participant or care provider blinding).
Participants	Knee OA, volunteers/patients 60 + yrs, USA, n = 439.
Interventions	I1: Aerobic exercise. 3-month facility-based walking program in classes of 10 to 15 people under the direct supervision of a trained exercise leader and walking on an indoor track, followed by a 15-month home-based walking program consisting of 2 phases 1) transition months 4 to 6 of home visits and telephone calls to develop the exercise program and 2) maintenance months 7 to 18 of telephone calls. n = 144. I2: Resistance exercise. 3-month facility-based program in classes of 10 to 15 people under the direct supervision of a trained exercise leader followed by a 15-month home based program with the same number of contacts as the aerobic group. Exercises designed to strengthen major muscle groups of both upper and lower limbs, using dumb bells, cuff weights, weights gradually increased. n = 146. C: Health education. Designed to provide attention, social interaction and education about osteoarthritis, in groups of 10 to 15. Months 1 to 3, people had 1.5 hour sessions each month led by a nurse, using videos, question and answer session, social period, pre-printed education material. Months 4 to 6 the nurse contacted people by phone biweekly and conducted a structured interview. Months 7 to 18, same phone call only once a month. n = 149. Treatment duration: 18 months.
Outcomes	Adherence: Proportion of prescribed sessions completed. Pain: Likert scale of pain in past week on 6 activities.

Ettinger 1997 (*Continued*)

Notes	Follow-up: Baseline, 3, 9, 18 months. Loss to follow up: 17% (I1: 19%, I2: 18%, C: 15%) NSD.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Ferreira 2007

Methods	RCT. Quality score: 6 (No blinding).
Participants	Chronic non-specific LBP, patients, adults, Australia, n = 240
Interventions	I1: General Exercise classes. Supervised classes (max. 8) modelled on 'Back to Fitness', increasing intensity, including strengthening & stretching for main muscle groups & cardiovascular exercises. n = 80. I2: Motor Control Exercise. Improving function of specific trunk muscles & isolating individual muscle groups, difficulty increased progressively. 12 sessions. n = 80. Both groups used CBT techniques to encourage self-reliance & told to exercise at home every day. I3: Spinal Manipulation. Based on Maitland joint mobilisation and manipulation with no exercises at sessions or home. Advised to avoid pain-aggravating activities. n = 80. Treatment duration: 8 weeks.
Outcomes	Adherence: class attendance. Pain: VAS (0-10). Function: RMDQ. Patient-specific functional scale- rated (1-10) difficulty with 3 patient-selected tasks
Notes	Follow up: baseline, 8 weeks, 6 & 12 months. Loss to follow up: 6 months 12% (I1: 9%, I2: 19%, I3: 9%) NSD

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Fransen 2007

Methods	RCT. Quality score: 7 (No participant or care provider blinding).
Participants	OA, patients and volunteers, 59-85 yrs, Australia, n = 152. Participants had to pay $35 towards study costs.

Fransen 2007 (*Continued*)

Interventions	I1: Hydrotherapy. n = 55 (77 including controls). I2: Tai-chi - Sun style. From Tai-chi for Arthritis video by Paul Lam. Could buy video to help home practice. n = 56 (75 including controls). C: Waiting list for 12 weeks, then 22 randomised to hydrotherapy & 19 to tai-chi. n = 41. Treatment duration: exercise classes (max 15 per class) 1 hour twice a week for 12 weeks
Outcomes	Adherence: class attendance. Pain: WOMAC (pain). Function: WOMAC (function).
Notes	Follow up: baseline, post-treatment (12 weeks) & 24 weeks. Loss to follow up: 7% (I1: 5%, I2: 14%) NSD

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Friedrich 1996

Methods	RCT. Quality score: 6 (Unknown concealment, no participant or care provider blinding)
Participants	LBP or neck pain (author report 63 had pain for 3 months or more), patients 20 - 70 yrs, Austria, n = 87
Interventions	I1: Supervised physiotherapy exercise. Individual exercise instruction by a physiotherapist. Depending on the status of each patient, exercise regimen of 3 to 5 different strengthening and stretching exercises. 8 sessions, and on the days between sessions, patients exercised at home for 20 minutes every day. n = 47. C: Exercise brochure. Patients given a brochure only, no initial instructions. Patients exercised on his or her own without the guidance of a physiotherapist. Told to exercise for 20 minutes every day. n = 40. Treatment duration: I1: 8 sessions.
Outcomes	Adherence: Exercise performance. Weekly training frequency. Pain: VAS (0-10).
Notes	Follow up: Baseline, approximately 34 days. Loss to follow up: None.

Friedrich 1998

Methods	RCT. Quality score: 5 (No participant or care provider blinding, no ITT)
Participants	LBP, patients 20 - 60 yrs, Austria, n = 93.

Friedrich 1998 (*Continued*)

Interventions	I: Combined physiotherapy exercise and motivation programme. As per standard physiotherapy exercise plus 5 interventions: 1) counselling and information strategies ensuring clear instructions emphasising importance of regular consistent exercise in reducing pain and further episodes, enhanced internal locus of control, problem solving, e.g. tailoring regime to patients daily routine; 2) reinforcement techniques e. g. positive feedback, reward and punishment strategies - set in mutual agreement; 3) treatment contract; 4) place treatment contract in prominent position; 5) completing exercise diary. n = 44. C: Standard physiotherapy exercise programme. Individual, sub maximal, gradually increased exercise programme. Exercises per session varied according to physical ability of each patient, as identified in 1st treatment session and adapted according to ongoing assessments. Directed at improving spinal mobility, trunk and lower limb length, force, endurance, coordination, thereby restoring normal function. Patients were encouraged to do exercises at home, daily if possible, and being physically active to help overcome fear avoidance. Also instructed about correct posture. n = 49. Treatment duration: 10 sessions.
Outcomes	Adherence: Attendance. Length of time continued exercise programme. Weekly training frequency. Pain: 101-point numerical rating scale. Function: Low back outcome scale questionnaire.
Notes	Follow-up: Baseline, 8th treatment session, 4, 12 months. Loss to follow up: 26% (I: 23%, C: 29%) NSD.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Fries 1997

Methods	RCT. Quality score: 3 (Unknown concealment, no inclusion criteria, no blinding, unknown ITT)
Participants	OA/RA (author report >50% OA), patients, adults, USA, n = 1099
Interventions	I: Individualised, mailed ASMP. Health assessment questionnaire delivered by mail and led to detailed and specific computer generated recommendation letters to participants signed by a physician and graphic reports showing participant's progress. 3-month follow on questionnaire/progress report reinforced positive changes and encouraged additional changes. With each questionnaire/report cycle a "deliverable" item i.e.- Arthritis Help Book, exercise videotape, relaxation audiotape, was also sent to participants. Computer generated report had over a billion possible configurations so individualised report took into consideration participants age, learning, and medication advice. n = 557. C: Waiting List. Received the full intervention after 12 months. n = 542. Treatment duration: 6 months.
Outcomes	Adherence: Number of exercise sessions per week. Pain: VAS (0-100). Function: Modified HAQ (physical function). QoL: Global vitality VAS (0-100).

Fries 1997 (*Continued*)

Notes	Follow-up: Baseline, 6 months. Loss to follow up: 26% (I: 33%, C: 20%) SD.

Halbert 2001

Methods	Sub study of RCT. Quality score: 5 (Unknown concealment, no blinding).
Participants	Hip or knee OA, patients, 60 + yrs, Australia, n = 69.
Interventions	I: Individualised physical activity advice. Delivered by exercise physiologist (20 minutes) at baseline appointment & follow up at 3 and 6 months. Participants chose aerobic activity but were given the same advice. n = 37. C: Leaflet on good nutrition. Discussed with exercise physiologist for 20 minutes. n = 32. Treatment duration: 6 months.
Outcomes	Adherence: Frequency and duration of walking, and vigorous exercise per week. Pain: WOMAC (pain). Function: WOMAC (function). QoL: SF-36.
Notes	Follow-up: baseline, 3, 6 and 12 months. Loss to follow up: None.

Harkapaa 1990

Methods	RCT. Quality score: 3 (Unknown concealment, no blinding, no variability of estimates, no ITT)
Participants	LBP, blue-collar workers and farmers, adults, Finland, n = 476
Interventions	I1: In-patient rehabilitation + refresher sessions. Treatment period plus a refresher programme after 1.5 years and five follow-ups. 3 weeks inpatient programme at a rehabilitation centre. Group of 6-8 patients. Modified Swedish back school, back and muscle relaxation exercises, and heat or electrotherapy prior to the back exercise sessions. Massage and attended physical exercise and muscle strength exercise. Two structured group discussions led by psychologist on how to cope with chronic pain, plus one session on back care led by physician. Taught a back exercise programme to be carried out after treatment. 2-week refresher programme 1.5 years after first programme. Revive and rehearse self-care skills. n = 157. I2: Outpatient rehabilitation + refresher sessions. Treatment period plus a refresher programme after 1.5 years and five follow-ups. Outpatients - 15 sessions of back treatment programme (twice a week during a two month period) either at the work place or a local health centre. Participation during working hours. Group of 6-8 patients. Modified Swedish back school, back and muscle relaxation exercises, and heat or electrotherapy prior to the back exercise sessions. Two structured group discussions led by psychologist on how to cope with chronic pain, plus one session on back care led by physician. Taught a back exercise programme to be carried out after treatment. 8-session refresher programme 1.5 years after first programme. Revive and rehearse self-care skills. n = 159. C: Written and oral instructions on back exercises and ergonomics during the physiatrist's examination at beginning of study, at 3-months, 1.5 year and 2.5 year follow up. n = 160. (Comparison between I2 and C)

Harkapaa 1990 (*Continued*)

	Treatment duration: I2: 2 months + 8 sessions at 1.5 years.
Outcomes	Adherence: Frequency of back exercises. Accomplishment of back exercises. Pain: The Pain Index. Function: The LBP Disability Index.
Notes	Follow-up: Baseline, 3, 8, 18, 22, 30 months. Loss to follow up: 16% (not reported separately for groups).

Huang 2003

Methods	RCT. Quality score: 4 (Unknown if similar at baseline, Unknown blinding, no ITT)
Participants	Knee OA, patients, adults, Taiwan, n = 132.
Interventions	I1: Isokinetic muscle strengthening exercises. n = 33. I2: Isotonic muscle strengthening exercises. n = 33. I3: Isometric exercises. n = 33. C: Control. Not described. n = 33. Treatment duration: I1, I2, and I3 exercised 3x a week for 8 weeks and a home exercise programme tailored to group allocation. All groups received 20 minutes hot pack and passive range of movement exercises on stationary bike x 5 minutes
Outcomes	Adherence: Attendance - proportion of participants completing treatment sessions. Pain: pain after weight bearing for 5 minutes (VAS, 0-10).
Notes	Follow up: Baseline, post treatment, 1 year. Loss to follow up: 14% (I1: 15%, I2: 12%, I3: 9%, C: 18%) NSD

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	

Huang 2005

Methods	RCT. Quality score: 5 (Unknown/no blinding, no ITT).
Participants	Knee OA, patients, adults, Taiwan, n = 120.
Interventions	I1:Isokinetic muscle strengthening exercises. Began with 60% of average peak torque, increasing intensity from 1 to 5 sets in sessions 1 to 5 and then at 6 repetitions for sessions 6 to 24, received 20 minutes hot packs and 5 minutes of passive range of movement exercise on a static bike of both knees before exercises, plus a home exercise program (15 minutes cycling). n = 30.

Huang 2005 (*Continued*)

	I2: Isokinetic exercise plus continuous ultrasound. Applied for 5 minutes to each treated region over the medial collateral ligament, anserine bursa, popliteal fossa), received 20 minutes hot packs and 5 minutes passive ROM exercise on a static bike of both knees before exercises, plus a home exercise program (15 minutes cycling). n = 30. I3: Isokinetic exercise plus pulsed ultrasound. Applied for 5 minutes to each treated region over the medial collateral ligament, anserine bursa, popliteal fossa), received 20 minutes hot packs and 5 minutes passive range of movement exercise on a static bike of both knees before exercises, plus a home exercise program (15 minutes cycling), n = 30. C: No exercise or ultrasound. n = 30. Treatment duration: 8 weeks.
Outcomes	Adherence: Attendance - proportion of participants completing treatment sessions. Pain: pain after weight bearing for 5 minutes (VAS, 0-10).
Notes	Follow-up: Baseline, post treatment, 1 year. Loss to follow up: 19% (I1: 30%, I2: 20%, I3: 7%, C: 20%) NSD

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Hughes 2004

Methods	RCT. Quality score: 3 (Unknown concealment, not similar at baseline, no blinding, no ITT)
Participants	Hip or knee OA, volunteers 60 + yrs, USA, n = 150.
Interventions	I: Facility based exercise classes + adherence focused home programme. Exercise class of 15 people, led by 1 of 2 physiotherapists. First 60 minutes = resistance training and fitness walking, last 30 minutes = group discussion education to enhance adherence efficacy. Session begins and ends with 10 min warm-up and cool-down. Also used reinforcement about opportunities to maintain exercise in the community or at home - followed 'Negotiated adherence model' (Jensen 1994) - participants were asked to develop a post-intervention exercise plan and asked to sign a post intervention exercise contract. Given a log to track changes over time, given copy of The Arthritis Help Book (Lorig and Fries 1995), graduation certificate, tapes of music used in the class at a graduation ceremony at 8 weeks. n = 80. C: Advice booklet. Given a copy of The Arthritis Help Book, list of exercise programmes in the community that they can access, variety of self-care materials and handouts at each follow up. Offered to participate in the intervention at the conclusion at 24 months. n = 70. Treatment duration: 8 weeks.
Outcomes	Adherence: Minutes exercised per week. Pain: WOMAC (pain). Function: WOMAC (function).
Notes	Follow up: Baseline, 2, 6 months. Loss to follow up: 36% (I: 25%, C: 49%) SD

Hurley 2007

Methods	RCT. Quality score: 6 (No participants or care provider blinding, no ITT)
Participants	Chronic knee pain, patients 50 + yrs, UK, n = 418.
Interventions	I1: Usual Primary Care + individual rehabilitation. Combined discussion on specific topics regarding self-management with an individualised, progressive exercise regimen. n = 146. I2: Usual Primary Care + group rehabilitation. Same intervention as I1 but in groups of about 8 participants. To ensure consistency in content and delivery the same experienced physiotherapist devised, supervised and progressed all sessions for all participants. n = 132. C: Usual Primary Care. n = 140. Treatment duration: Twice weekly for 6 weeks.
Outcomes	Adherence: Proportion attending 10+ sessions. Pain: WOMAC (pain). Function: WOMAC (function). QoL: EQ-5D.
Notes	Follow-up: Baseline, 6 weeks, 6 months. Loss to follow up: 18% (I1: 17%, I2: 18%, C: 19%) NSD

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	

Jensen 2001

Methods	RCT. Quality score: 5 (Unknown if similar at baseline, no blinding)
Participants	Spinal pain, on sick leave, 18 - 60 yrs, Sweden, n = 214.
Interventions	I1: Behaviour orientated physiotherapy. Aimed at improving physical functioning and to facilitate lasting behaviour change. Goal setting gradually increased exercise to improve muscular endurance, aerobic training, water exercise, relaxation, and body awareness therapy. 'Homework' given at end of each session according to participants interest and problem areas. n = 54. I2: CBT. Aimed to improve ability to manage pain and resume normal level of activity. Included planning and goal setting, problem solving, applied relaxation, cognitive coping techniques, activity pacing, role of vicious circles and how to break them, role of significant others, assertion training. 'Homework' given according to factors identified during the session. n = 49. I3: Combined treatment. Common to all interventions: Conducted in groups of 4-8 participants, access to physician, included 2 sessions on ergonomics, 2 sessions on medical aspects of chronic spinal pain, scheduled time for visit to work place and work manager and rehab officials invited to discharge session where rehab plan agreed. n = 63. C: Usual Care. n = 48. Treatment duration: 4 weeks + 6 booster sessions (90 minutes per session) over 1 year

Jensen 2001 (*Continued*)

Outcomes	Adherence: High or full adherence to lifestyle treatment plans. Attendance. QoL: SF-36.
Notes	Follow-up: Baseline, post treatment, 6, 18 months. Loss to follow up: 13% (I1: 11%, I2: 16%, I3: 22%) NSD.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Koumantakis 2005

Methods	RCT. Quality score: 8 (No care provider blinding).
Participants	LBP, patients, adults, UK, n = 55.
Interventions	I1: Back book + stabilisation enhanced exercise. Included both general exercise and specific stability exercise for abdominal and trunk muscles, 8 exercise levels of progressively increasing difficulty were provided, plus a copy of the back book advice leaflet. n = 29. I2: Back book + general exercise. This was general trunk and abdominal muscle exercises, not aerobic exercise. 8 exercise levels of progressively increasing difficulty were provided, plus a copy of the back book advice leaflet. n = 26. Treatment duration: 8 weeks.
Outcomes	Adherence: Attendance. Frequency of home exercise (diary). Pain: SF-MPQ. Function: RMDQ.
Notes	Follow-up: Baseline, post-intervention, 3 months. Loss to follow up: 31% (I1: 28%, I2: 35%) NSD.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Lorig 1985

Methods	RCT. Quality score: 2 (Unknown concealment, no inclusion criteria, not similar at baseline, no blinding, unknown ITT)
Participants	Arthritis, volunteers, adults, USA, n = 190 (included in analysis)
Interventions	I: Group ASMP. Emphasised nature of arthritis, appropriate use of medication, ROM and isometric exercises, relaxation techniques, joint protection, nutrition, interaction of patients with physicians, evaluation of non-traditional treatments (contents published as the arthritis help book). 15-20 participants, plus family member if wished. Education emphasised group discussion, practice, use of contracts and diaries to improve compliance, weekly feedback. Programme costs were approximately $15-20 per participant. Led by lay members. n = 134. C: No intervention. n = 65. Treatment duration: 4 months.
Outcomes	Adherence: Change in frequency of arthritis exercise per month. Pain: VAS (0-10). Function: HAQ.
Notes	Follow-up: Baseline, 4 months. Loss to follow up: 5% (I: 4%, C: 6%) NSD.

Luszczynska 2006

Methods	RCT. Quality score: 4 (Unknown concealment, no blinding, no ITT).
Participants	Spondylosis, patients, adults, Poland, n = 66.
Interventions	I: Education session on exercises and discussion with consultant plus re-enforcing intervention (performing exercise in front of consultant and being applauded on successful completion) and leaflet to fill in to record exercises completed successfully. C: Education session and explanatory leaflet on recommended exercises only. Number in each group not stated. Treatment duration: 3 weeks.
Outcomes	Adherence: self-reported global index of exercise - performance of recommended exercises, exercise performance accuracy & frequency of exercises. No clinical outcomes.
Notes	Follow up: baseline, 3 weeks (post-intervention). Loss to follow up: 9% (not reported separately for groups).

Mangione 1999

Methods	RCT. Quality score: 4 (Unknown concealment, unknown/no blinding, no ITT)
Participants	Knee OA, volunteers, 50 + yrs, USA. n = 54.
Interventions	I1: High intensity static cycling exercise. Consisted of warm-up exercises (fast walking and upper limb and trunk exercises) then cycling for 25 minutes with adjusted seat height, intensity determined from max Heart Rate achieved in previous treadmill testing, high intensity exercised at 70% heart rate reserve using increase pedal speed, then cool down (slow walking and breathing exercises). n = 19. I2: Low intensity static cycling exercise. Consisted of warm-up exercises (fast walking and upper limb and trunk exercises) then cycling for 25 minutes with adjusted seat height, intensity determined from max Heart Rate achieved in previous treadmill testing, low intensity exercised at 40% heart rate reserve using increased pedal speed, then cool down (slow walking and breathing exercises). n = 20. Treatment duration: 3 times per week for 10 weeks.
Outcomes	Adherence: Measure not stated. Pain: AIMS2 pain score.
Notes	Follow up: baseline, 10 weeks. Loss to follow up: 28% (not reported separately for groups).

McCarthy 2004

Methods	RCT. Quality score: 5 (Unknown concealment, no participant or care provider blinding, no ITT)
Participants	Knee OA, patients, adults, UK, n = 214.
Interventions	I1: Home exercise. 1 session of advice and education drawing from ARC booklet for OA knee. At this session muscle weakness addressed by including 2 strength exercises, muscle fatigue by muscle endurance exercise, balance and proprioception by manoeuvres required concentrating on balance during activity. Intensity of exercises individualised to patient. Initial assessment provided base line ability, reassessed and increased at 4- and 8-week review. If pain from exercises, intensity was reduced or maintained for further 4 weeks. Told not to alter levels of analgesics during trial and complete home exercises diary daily. n = 103. I2: Home exercise + class exercise. As above plus 8 week class programme involved attending physiotherapy department 2x week 45 minutes. Completed circuit of exercises supervised by a senior physiotherapist consisting of progressive resistance training, accelerated walking, stretching, balance. Max 12 per class. n = 111. Treatment duration: 8 weeks.
Outcomes	Adherence: Number of exercises. Time spent exercising in past month. Change in activity level at 6 months. Pain: VAS (0-100) walking pain in past week. SF-36 (pain). Function: WOMAC (function). SF-36 (physical function). QoL: EQ-5D.
Notes	Follow-up: Baseline, post treatment, 6, 12 months. Loss to follow up: 29% (I1: 31%, I2: 28%) NSD.

Mikesky 2006

Methods	RCT. Quality score: 6 (Unknown concealment, no participant or care provider blinding)
Participants	Knee OA, volunteers, 55 + yrs, USA, n = 221.
Interventions	I: Strength training. 3 months training twice at National Institute for Fitness & Sport plus once at home per week; next 3 months once at Institute & twice at home per week; next 3 months twice per month at Institute & 3 times a week at home; last 3 months, once a month at Institute & remaining sessions at home. Returned to Institute for strength testing & assessment every 6 months following. Warm up & CYBEX resistance training equipment. n = 113. C: Range of Motion exercises. 45-minute sessions at Institute with gradual change to home exercise same as strength (I) group & exercise booklets. n = 108. Treatment duration: 12 months.
Outcomes	Adherence: Attendance at Institute training. Self-reported home exercise frequency. Pain: WOMAC (pain). Function: WOMAC (function). QoL: SF-36.
Notes	Follow up: baseline, 12, 18, 24 & 30 months. Loss to follow up: 30% (I: 36%, C: 24%) SD.

Minor 1989

Methods	RCT. Quality score: 4 (Unknown concealment, unknown/no blinding, no ITT)
Participants	Lower limb OA, volunteers and patients, 20 + yrs, USA, n = 120
Interventions	I1: Aerobic walking. Warm up of general flexibility and isometric exercises for postural muscles followed by 30 minutes walking on level course at exercise heart rate and 10 minutes cool down. n = 36. I2: Aerobic aquatics. Warm up of general flexibility and isometric exercises for postural muscles followed by 30 minutes deep water jogging and callisthenics, and 10 minutes cool down. n = 47. C: ROM exercises. Active ROM and isometric strengthening and relaxation exercises. n = 32. Treatment duration: 1-hour sessions 3x a week for 12 weeks.
Outcomes	Adherence: Proportion of participants completing treatment. Mean exercise minutes per week. Proportion doing > 60 min exercise per week. Pain: AIMS (pain). Function: AIMS (physical activity).
Notes	Follow-up: Baseline, 3, 9 months. Loss to follow up: 19% (I1: 22%, I2: 15%, C: 13%) NSD.

Nour 2006

Methods	RCT. Quality score: 5 (Unknown concealment, no participants or care provider blinding, no ITT)
Participants	OA (65%) or RA, patients, 50 + yrs, Canada, n = 113.
Interventions	I: SMP with CBT approach. "I'm taking change of my arthritis" intervention. Weekly 1-hour home visits by practitioner over 6 weeks, included goals & contracts each week, 1 session on exercise & relaxation. n = 65. C: Waiting list. 1-year - received intervention in 2nd year of study. n = 48
Outcomes	Adherence: Self-reported weekly exercise frequency. Change in frequency of walking, stretching and strengthening exercises. No clinical outcomes
Notes	Follow up: baseline, pre-intervention, post-intervention (8 weeks after randomisation) & post-intervention (6 weeks later). Loss to follow up: 14% (I: 11%, C: 19%) NSD.

Petrella 2000

Methods	RCT. Quality score: 7 (Not similar at baseline, no care provider blinding)
Participants	Knee OA, patients 65 + yrs, USA, n = 179.
Interventions	I: Oxaprozin + progressive exercise. Home-based progressive knee exercise plus NSAID oxaprozin 1200mg daily. Series of progressive, simple, ROM and resistance exercises using common items in the home. Consisted of 10 min warm-up of stretching, a specific series of repetitions, exercises, frequency and resistance. n = 91. C: Oxaprozin + joint unloading. Included non-weight-bearing joint unloading and stretches that did not include resistance or progression. n = 88. Treatment duration: 8 weeks.
Outcomes	Adherence: PASE. Pain: WOMAC (pain). Function: WOMAC (function).
Notes	Follow up: Baseline, 8 weeks. Loss to follow up: 2% (I: 1%, C: 3%).

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	

Schoo 2005

Methods	RCT. Quality score: 3 (Unknown concealment, no blinding, no variability of estimates, no ITT)
Participants	Hip or knee OA, patients 60 + yrs, Australia, n = 115.
Interventions	All interventions consisted of face-to face verbal instruction from physiotherapist on performance of 9 home exercises, including how executed, frequency, intensity. Same for all participants. plus: I1: Brochure. Written instruction to assist correctness of prescribed exercise. Brochure written in font no smaller than 12 and classified as 'easy to read'. n = 30. I2: Brochure + audiotape. n = 30. I3: Brochure + videotape. Contained visual as well as verbal clues to assist correct exercise performance. n = 30. Treatment duration: 8 weeks.
Outcomes	Adherence: Correctness of exercise performance. Frequency of exercises. No clinical outcome.
Notes	Follow up: Baseline, 4, 8 weeks. Loss to follow up: 22% (I1: 32%, I2: 27%, I3: 17%) NSD.

Sherman 2005

Methods	RCT. Quality score: 6 (Not similar at baseline, no participants or care provider blinding)
Participants	Non-specific CLBP, patients, adults, USA, n = 101.
Interventions	I1: Yoga. 'Viniyoga' sessions run by senior teacher. Patients given audio CDs to guide them through postures at home. n = 36. I2: Physiotherapy Exercise. Run by physiotherapist, made different from other exercise classes to maximise adherence, including education, aerobic exercise, strengthening & stretching exercise. n = 35. I3: Self-care book (The Back Pain Helpbook). n = 30. Treatment duration: 12 weekly sessions lasting 75 minutes.
Outcomes	Adherence: Class attendance. Average duration of practice - home exercise logs. Function: RMDQ
Notes	Follow up: Baseline, 6, 12, 26 weeks. Loss to follow up: 26 weeks 6% (I1: 6%, I2: 9%, I3: 3%) NSD.

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	

Smeets 2006

Methods	RCT. Quality score: 6 (No blinding).
Participants	LBP, patients, 18 - 65 yrs, Netherlands, n = 227.
Interventions	I1: Active physical treatment. 30 minutes aerobic training (5 min warm up 20 min performing at 65%-80% max heart rate and 5 min cool down) followed by 75 minutes' strength and endurance training. Heart rate target was calculated and increased by 5% at 2 and 4 weeks into training. Other exercises gradually built up over the weeks - 3 strengthening exercises for legs and trunk 15 - 18 reps and gradually increased the resistance. Also from 3rd week - sprinting X3 in one minute. n = 54. I2: CBT. 2 parts - 1) graded activity led by a physiotherapist or occupational therapist - aimed to help patients to reach their daily life goals and increase their activity. The patient chose 3 activities that were of highest importance but compromised by pain, the activity tolerance level was calculated and final treatment goals set. Patients recorded progress on a daily diary and instructed to do no more and no less than the agreed amount of the activity set each day, and 2) problem solving training with clinical psychologist or trained social worker - patients received a booklet and instruction on problem solving techniques with patients picking their own personal problem areas. n = 60. I3: Combined treatment. n = 62. C: Waiting list. n = 51. Treatment duration: 10 weeks.
Outcomes	Adherence: Proportion attending at least 2/3 sessions. Pain: Pain intensity (VAS (100mm)). PRI-T. Function: RMDQ.
Notes	Follow-up: Baseline, post treatment, 6, 12 months (only post treatment data available). Loss to follow up: 7% (I1: 4%, I2: 8%, I3: 11%, C: 2%)

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Soderlund 2001

Methods	RCT. Quality score: 5 (Unknown concealment, no participants or care provider blinding, no ITT)
Participants	Whiplash associated disorders, patients, 18 - 60 yrs, with Sweden, n = 33
Interventions	I1: Regular primary care physiotherapy. A uniform approach to treatment for comparison group was agreed before the trial by asking physiotherapists how they would usually treat WAD. Included exercises to enhance muscular stabilisation of neck, neck and shoulder mobility and stretching and coordination of head movements as well as exercises to maintain the body posture and arm muscle strength. Oral and or written information. Expected to exercise at home or physiotherapy gym or both. Could also include pain relieving methods e.g. relaxation, TENS, acupuncture and heat. n = 16. I2: Physiotherapy including CBT. Four phases. Learning of basic physical and psychological skills (relaxation training, cervicothoracic muscular stabilisation postural techniques, discussion of coping strategies and self efficacy, exercises

	for neck ROM, co-ordination, endurance and re-education of normal humeroscapular rhythm), application and generalisation of basic skills in everyday activities derived from functional behavioural analysis and a maintenance phase (repetition of key components and written summary of program). Functional behaviour analysis approach was used to highlight the problem behaviours and to establish treatment goals, which also served as basis for each treatment phase. All skills training would be done at home. n = 17. Treatment duration: Up to 12 sessions.
Outcomes	Adherence: Exercise diary. Global questions (including perceived recovery, ability to perform daily activities, satisfaction with results, use of medication). Pain: Pain Disability Index. Numerical rating scale.
Notes	Follow up: Baseline, post treatment, 3 months. Loss to follow up: I1: 6% - no data provided for I2.

Song 2003

Methods	RCT. Quality score: 4 (Unknown concealment, unknown/no blinding, no ITT)
Participants	OA, female patients, 55 + yrs, Korea, n = 72.
Interventions	I: Tai-chi for arthritis. 1 hour session 3 times a week for 2 weeks, from week 3 supervised once a week and 3-4 times a week at home for 10 weeks. Contract and weekly phone calls plus exercise log to record frequency & duration of home tai-chi (assessed at supervised session). n = 38. C: Control intervention not described in this paper. n = 34. Treatment duration: 12 weeks.
Outcomes	Adherence: Mean change in exercise behaviour. Pain: K-WOMAC.
Notes	Follow up: baseline, 12 weeks (post-treatment). Loss to follow up: 41% (I: 43%, C: 39%) NSD.

Soukup 1999

Methods	RCT. Quality score: 4 (Unknown concealment, no blinding).
Participants	LBP, volunteers and patients, 18 - 50 yrs, Norway, n = 77.
Interventions	I1: Mensendieck exercise programme. Designed as a secondary prevention program for persons with LBP. Consists of exercises and biomechanical/ergonomic education. n = 39. C: Received written and oral information about the Mensendiek approach as a secondary prevention programme at the beginning of the study. n = 38
Outcomes	Adherence: Frequency of participation in regular leisure physical training. Pain: VAS (100mm).

Soukup 1999 (*Continued*)

	Function: VAS (100mm). Dartmouth COOP Functional Assessment Charts
Notes	Follow-up: Baseline, 5, 12 months. Loss to follow up: 10% (I: 13%, C: 8%) NSD.

Taimela 2000

Methods	RCT. Quality score: 6 (Unknown concealment, no participants or care provider blinding)
Participants	Neck pain, workers, 30 - 60 yrs, Finland, n = 76.
Interventions	I1: Active multimodal treatment. Led by 2 trained physical therapists. 1) cervicothoracic stabilisation training designed to restore muscle endurance and coordination; 2) relaxation to reduce muscle tension; 3) behavioural support to reduce anxiety and fear of pain; 4) eye fixation to prevent dizziness; 5) seated wobble board training to improve postural control. In final stage of the program, patients also attended a lecture about neck pain and its consequences, and received a booklet about home exercises. n = 25. I2: Lecture + home exercises. Patients attended a lecture about neck pain and its consequences and received written information about neck exercises plus additional practical training for their home exercises and maintaining a progress diary. Practical part was provided in smaller groups at the beginning, twice with a 1-week interval. n = 25. C: Lecture + recommendation to exercise. Patients attended a lecture about neck pain and its consequences and received written information about neck exercises to be applied at home and at the workplace. n = 26. Treatment duration: 12 weeks.
Outcomes	Adherence: Habitual physical activity. Pain: VAS (100mm). Function: Self-reported physical impairment in ADLs questionnaire
Notes	Follow up: Baseline, 3, 12 months. Loss to follow up: 18% (I1: 16%, I2: 24%, I3: 15%) NSD.

Talbot 2003

Methods	RCT. Quality score: 4 (Unknown concealment, no blinding, no ITT).
Participants	OA, volunteers, 60 + yrs, USA, n = 34.
Interventions	I: ASMP + walking. Single nurse instructed this. At initiation to ASMP patients were instructed to wear pedometer for monitoring daily steps. Baseline step count was increased by 10% every 4 weeks. By end of 12 weeks, would be walking 30% above baseline step count. During brief individual counselling (< 5 mins) pedometer logs reviewed and feedback given. Also given booklet explaining principles of exercise, including warm up cool down, stretching arthritis principles such as 2-hour plain rule and balancing rest with activity. n = 17. C: ASMP. 12-hour programme teaches coping techniques, includes 1-hour unit on exercise as a component of arthritis management. 2 registered nurses attended the arthritis foundation 16-hour training course and conducted all classes. n = 17. Treatment duration: 12 weeks.

Talbot 2003 (*Continued*)

Outcomes	Adherence: Step count. Accelerometer. Pain: Present Pain Intensity Scale. Pain Rating Index Total from McGill Pain Questionnaire
Notes	Follow-up: Baseline, 12, 24 weeks. Loss to follow up: 18% (I: 12%, C: 24%) NSD.

Veenhof 2006

Methods	Cluster RCT. Quality score: 7 (No participants or care provider blinding)
Participants	Hip or knee OA, patients and volunteers, adults, Netherlands, n = 200
Interventions	I: Behavioural graded activity. Combined operant conditioning with exercise therapy, based on time-contingency management. Included written materials (eg education messages, activity diaries, performance charts). Max. 18 sessions over 12 weeks & 5 preset booster moments with max 7 sessions (wks 18, 25, 34, 42 & 55). n = 97. C: Physiotherapy usual care. Provided according to Dutch physiotherapy guidelines. n = 103
Outcomes	Adherence: Proportion doing home exercises. SQUASH. Pain: VAS (0-10). WOMAC (pain). Function: WOMAC (physical function).
Notes	Follow up: baseline, week 13 & week 65 + mailed questionnaire in week 39. Loss to follow up: 65 weeks 11% (I: 10%, C: 11%).

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	

Viljanen 2003

Methods	RCT. Quality score: 5 (Not similar at baseline, no blinding).
Participants	Neck pain, female office workers, 30 - 60 yrs, Finland, n = 393
Interventions	I1: Dynamic muscle training. Training done by experienced physiotherapist in groups of up to 10. Dumbbells used. Exercises aimed to activate large muscle groups at the neck and shoulder. Stretching followed. From week 5 participants taught 3 exercises from programme, with stretches. After week 9 asked to perform training programme by themselves in the group and the instructor gave feedback. n = 135. I2: Relaxation training. Training done by experienced physiotherapist in groups of up to 10. Various techniques included based on the progressive relaxation method, autogenic training, functional relaxation, and systematic desensitisation. Exercises aimed to teach participants to activate only the muscles needed

Viljanen 2003 (*Continued*)

	for different ADLs and to relax other muscles. Performed techniques independently after week 5 and to avoid unnecessary tension in neck muscles. n = 128. C: Continue with usual activity levels. Instructed not to change their physical activity or means of relaxation during the 12 months follow up. n = 130. Treatment duration: 12 weeks + 1 week 6 months post-randomisation
Outcomes	Adherence: Attendance. Average minutes per week spent completing intervention specific exercise. Pain: VAS (0-10). Function: Neck Disability Index developed.
Notes	Follow up: Baseline, 3, 6, 12 months. Loss to follow up: 13% (I1: 18%, I2: 14%, C: 8%) NSD.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	

Yip 2007

Methods	RCT. Quality score: 5 (Unknown concealment, unknown/no blinding).
Participants	Knee OA, patients, adults, Hong Kong, n = 182.
Interventions	I: ASMP (Lorig & Fries 2000). Small groups weekly, 2-hour classes for 6 weeks by trained nurses. Action plan with 3 exercises (walking, strengthening & tai-chi movements) & given pedometer to reinforce walking. n = 88. C: Usual Care. n = 94.
Outcomes	Adherence: light exercise (hours/week). Pain: VAS (0-100). ASE (pain). QoL: Modified HAQ.
Notes	Follow up: baseline, 1 week post-treatment & 16 weeks post-treatment. Loss to follow up: 16 weeks 34% (I: 24%, C: 44%) SD.

Ylinen 2003

Methods	RCT. Quality score: 7 (No participant or care provider blinding).
Participants	Neck pain, female office workers, 25 - 53 yrs, Finland, n = 180
Interventions	I1: Endurance dynamic neck training. 5 sessions (groups of 10 per session) per week each lasting 45 minutes. Dynamic neck exercises plus dynamic exercises for the shoulders and upper extremities with dumbbells. Advice to do aerobic and stretching exercises regularly 3 times a week. Also received 4 sessions

	of physical therapy (massage and mobilisation). n = 60. I2: High intensity isometric neck strengthening and stabilisation exercises. High intensity isometric neck strengthening and stabilisation exercises with an elastic band plus dynamic exercises for the shoulders and upper extremities with dumbbells. Advice to do aerobic and stretching exercises regularly 3 times a week. Also received 4 sessions of physical therapy (massage and mobilisation). n = 60. C: Recreational activities and home exercise programme. Spent 3 days at the rehab centre and performed recreational activities in addition to doing the baseline measurements and again measurements at 2 monthly intervals. Advice to do aerobic and stretching exercises regularly 3 times a week plus written information about the same stretching exercises performed by the other groups. n = 60. Treatment duration: 2 weeks + 12 months home exercise.
Outcomes	Adherence: Training frequency per week. Pain: VAS (100mm). Modified neck and shoulder pain and disability index. Function: Vernon Neck Disability Index.
Notes	Follow up: Baseline, 2,6, 12 months. Loss to follow up: 2% (I1: 3%, I2:0%, I3: 2%) NSD.

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	

ADLs: activities of daily living
AIMS: Arthritis Impact Measurement Scales
AIMS2: Arthritis Impact Measurement Scales - 2
ARC: Arthritis Research Campaign
ASE: Arthritis Self-Efficacy
ASMP: Arthritis Self-Management Program
CBT: cognitive behaviour therapy
CLBP: chronic lower back pain
COOP: Cooperative
EQ-5D: Euroqol Questionnaire
HAQ: Health Assessment Questionnaire
ITT: intention to treat
K-WOMAC: Korean version of Western Ontario and McMaster Universities Index
LBP: low back pain
NSAID: non-steroidal anti-inflammatory drugs
NSD: no significant difference
OA: osteoarthritis
PASE: Physical Activity Scale for the Elderly
PDI: Pain Disability Index
PRI-T: Pain Rating Index Total score
QoL: quality of life
QOLS: Quality of Life Survey
RA: rheumatoid arthritis
RCT: randomised controlled trial

RMDQ: Roland and Morris Disability Questionnaire
ROM: Range of motion
SD: significant difference
SF-12: The Short Form 12 Health Survey
SF-36: Medical Outcomes Study 36-item Short Form Scales
SF-MPQ: Short Form-McGill Pain Questionnaire
SMP: self-management program
SQUASH: Short QUestionnaire to ASsess Health enhancing physical activity
TENS: transcutaneous electrical nerve stimulation
VAS: Visual Assessment Scale
WAD: Whiplash Associated Disorder
WOMAC: Western Ontario and McMaster Universities Index

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Berwick 1989	Participants: Author unable to confirm whether 50% or more of the sample had chronic pain
Descarreaux 2002	Participants: Author unable to confirm whether 50% or more of the sample had chronic pain
Dziedzic 2005	No aim to improve adherence and no comparison intervention that aimed to increase adherence
Ferrell 1997	Adherence measure: Attendance. However, compared exercise sessions to education/information sessions, therefore a true comparison of exercise adherence between groups can not be achieved
Foley 2003	No aim to improve adherence.
Goeppinger 2007	Participants: Unable to contact the author to confirm whether 50% or more of the sample had osteoarthritis
Hagberg 2000	No aim to improve adherence.
Helmhout 2004	No aim to improve adherence.
Hibbard 2007	Participants: Unable to contact the author to confirm whether 50% or more of the sample had osteoarthritis
Kamwendo 1991	Participants: Unable to contact the author to confirm whether 50% or more of the sample had chronic pain
Lewis 2005	No aim to improve adherence.
Ljunggren 1997	Participants: Author unable to confirm whether 50% or more of the sample had chronic pain
Long 2004	No aim to improve adherence and no comparison intervention that aimed to increase adherence
Martire 2003	Adherence measure: Attendance at education sessions therefore not measuring exercise adherence
Messier 2000	No aim to improve adherence and no comparison intervention that aimed to increase adherence

(*Continued*)

Messier 2004	No aim to improve adherence and no comparison intervention that aimed to increase adherence
Miller 2004	Participants: Unable to contact the author to confirm whether 50% or more of the sample had chronic pain
Pariser 2005	Adherence measure: % of participants meeting treatment goal. Only 17/85 participants selected 'exercise more' as a treatment goal
Peloquin 1999	Adherence measure: compared attendance at exercise sessions with attendance at education/information sessions, therefore no comparison of exercise adherence between groups
Ravaud 2004	No comparison intervention that aimed to improve adherence.
Reilly 1989	Participants: Unable to contact the author to confirm whether 50% or more of the sample had chronic pain
Simeoni 1995	Participants: Only 46.6% of participants in the control group had osteoarthritis compared to rheumatoid arthritis
Suomi 2003	No aim to improve adherence.
Thomas 2002	No aim to improve adherence.
UKBeam 2004	No aim to improve adherence and no comparison intervention that aimed to increase adherence
van Baar 1998	No aim to improve adherence.

DATA AND ANALYSES

This review has no analyses.

ADDITIONAL TABLES

Table 1. Summary of results - Type of exercise

RCT	Trial Participants	Interventions	Results for adherence measures	Results for clinical outcomes
Carr 2005 (Moderate quality)	LBP (n = 237)	I1: Back to fitness programme I2: Individual physiotherapy	NSD	Pain: NSD Function: NSD QoL:. NSD
Ettinger 1997 (FAST) (High quality)	Knee OA (n = 439)	I1: Aerobic exercise I2: Resistance exercise C: Health education	NSD	Pain: SD (I1 > C, I2 > C)
Ferreira 2007 (Moderate quality)	LBP (n = 240)	I1: General Exercise classes I2: Motor Control Exercise I3: Spinal Manipulation	NSD	Pain: NSD Function: 8 weeks SD (I2 > I1), 6 & 12 months NSD
Fransen 2007 (High quality)	OA (n = 152)	I1: Hydrotherapy I2: Tai-chi C: Waiting list	SD (I1 > I2)	Pain: NSD Function: NSD
Halbert 2001 (Moderate quality)	Hip or Knee OA (n = 69)	I: Individualised physical activity advice C: Leaflet on good nutrition	NSD	Pain: NSD Function: NSD QoL: NSD
Huang 2003 (Moderate quality)	Knee OA (n = 132)	I1: Isokinetic muscle strength exercises I2: Isotonic muscle strength exercises I3: Isometric muscle strength exercises C: Not stated	NSD	Pain: SD (I1 > C, I2 > C, I3 > C)
Huang 2005 (Moderate quality)	Knee OA (n = 120)	I1: Isokinetic muscle strength exercises I2: Isokinetic muscle strength exercises + continuous ultrasound I3: Isokinetic muscle strength exercises + pulsed ultrasound	NSD	Pain: SD (I1 > C, I2 > C, I3 > C)

Table 1. Summary of results - Type of exercise (*Continued*)

		C: No exercise or ultrasound		
Koumantakis 2005 (High quality)	LBP (n = 55)	I1: Back book + stabilisation enhanced exercise I2: Back book + general exercise	NSD any adherence measure	Pain: NSD Function: SD (I2 > I1 post-intervention only)
Mangione 1999 (Moderate quality)	Knee OA (n = 54)	I1: High intensity static cycling exercise I2: Low intensity static cycling exercise	NSD	Pain: NSD
Mikesky 2006 (Moderate quality)	Knee OA (n = 221)	I1: Strength training C: ROM exercises	NSD any adherence measure	Pain: NSD Function: NSD QoL: NSD
Minor 1989 (Moderate quality)	Lower limb OA (n = 120)	I1: Aerobic walking I2: Aerobic aquatics C: ROM exercises	NSD any adherence measure	Pain: NSD Function: SD (12 weeks I1 + I2 > C)
Petrella 2000 (High quality)	Knee OA (n = 179)	I: Oxaprozin + progressive exercise C: Oxaprozin + joint unloading	NSD	Pain: SD (I > C) Function: SD (I > C)
Sherman 2005 (Moderate quality)	LBP (n = 101)	I1: Yoga I2: Physiotherapy Exercise C: Self-care book	NSD any adherence measure	Function: 12 weeks SD (I1 > I2). 6 weeks & 26 weeks NSD
Song 2003 (Moderate quality)	OA (n = 72)	I: Tai-chi for arthritis C: Not described	NSD	Pain: SD (I > C)
Soukup 1999 (Moderate quality)	LBP (n = 77)	I: Mensendieck exercise programme C: Received written and oral information	NSD	Pain: NSD Function: NSD - VAS & Dartmouth Dartmouth COOP Functional Assessment Charts
Viljanen 2003 (Moderate quality)	Neck Pain (n = 393)	I1: Dynamic muscle training I2: Relaxation training C: Continue with usual activity levels	NSD both adherence measures	Pain: NSD Function: NSD
Ylinen 2003 (High quality)	Neck Pain (n = 180)	I1: Endurance dynamic neck training I2: High intensity iso-	SD	Pain: NSD (I1 v C, I2 v C). SD (I1 + I2 > C) Function: NSD (I1 v C,

Table 1. Summary of results - Type of exercise (*Continued*)

		metric neck strengthening and stabilisation exercises C: Recreational activities and home exercise programme		I2 v C). SD (I1 + I2 > C)

* Comparisons are for all time points unless otherwise stated
Abbreviations listed at end of Table 4.

Table 2. Summary of results - Exercise Delivery

RCT	Trial Participants	Interventions	Results for adherence measures	Results for clinical outcomes
Friedrich 1996 (Moderate quality)	LBP & Neck Pain (n = 87 (63 Chronic))	I: Supervised physiotherapy exercise C: Exercise brochure	SD (I > C) for both adherence measures	Pain: SD (I > C)
Harkapaa 1990 (Low quality)	LBP (n = 476)	I1: In-patient rehabilitation + refresher sessions I2: Outpatient rehabilitation + refresher sessions C: Written and oral instructions	SD (I1 > I2, I1 > C) for both adherence measures at 1.5 & 2.5 years	Pain: 3 months SD (I1 > I2, I1 > C), 1.5 yrs SD (I1 > I2), 22 months SD (I1 > C), 2.5 yrs NSD Function: 3 months SD (I1 > C, I2 > C), NSD other time points
Hurley 2007 (Moderate quality)	Knee pain (n = 418)	I1: Usual Primary Care + individual rehabilitation I2: Usual Primary Care + group rehabilitation C: Usual primary care	SD (I1 > I2)	Pain: SD (I1 > C, I2 > C) . NSD (I1 v I2) Function: SD (I1 > C, I2 > C). NSD (I1 v I2) QoL: NSD
McCarthy 2004 (Moderate quality)	Knee OA (n = 214)	I1: Home exercise I2: Home exercise + class exercise	Ordinal logistic model (I2 > I1) - physical activity NSD - number of exercises, time spent exercising in past month & change in activity level	Pain: SD (I2 > I1) all measures Function: SD (I2 > I1) all measures QoL: NSD - EQ-5D
Schoo 2005 (Low quality)	Hip & Knee OA (n = 115)	I1: Brochure I2: Brochure + audiotape I3: Brochure + videotape	SD (I2 > I1, I3 > I1) assessment 1 and 3 - correctness of exercise performance NSD - frequency of exercises	No clinical outcome measures.

Table 2. Summary of results - Exercise Delivery (*Continued*)

Taimela 2000 (Moderate quality)	LBP (n = 76)	I1: Active multimodal treatment I2: Lecture + home exercises C: Lecture + recommendation to exercise	NSD (no data given).	Pain: SD (I1 & I2 > C) Function: NSD

* Comparisons are for all time points unless otherwise stated
Abbreviations listed at end of Table 4.

Table 3. Summary of results - Exercise plus adherence component

RCT	Trial Participants	Interventions	Results for adherence measures	Results for clinical outcomes
Basler 2007 (High quality)	LBP (n = 170)	I: Physiotherapy plus counselling C: Physiotherapy plus placebo ultrasound	NSD	Function: NSD
Friedrich 1998 (Moderate quality)	LBP (n = 93)	I: Combined physiotherapy exercise and motivation programme C: Standard physiotherapy exercise programme	SD (I > C) - attendance & weekly training frequency NSD - length of time continued exercise programme	Pain: SD (I > C) Function: SD (I > C)
Hughes 2004 (Low quality)	Hip or Knee OA (n = 150)	I: Facility based exercise classes + adherence focused home programme C: Advice booklet	SD (I > C,2, 6 & 12 months)	Pain: SD (I > C, 6 months) Function: NSD
Luszczynska 2006 (Moderate quality)	Spondylosis (n = 66)	I: Education session on exercises and discussion with consultant C: Education session and explanatory leaflet	SD (I > C) - frequency of exercise NSD - higher performance of recommended exercises & performance accuracy	No clinical outcomes measured

* Comparisons are for all time points unless otherwise stated
Abbreviations listed at end of Table 4.

Table 4. Summary of results - Self-management interventions

RCT	Trial Participants	Interventions	Results for adherence measures	Results for clinical outcomes
Barlow 2000 (Moderate quality)	Arthritis (n = 544)	I: Group ASMP C: Waiting list	SD (calculated by review authors) - proportions doing flexibility and strengthening exercises	Pain: NSD. Function: NSD. QoL: NSD (sub-sample only)
Blixen 2004 (Moderate quality)	OA (n = 32)	I: Telephone health education strategy C: Usual Rheumatologist care	NSD (no data).	Pain: NSD Function: NSD QoL: NSD
Ersek 2004 (Moderate quality)	OA (n = 45)	I: Group ASMP C: Educational booklet	NSD	Pain: NSD. Function: NSD. QoL: NSD
Fries 1997 (Low quality)	Arthritis (n = 1099)	I: Individualised, mailed ASMP C: Waiting list	SD (I > C)	Pain: SD (I > C) Function: SD (I > C) QoL: SD (I > C)
Lorig 1985 (Low quality)	Arthritis (n = 190)	I: Group ASMP C: No intervention	SD (I > C)	Pain: SD (I > C) - VAS. NSD - ordinal scale Function: NSD
Nour 2006 (Moderate quality)	Arthritis (n = 113)	I: SMP with CBT approach C: Waiting list	SD (I > C) - self-reported weekly occurrence of exercise & stretching exercises NSD - change in occurrence of walking and strengthening exercises	No clinical outcomes reported
Talbot 2003 (Moderate quality)	OA (n = 34)	I1: ASMP + walking C: ASMP	SD (I1 > C) - step count NSD - accelerometer	Pain: NSD both pain measures
Yip 2007 (Moderate quality)	Knee OA (n = 182)	I: ASMP C: Usual care	SD (I > C)	Pain: SD (I > C) QoL: NSD

* Comparisons are for all time points unless otherwise stated
Abbreviations listed at end of Table 4.

Table 5. Summary of results - cognitive or behavioural interventions

RCT	Trial Participants	Interventions	Results for adherence measures	Results for clinical outcomes
Asenlof 2005 (Moderate quality)	CMP (n = 122)	I: Individually tailored behavioural medicine treatment C: Physiotherapy exercise	NSD	Pain: SD (I > C) Function: SD (I > C)
Bernaards 2007 (Moderate quality)	RSI (n = 466)	I1: Work style (WS) group I2: Work Style & Physical Activity group C: Usual care	NSD	Pain: NSD - 6 months, SD (I1 > C, 12 months) Function: NSD
Cohen 1983 (Low quality)	LBP (n = 36)	I: Behavioural therapy C: Physiotherapy	NSD	Pain: SD (I > C) Function: NSD
Jensen 2001 (Moderate quality)	Spinal Pain (n = 214)	I1: Behaviour orientated physiotherapy I2: CBT I3: Combined treatment C: Waiting list	NSD - attendance & adherence to lifestyle treatment plans (SD for males only)	QoL: SD (I2, I3 > C, 18 months)
Smeets 2006 (Moderate quality)	LBP (n = 227)	I1: Active physical treatment I2: CBT I3: Combined treatment C: Waiting list	NSD	Pain: SD (I1 > C, I2 > C, I3 > C) - VAS. NSD-PRI-T Function: SD (I1 > C, I2 > C, I3 > C)
Soderlund 2001 (Moderate quality)	WAD (n = 33)	I1: Regular primary care physiotherapy I2: Physiotherapy including CBT	SD (I2 > I1)	Pain: NSD
Veenhof 2006 (High quality)	Hip or Knee OA (n = 200)	I: Behavioural graded activity C: Physiotherapy usual care	SD (I > C) - adherence to home exercises NSD - SQUASH	Pain: NSD Function: NSD

* Comparisons are for all time points unless otherwise stated

Explanatory notes:

NSD - No significant difference between groups

SD - Significant difference between groups

I1 > I2 - result in intervention group I1 better than intervention group I2

I > C - result in intervention group I better than in control group C

I1+I2 > C - combined results from intervention groups I1 and I2 better than control group C

I1vC - intervention group I1 compared with control group C

List of abbreviations used in the tables

ASMP = Arthritis Self Management Programme, AIMS = Arthritis Impact Measurement Scales, ASE = Arthritis Self-Efficacy Scale, C = control group, CBT = Cognitive Behavioural Therapy, EQ-5D = EuroQol health-related quality of life measure, FAST = Fitness Arthritis and Seniors Trial, GP = General Practitioner, HAQ = Health Assessment Questionnaire, Hr = hours, I = Intervention group, K-WOMAC = Korean version of Western Ontario and McMaster Universities Index, LBP = low back pain, Max = maximum, Mins = minutes, OA = osteoarthritis, PDI = Pain Disability Index, QoL = quality of life, QOLS = Quality of Life Survey, RA = rheumatoid arthritis, RMDQ = Roland and Morris Disability Questionnaire, SF-12 = The Short Form 12 Health Survey, SF-36 = Medical Outcomes Study 36-item Short Form Scales, SF-MPQ= Short-Form McGill Pain Questionnaire, TENS = Transcutaneous Electrical Nerve Stimulation, VAS = Visual Analogue Scale, WOMAC = Western Ontario and McMaster Universities Index.

Table 6. Quality assessment for included studies using the Delphi List

Study ID	Allocation randomised	Allcoation concealed	Inclusion criteria specified	Baseline similar	Blinded outcome assessment	Blinded care provider	Blinded participants	Point estimate & variability	Intention-to-treat
Asenlof 2005	Yes	Don't know	Yes	Yes	No	No	No	Yes	Yes
Barlow 2000	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes
Basler 2007	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Bernaards 2007	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes
Blixen 2004	Yes	Don't know	Yes	Yes	Yes	No	No	Yes	No
Carr 2005	Yes	Yes	Yes	Yes	No	No	No	Yes	Don't know
Cohen 1983	Don't know	Don't know	Yes	Yes	No	No	No	No	Don't know
Ersek 2004	Yes	Don't know	Yes	Yes	Yes	No	No	Yes	Yes
Ettinger 1997	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Ferreira 2007	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes

Table 6. Quality assessment for included studies using the Delphi List (*Continued*)

Fransen 2007	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Friedrich 1996	Yes	Don't know	Yes	Yes	Yes	No	No	Yes	Yes
Friedrich 1998	Yes	Don't know	Yes	Yes	Yes	No	No	Yes	Don't know
Fries 1997	Yes	Don't know	No	Yes	No	No	No	Yes	Don't know
Halbert 2001	Yes	Don't know	Yes	Yes	No	No	No	Yes	Yes
Harkapaa 1990	Yes	Don't know	Yes	Yes	No	No	No	No	No
Huang 2003	Yes	Yes	Yes	Don't know	Don't know	Don't know	Don't know	Yes	No
Huang 2005	Yes	Yes	Yes	Yes	Don't know	No	Don't know	Yes	No
Hughes 2004	Yes	Don't know	Yes	No	No	No	No	Yes	No
Hurley 2007	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Jensen 2001	Yes	Yes	Yes	Don't know	No	No	No	Yes	Yes
Koumantakis 2005	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Lorig 1985	Yes	Don't know	No	No	No	No	No	Yes	Don't know
Luszczynska 2006	Yes	Don't know	Yes	Yes	No	No	No	Yes	Don't know
Mangione 1999	Yes	Don't know	Yes	Yes	Don't know	No	Don't know	Yes	Yes
McCarthy 2004	Yes	Don't know	Yes	Yes	Yes	No	No	Yes	Yes

Table 6. Quality assessment for included studies using the Delphi List (*Continued*)

Mikesky 2006	Yes	Don't know	Yes	Yes	Yes	No	No	Yes	Yes
Minor 1989	Yes	Don't know	Yes	Yes	Don't know	No	No	Yes	No
Nour 2006	Yes	Don't know	Yes	Yes	Yes	No	No	Yes	Yes
Petrella 2000	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Schoo 2005	Yes	Don't know	Yes	Yes	No	No	No	No	No
Sherman 2005	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes
Smeets 2006	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes
Soderlund 2001	Yes	Don't know	Yes	Yes	Yes	No	No	Yes	No
Song 2003	Yes	Don't know	Yes	Yes	Don't know	No	No	Yes	No
Soukup 1999	Yes	Don't know	Yes	Yes	No	No	No	Yes	Yes
Taimela 2000	Yes	Don't know	Yes	Yes	Yes	No	No	Yes	Yes
Talbot 2003	Yes	Don't know	Yes	Yes	No	No	No	Yes	No
Veenhof 2006	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Viljanen 2003	Yes	Yes	Yes	No	No	No	No	Yes	Yes
Yip 2007	Yes	Don't know	Yes	Yes	Don't know	No	No	Yes	Yes
Ylinen 2003	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes

APPENDICES

Appendix 1. Full Search Strategy for Medline on Dialog Datastar interface

We used the following search strategy to identify trials in MEDLINE using the Dialog/Datastar interface and adapted it for searches in the other electronic databases.

[MP indicates searches for words in the title, abstract and MeSH descriptors; DE searches for words in the MeSH descriptors only]

ADHERENCE

1. CONCORDANCE.MP.
2. (ADHERE$ OR ADHERING).MP.
3. (COMPLIAN$ OR COMPLYING).MP.
4. ((CHANGE OR CHANGES OR CHANGING) NEAR (BEHAVIOUR OR BEHAVIOR)).TI,AB.
5. ((MODIFY OR MODIFIES OR MODIFYING OR MODIFICATION) NEAR (BEHAVIOUR OR BEHAVIOR)).TI,AB.
6. MOTIVAT$.MP.
7. (INCENTIVE$ OR DISINCENTIVE$).MP.
8. BARRIER$.MP.
9. BELIEF$.MP.
10. (PERCEIVE$ OR PERCEPTION$).MP.
11. (SELF ADJ EFFICACY).MP.
12. ATTITUDE$.MP.
13. EMPOWER$.MP.
14. (TREAT$ NEAR REFUS$).MP.
15. ((THERAPY OR THERAPEUTIC) NEAR REFUS$).MP.
16. NONCOMPLIAN$.MP.
17. NONADHEREN$.MP.
18. MOTIVATION#.W..DE.
19. MOTOR-ACTIVITY.DE.
20. PATIENT-ACCEPTANCE-OF-HEALTH-CARE.DE.
21. PATIENT-PARTICIPATION.DE.
22. PATIENT-DROPOUTS.DE.
23. (PATIENT ADJ EDUCATION).MP.
24. ADAPTATION-PSYCHOLOGICAL#.DE.
25. PSYCHOLOGY-SOCIAL#.DE.
26. BEHAVIOR.W..DE.
27. ACHIEVEMENT.W..DE. OR DRIVE#.W..DE. OR GOALS.W..DE. OR INTENTION.W..DE.
28. ANXIETY#.W..DE. OR BOREDOM.W..DE. OR FEAR#.W..DE. OR FRUSTRATION.W..DE.
29. COMMUNICATION#.W..DE. OR HABITS.W..DE. OR HEALTH-BEHAVIOR.DE. OR PERSONAL-SATISFACTION.DE.
30. ATTEND$.MP.
31. ((PATIENT OR PATIENTS) NEAR AGREEMENT).MP.
32. (LIFESTYLE NEAR (CHANGE OR CHANGES OR CHANGING)).MP.
33. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 ADJ OR10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31 OR 32
34. EXERCISE.W..DE.
35. EXERCISE-THERAPY.DE.
36. EXERCISE-MOVEMENT-TECHNIQUES.DE.
37. TAI-JI.DE.
38. WALKING.W..DE.
39. YOGA.W..DE.
40. EXERTION.W..DE.
41. MOVEMENT.W..DE.
42. LEISURE-ACTIVITIES.DE.
43. PHYSICAL-FITNESS.DE.

44. SPORTS#.W..DE.
45. PHYSICAL-EDUCATION-AND-TRAINING#.DE.
46. (SELF ADJ (HELP OR CARE OR MANAGEMENT OR EFFICACY)).MP.
47. (FUNCTIONAL NEAR (THERAPY OR RESTORE OR RESTORING OR RESTORATION)).MP.
48. (PHYSICAL$ NEAR (ACTIVE OR ACTIVITY OR ACTIVITIES)).MP.
49. (REHAB OR REHABILITATION).MP.
50. HYDROTHERAP$.MP.
51. (STAIR$ OR STEP OR STEPS).MP.
52. (PROGRAM OR PROGRAMS OR PROGRAMME OR PROGRAMMES).MP.
53. ((MUSCLE OR MUSCLES) NEAR STRENGTHEN$).MP.
54. (SWIM$ OR JOG$ OR RUN OR RUNNING OR WALK OR WALKING).MP.
55. ((CIRCUIT$ OR RESISTANCE OR STRENGTH$ OR PHYSICAL OR WEIGHT) NEAR (TRAIN OR TRAINING)).MP.
56. EXERCISE$.MP.
57. (SPORT OR SPORTS).MP.
58. AEROBIC$.MP.
59. 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41OR 42 OR 43 OR 44 OR 45 OR 46 OR 47 OR 48 OR 49 OR 50 OR 51 OR 52 OR 53 OR 54 OR 55 OR 56 OR 57 OR 58
60. ARTHRALGIA#.W..DE. OR BACK-PAIN.DE. OR NECK-PAIN.DE. OR NEURALGIA#.W..DE. OR SHOULDER-PAIN.DE.
61. MUSCULOSKELETAL-DISEASES#.DE.
62. MUSCULOSKELETAL-SYSTEM#.DE.
63. PAIN#.W..DE.
64. 62 AND 63
65. ((MUSCULO$ OR MUSCULAR) NEAR PAIN).MP.
66. ((BACK OR LUMBAR OR LUMBO$ OR SPINE OR SPINAL) NEAR PAIN).MP.
67. ((NECK OR CERVICAL) NEAR PAIN).MP.
68. ((KNEE$ OR HIP OR HIPS OR SHOULDER$) NEAR PAIN).MP.
69. OSTEOARTHRIT$.MP.
70. SPONDYLITIS.MP.
71. SPONDYLOSIS.MP.
72. (OSTEITIS OR OSTEOCHONDRITIS).MP.
73. (ARTHROPATHY OR NEUROGENIC OR BURSITIS OR SHOULDER NEXT IMPINGEMENT).MP.
74. MYALGIA.MP.
75. LORDOSIS.MP.
76. LUMBAGO.MP.
77. SCIATICA.MP.
78. CERVICOGENIC.MP.
79. ADVERSE NEXT NEURAL NEXT TENSION.MP.
80. ((FLANK OR BUTTOCK) NEXT PAIN).MP.
81. DYSKINESIS.MP.
82. TENDINITIS.MP.
83. (JOINT ADJ PAIN).MP.
84. (RADICULAR ADJ PAIN).MP.
85. ALLODYNIA.MP.
86. HYPERALGESIA.MP.
87. SACROILIAC.MP.
88. SUBLUXATION.MP.
89. DISC.MP.
90. MISALIGNMENT.MP.
91. (OSTEOPATHIC ADJ LESION).MP.
92. (FROZEN ADJ SHOULDER).MP.
93. (DEGENERATIVE ADJ JOINT ADJ DISEASE).MP.

94. 60 OR 61 OR 64 OR 65 OR 66 OR 67 OR 68 OR 69 OR 70 OR 71 OR 72 OR 73 OR 74 OR 75 OR 76 OR 77 OR 78 OR 79 OR 80 OR 81 OR 82 OR 83 OR 84 OR 85 OR 86 OR 87 OR 88 OR 89 OR 90 OR 91 OR 92 OR 93
95. 33 AND 59 AND 94
This was then combined with the Cochrane highly sensitive search strategy to find controlled clinical trials.

WHAT'S NEW

Last assessed as up-to-date: 8 October 2007.

Date	Event	Description
11 November 2009	Amended	Review first published Issue 1, 2010. CMSG ID: C135-R

HISTORY

Protocol first published: Issue 2, 2006

Review first published: Issue 1, 2010

Date	Event	Description
4 April 2008	Amended	CMSG ID: C038-P
4 April 2008	Amended	Converted to new review format.
14 February 2006	New citation required and major changes	Substantive amendment

CONTRIBUTIONS OF AUTHORS

All the reviewers helped to develop the protocol, assessed the quality of and extracted data from the included studies and contributed to all stages of writing the final review. Joanne Jordan and Melanie Holden carried out literature searches and drew up lists of studies to be reviewed.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- Keele University, UK.

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Statistical pooling was not possible due to differences in the populations, interventions and outcomes in the included trials. We have removed details of the statistical analysis. It was also not possible to complete Clinical Relevance tables and Summary of Findings tables.

INDEX TERMS

Medical Subject Headings (MeSH)

*Exercise Therapy; *Patient Compliance; Back Pain [rehabilitation]; Chronic Disease; Musculoskeletal Diseases [*rehabilitation]; Osteoarthritis [rehabilitation]; Pain [*rehabilitation]; Randomized Controlled Trials as Topic

MeSH check words

Adult; Humans