Physiotherapy interventions for ankylosing spondylitis

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A substantive amendment to this systematic review was last made on 12 August 2004. Cochrane reviews are regularly checked and updated if necessary.

Abstract

Background: Ankylosing spondylitis (AS) is a chronic, inflammatory rheumatic disease. Due to the consequences of the disease, physiotherapy is considered to be an important part of the overall management of AS.

Objective: The objective of this review was to summarise the available scientific evidence on the effectiveness of physiotherapy interventions in the management of AS.

Search strategy: We searched the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE, AMED, CINAHL and PEDro up to February 2004 for all relevant publications, without any language restrictions. The reference lists of relevant articles were checked and the authors of included articles were contacted.

Selection criteria: We included randomised and quasi-randomised studies with patients classified by the AS New York criteria and where at least one of the comparison groups received some kind of physiotherapy. The main outcomes of interest were pain, stiffness, spinal mobility, physical function and patient global assessment.

Data collection and analysis: Two reviewers independently selected trials for inclusion, extracted data and assessed trial quality. Investigators were contacted to obtain missing information.

Main results: Six trials with a total of 561 participants were included in this updated review as compared to three trials and 241 patients in the previous version. Two trials compared individualised home exercise programs with no intervention and reported low quality evidence for effects in spinal mobility (relative percentage differences (RPD) 37%) and physical function, in favour of the home exercise program. Three trials compared supervised group physiotherapy with an individualised home-exercise program and reported moderate quality evidence for small differences in spinal mobility (RPD 18%) and patient global assessment in favour of supervised group exercises. Finally, in one study a three week inpatient spa-exercise therapy followed by 37 weeks of weekly outpatient group physiotherapy (without spa) was compared with weekly outpatient group physiotherapy alone; there was moderate quality evidence for effects in pain (RPD 18%), physical function (RPD 24%) and patient global assessment (RPD 29%), in favour of the combined spa-exercise therapy.

Reviewers' conclusions: The results of this review suggest that a home exercise program is better than no intervention, supervised group physiotherapy is better than home exercises, and that combined inpatient spa-exercise therapy followed by supervised outpatient weekly group
physiotherapy is better than weekly group physiotherapy alone. The tendency toward positive effects of physiotherapy in the management of AS calls for further research in this field. New trials should also address other physiotherapy interventions commonly used in clinical practice.

Background

Ankylosing spondylitis (AS) is a chronic, progressive, inflammatory disorder predominantly affecting young men and women (Khan 1994). The aetiology of AS is unknown. The disorder mainly affects the axial skeleton with an aseptic inflammation of synovial tissue, the spinal ligaments, intervertebral discs and facet joints. It is characterised clinically by pain and stiffness of the back and the sacroiliac joints. Radiographic findings used as diagnostic criteria are arthritic changes in the sacroiliac joints and in the spine. The most frequently reported prevalence of AS is 0.1 to 0.2%, but is reported in the literature up to 1.4%; the male to female ratio is about 2:1 to 3:1 (Dougados 1995; Gran 1993; Robbins 2001; Van der Linden 1990; Will 1990). AS leads to variable degrees of pain, reduced spine mobility and limitations in physical functioning. Physiotherapy is, therefore, considered to be an important part of the clinical management. The main goals of physiotherapy in AS are to maintain or improve spinal mobility and fitness and to reduce pain. In addition, physiotherapists play a central role in educating and motivating the patients living with a lifelong disease.

Objectives

• The purpose of this review was to assess the effectiveness of various physiotherapy interventions in the management of patients with AS.
• The following main comparisons were made:
  1: physiotherapy versus other interventions (including no intervention);
  2: comparison of different modalities or applications of physiotherapy.

Criteria for considering studies for this review

Types of studies

Randomised or quasi-randomised controlled studies examining the effectiveness of physiotherapy in AS were evaluated.

Types of participants

Males and females with the diagnosis of AS according to the classification system described in the modified New York criteria (Van der Linden 1984). Trials were excluded if the diagnostic criteria were unsure or not met.

Types of intervention

Studies were included if the intervention included any physiotherapy modality considered relevant in the management of AS. If co-interventions were included, they had to be similar in the comparator groups. The relevant physiotherapy modalities in the management of AS include: supervised and unsupervised exercises, training, manual therapy, massage, hydrotherapy, electrotherapy, acupuncture, patient information and educational programs.
Types of outcome measures

The study group for Assessment in AS (ASAS) has suggested a core set of outcome measures in physiotherapy (Van der Heijde 1999). Studies which have any of these outcome measures were included in the review.

- Pain
- Stiffness
- Spinal mobility
- Physical function
- Patient global assessment
- Other relevant outcome measures

Search strategy for identification of studies

See: Cochrane Musculoskeletal Group search strategy

Relevant studies were identified by searching the Cochrane Central Register of Controlled Trials (CENTRAL), AMED, MEDLINE, EMBASE, CINAHL and PEDro (up to February 2004), without any language restrictions.

- The search strategy below was used:
  1 spondylitis, ankylosing (MESH)
  2 spondylarthropathies
  3 Mb. Bekhterev (Bechterew)
  4 OR/ 1-3
  5 physiotherapy
  6 physical therapy
  7 exercises
  8 training
  9 hydrotherapy
  10 manual therapy
  11 electrotherapy
  12 education
  13 treatment
  14 OR/ 5-13
  15 randomised controlled trials
  16 controlled clinical trials
  17 OR/ 15-16

18/ 4 AND 14 AND 17

The reference lists of retrieved studies were scanned to identify additional relevant trials, and authors of relevant studies were contacted. The search strategies recommended in the Cochrane Reviewers' Handbook 4.2.1 (Alderson 2004) were used.

Methods of the review
Trials included in the review were independently selected by the two reviewers (HD and KBH) using a standard pre-developed form that was pilot-tested.

- **Methodological quality**
  - The methodological quality of the included studies was assessed independently by the same two reviewers (HD and KBH). Disagreement was easily resolved by discussion. Internal validity was assessed using criteria according to the Cochrane Collaboration Reviewers' Handbook (Alderson 2004). The internal validity was assessed using the following four criteria:
    1. concealment of allocation;
    2. co-intervention;
    3. intention-to-treat analysis and losses to follow up;
    4. outcome assessment.
  - These four criteria were rated as "MET", "UNCLEAR" or "NOT MET". Blinding of providers and patients is considered to be inapplicable in most physiotherapy interventions and was, therefore, not used as a criterion in this review.

- **Operationalisation of the four methodological quality criteria**
  1. **Concealment of allocation**
     - Met: use of a centralised (e.g. group assignment by a central office unaware of participant characteristics); on-site computer system combined with group assignments in a locked unreadable computer file that could be accessed only after entering of an enrolled participant; sequentially numbered, sealed, opaque envelopes; i.e. the randomisation was independent of provider and investigator.
     - Unclear: concealment approach not reported and could not be verified by contacting the investigators.
     - Not met: included alternation, case record numbers, dates of birth, day of week, and any allocation procedure that was entirely transparent before assignment such as open list of random numbers of assignments.
  2. **Co-intervention**
     - Met: interventions other than those compared were avoided or used similarly across comparison groups.
     - Unclear: co-interventions not reported and could not be verified by contacting investigators.
     - Not met: dissimilar use of interventions other than physiotherapy.
  3. **Intention-to-treat analysis and losses to follow up**
     - Met: intention-to-treat analysis performed AND losses to follow up less than 20% and equally distributed between comparison groups.
     - Unclear: intention-to-treat analysis or losses to follow-up not reported and could not be verified by contacting the authors.
     - Not met: exclusion not reported and could not be verified by contacting the investigators AND losses to follow up greater than 20%.
  4. **Outcome assessment**
     - Met: assessors unaware of the assigned treatment when collecting outcome measures.
     - Unclear: blinding of assessor not reported, and could not be verified by contacting the investigators.
     - Not met: assessor aware of the assigned treatment when collecting outcome measures.
     - An overall assessment of internal validity was based on a summary of these four criteria: low risk of bias meant that all criteria were met; moderate risk of bias meant that three criteria were met; and high risk of bias meant that less than three criteria were met.
• Data extraction and analyses
Data were independently extracted by two reviewers (KBH and HD) using a pilot-tested data extraction form. Disagreement was resolved by discussion. If the article did not provide sufficient information for methodological assessment or necessary data for statistical analyses letters were sent to investigators to collect missing data. Six letters were sent and four of the authors replied to our request. Two provided additional information regarding methodological quality and two provided additional data for statistical analyses.

• Analyses
For the first main comparison of physiotherapy interventions versus other interventions or no intervention the pre-planned stratified analyses were trials comparing home program of therapeutic exercises and disease education programs with no intervention.
For the second main comparison of different modalities or applications of physiotherapy the pre-planned stratified analyses were:
a) trials comparing home exercise regimes with supervised, inpatient or outpatient group physiotherapy (including hydrotherapy);
b) trials comparing inpatient spa-exercise therapy with supervised, weekly group physiotherapy.
The various outcome measures are presented separately (see Graphs 01.01 to 03.16). Since all outcomes were continuous variables results are expressed, if possible, as weighted mean differences (WMD) with corresponding 95 percent confidence intervals (CI) (Deeks J 2004).

Due to insufficient data reporting, overall effects could be calculated only for two outcomes in one comparison. Both outcomes were measured with identical instruments across studies and WMDs were calculated. Both random effect models and fixed effect models were employed. For the other comparisons and outcomes only data from single studies provided data for statistical analyses. For studies not providing sufficient data, qualitative analyses were undertaken. In one trial (Van Tubergen 2001) two interventions were considered clinically similar and were, therefore, combined for analytical purposes.

• Clinical relevance
In order to improve the clinical relevance of the review, absolute benefit and relative percentage differences (RPD) were calculated, if possible, for statistically significant differences. Absolute benefit was calculated as the improvement in the treatment group less the improvement in the control group using the original units. RPD was calculated as the absolute benefit divided by the baseline mean in the control group (CMSG, Draft 2003). According to the Philadelphia Panel an improvement at 15% relative to a control group was considered clinically relevant (presented in Additional tables).

• Quality of evidence
Finally, the quality of evidence was assessed according to a recently developed systematic and explicit method (Grade Working Group). In order to indicate the extent to which one can be confident that an estimate of effect is correct, judgments about the quality of evidence were made for each comparison and outcome. These judgments considered study design (RCT, quasi RCT or observational study), study quality (detailed study design and execution), consistency of results (similarity of estimates of effect across studies) and directness (the extent to which people, interventions and outcome measures are similar to those of interest). The following definitions in grading the quality of evidence for each outcome were used.
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 may change the estimate.

Very low: any estimate of effect is very uncertain.

In addition, there are some considerations that can lower or raise the quality of evidence which were not employed in this review (Grade Working Group).

Description of studies

Included studies
We considered 43 studies for inclusion in this review. Thirty-three of them were excluded either due to study design, the participants, the intervention or the outcome measures (see Characteristics of excluded studies). Two conference abstracts (Ahmad 2000; Pickering 2000) were considered as potentially eligible but full reports were not available (see Studies waiting for assessment). Eight published studies were RCTs and investigated the effect of physiotherapy in the management of patients with AS (Analay 2003; Helliwell 1996; Hidding 1993; Hidding 1994; Kraag 1990; Kraag 1994; Sweeney 2002; Van Tubergen 2001). However, two of these were cross-over or follow up studies that did not provide independent results and were consequently excluded from the review (Hidding 1994, Kraag 1994). Six studies were included in the review. These were undertaken in Canada (Kraag 1990), the Netherlands (Hidding A 1993), United Kingdom (Helliwell 1996 and Sweeney 2002), Austria, Germany and Netherlands (Van Tubergen 2001), and Turkey (Analay 2003).

Study selection
Six studies met the inclusion criteria. Two studies compared physiotherapy interventions with no intervention (Kraag 1990; Sweeney 2002), and four studies compared different modalities or applications of physiotherapy (Analay 2003; Helliwell 1996; Hidding 1993; Van Tubergen 2001).

Participants
Kraag 1990 included 53 patients, 79% were men. The patients were stratified according to age: 18 to 35 years, and 36 years and over. The exclusion criteria were patients with reduced hip flexion and patients receiving contravening treatment.

Hidding 1993 included 144 patients, aged between 17 and 69 years, 76% men. Patients were excluded if they were unable to engage in physiotherapy for any reason.

Helliwell 1996 conducted a study of 44 patients, 89% were men. Mean (SD) age in the inpatient, outpatient and home exercise groups were 38.9 (11.1), 42.8 (12.6) and 41.9 (11.9) years respectively. The participants were stratified into two levels of disease severity. Patients were excluded if they had severe peripheral joint involvement which made them unable to exercise.

Van Tubergen 2001 included a total of 120 patients in their trial. Mean (SD) age in the two spa-exercise groups were 48 (10) and 49 (9) years; and in the control group, 48 (10) years. In the two spa-exercise groups, the proportion of men was 67 and 70% respectively, while the control group included 85% men. The exclusion criteria were unwillingness to participate in weekly group physical therapy, pregnancy, claustrophobia, severe co-morbidity and patients having AS for more than 20 years.

In the study of Sweeney 2002, 155 patients between 16 and 65 years participated, 68% men in the intervention group and 66% men in the control group. Exclusion criteria were not described.
Analay 2003 conducted a study of 45 patients aged between 18 and 55 years. Mean (SD) age was 37.6 (11.3) years in the intervention group and 34.3 (7.9) years in the control group. The proportion of men was 87% in the intervention group and 82% in the control group. The participants fulfilled the AMOR criteria for spondylarthropathies, which were considered equal to the New York criteria (Amor 1991). Patients were excluded if they had systemic organ involvement, hip or knee deformities, had been treated by a physiotherapist within the last three months, were practising regular exercises, or were receiving DMARDs.

- **Interventions**
- Exercises were the main experimental treatment in all trials although other physiotherapy modalities were reported as 'occasionally used' (Helliwell 1996; Kraag 1990).
- Kraag 1990 compared a four month home exercise and educational program (supervised, one-to-one design) with no intervention. The educational program was not described but the treatment objectives were disease education, pain control and improved posture and function.

The group exercise program in the study of Hidding 1993 consisted of one hour physical training, one hour sporting activity and one hour hydrotherapy. The intervention period was nine months, and the intervention was compared to an individualised home exercise program.

The participants in the study of Helliwell 1996 were randomised into three groups: firstly an inpatient group receiving a three week program, including one hour group exercise five days a week and, in addition, hydrotherapy three times per week; secondly, an outpatient hydrotherapy and home exercise group; and finally, a group doing individualised home exercises. The analyses in this review did not include the outpatient hydrotherapy group. Thus, the three weeks inpatient intervention program was compared to the individualised home exercise intervention.

Van Tubergen 2001 investigated the efficacy of combined spa-exercise therapy in addition to standard treatment with drugs and weekly group physiotherapy. The spa-exercise interventions were provided in two groups, one group treated in a spa resort in Austria and one in The Netherlands. These two groups were considered clinically similar and were combined for analytical purposes in this review. The three week spa-exercise therapy consisted of group physical exercises, walking, correction therapy (lying supine), hydrotherapy, sports and sauna. A control group stayed home and followed weekly group physiotherapy sessions. After the intervention period, all patients from the three groups engaged in weekly group physiotherapy sessions for another 37 weeks follow-up period.

- Sweeney 2002 compared the effect of a six month home based exercise intervention package with a non-intervention control group. The intervention consisted of an exercise/information video, exercise progress chart, patient education booklet and exercise reminder stickers.
- In the study of Analay 2003, a group of patients was included in a six week intensive, supervised physiotherapy program. The exercise program included stretching, mobilization and strengthening exercises, aerobic exercises and postural and respiratory exercises; this intervention was compared to an individualised home exercise program.
- All interventions in all studies were delivered by physiotherapists.

- **Outcomes**
- Pain was reported in all studies. In five studies, pain was measured with a VAS-scale (0 to 10 cm) and in one study (Sweeney 2002), with the Stanford Self-Efficacy Scale (1 to 10 cm). Helliwell 1996 combined the scores of pain and stiffness to produce one assessment (2 VAS scales added giving a maximum score of 200); Hidding 1993 measured stiffness on a
A separate VAS scale (0 to 10 cm). Analay 2003; Kraag 1990; Van Tubergen 2001 reported the duration of morning stiffness in minutes, and Sweeney 2002 did not measure stiffness.

Spinal mobility was measured in four studies. Kraag 1990; Analay 2003 measured the patient's distance from fingertip-to-floor (FFD) in maximal flexed position (in cm). Hidding 1993 assessed the thoracolumbar flexion and extension using the 10 cm segment method (Miller), while Helliwell 1996; Kraag 1990; Analay 2003 used the Modified Schober's test (cm). The chest expansion was measured in cm by Analay 2003; Helliwell 1996, and cervical rotation was reported in degrees by Helliwell 1996; Hidding 1993.

Physical functioning and health status were assessed by the Health Assessment Questionnaire for the Spondylarthropathies (HAQ-S: 0 to 3, 3 worst score) and the Functional Index (FI: 0 to 2, 2 worst score) in the study of Hidding 1993. Sweeney 2002; Van Tubergen 2001 measured self-reported physical functioning by the Bath Ankylosing Spondylitis Functioning Index (BASFI: VAS scales 0 to 10 cm, 10 worst score). Helliwell 1996; Kraag 1990 did not include physical function as an outcome measure.

Patient global assessment was reported by Hidding 1993; Sweeney 2002; Van Tubergen 2001 and assessed by a VAS scale (0 to 10 cm).

Points of assessment varied in the studies. In Helliwell 1996 assessment points were two times prior to intervention, immediately after completing treatment, and two, four and six months after cessation of treatment. Hidding 1993 evaluated the participants at baseline and subsequently every third months up to nine months. Kraag 1990 evaluated the patients at baseline and after the four month intervention period; Sweeney 2002 at baseline and after the six months intervention period; and Analay 2003 at baseline, after the six weeks intervention period and at three months. In the study of Van Tubergen 2001 the points of assessment were baseline (two weeks before spa-exercise therapy) and at one, four, seven and ten months after the start of the spa-exercise therapy.

**Methodological quality**

Three of the included studies met the concealment of allocation criterion (Analay 2003; Hidding 1993; Van Tubergen 2001). Helliwell 1996 allocated the participants by throwing a dice and thereby the criterion was not met. Kraag 1990; Sweeney 2002 did not report the randomisation procedures and were, therefore, rated as unclear.

Co-interventions in the trials were adequately reported by Hidding 1993; Kraag 1990; Van Tubergen 2001. These studies met the criterion for avoiding performance bias. Analay 2003; Helliwell 1996; Sweeney 2002 did not report if co-interventions were avoided or comparable in the groups.

Exclusions or losses to follow up were less than 20% in the studies of Analay 2003; Hidding 1993; Kraag 1990; Van Tubergen 2001. In the study of Helliwell 1996 the losses to follow up were approximately 40% for two of the intervention groups, and Sweeney 2002 studied only the completers.

In four of the studies, the assessor was unaware of the assigned treatment when collecting outcome measures (Analay 2003; Hidding 1993; Kraag 1990; Van Tubergen 2001). The study of Helliwell 1996 did not meet the criterion for avoiding detection bias whereas the study of Sweeney 2002 was rated as unclear on this criterion.
The overall assessment of the methodological quality of the trials in this review was as follows. Two studies (Hidding 1993; Van Tubergen 2001) met all four criteria of internal validity and were rated to have low risk of bias. Two studies (Analay 2003; Kraag 1990) met three criteria and were assessed to have moderate risk of bias, and two studies did not meet any of the criteria and were assessed to have high risk of bias (Helliwell 1996; Sweeney 2002) (see the table Characteristics of included studies).

- **Baseline comparability**
  - Even if Helliwell 1996 stratified the participants into two disease severity groups before randomisation the treatment groups varied in proportion of patients in each severity group, resulting in different baseline values. In the study of Hidding 1993 there were no relevant differences between the study groups at baseline. In the study of Kraag 1990 the initial measurements of the groups were comparable except for one variable, the control group reported significantly more rib cage pain and stiffness than the experimental group. In the study of Sweeney 2002 the groups were comparable at baseline. Analay 2003 found the groups comparable at baseline in all parameters except for modified Schober. In Van Tubergen 2001 relatively more men than women were allocated to the control group than to the intervention groups; remaining characteristics were balanced among the groups.

### Results

- **Study selection**
  - Six studies met the inclusion criteria. Two studies compared physiotherapy interventions with no intervention and were classified in main comparison one (Kraag 1990; Sweeney 2002). Four studies compared different modalities or applications of physiotherapy and were classified in main comparison two (Analay 2003; Helliwell 1996; Hidding 1993; Van Tubergen 2001).

- **Main comparison 1 - physiotherapy versus other treatment (including no treatment)**
- **Two trials comparing home exercise and educational programs with no intervention were included (Kraag 1990; Sweeney 2002). One of the studies was assessed to have moderate risk of bias (Kraag 1990) and one to have high risk of bias (Sweeney 2002).**

- **Pain**
  - In the study of Kraag 1990 no significant differences between the groups were found in pain reduction from baseline to four months. In the study of Sweeney 2002 no group differences in change were reported at six months. A small, but significant weighted mean difference (WMD) was found (WMD 0.56; 95% CI 0.2 to 0.9). The absolute benefit was 0.13 and, considering the baseline mean for the control group at 6.2, the relative percentage difference (RPD) was 2%. Based on these results we conclude that there was low quality of evidence for no group differences in pain reduction.

- **Stiffness**
  - This was not measured in the studies. However, stiffness is included in the BASDAI score and no group differences were found on the BASDAI in the study of Sweeney 2002.

- **Spinal mobility**
  - In the study of Kraag 1990 spinal mobility was measured as fingertip-to-floor distance. After the four month intervention period, the authors reported that the intervention group had improved significantly compared to the control group (p < 0.001). Based on the reported baseline values and change scores, the absolute benefit was calculated as 10.3 and the RPD was 37% in favour of the intervention group. However, there was no significant difference.
in the Schober test. Sweeney 2002 did not measure spinal mobility. We concluded that there was low quality evidence for a positive effect of a home exercise program on some measures of spinal mobility.

- **Physical function**
  - Physical function score was significantly better in the experimental group than in the no intervention group in the study of Kraag 1990 (p < 0.001). Average difference after treatment was about 4 points on a 33 points scale (modified Toronto Activities of Daily Living Questionnaire). Sweeney 2002 reported no significant group difference after six months for self-reported physical function (BASFI), p = 0.08. In conclusion, there was low quality evidence for a treatment effect on self-reported physical function when compared to no intervention.
  - Patient global assessment was not measured in the study of Kraag 1990. Sweeney 2002 reported no group differences in the patient global (BAS-G). Thus, there was low quality of evidence for no difference between the groups on patient global assessment.

- **Main comparison 2 - different modalities or applications of physiotherapy**
  - 2a) Trials comparing supervised group physiotherapy (including hydrotherapy) with home exercise regimes
  - Three trials were included in this comparison. One trial was assessed to have low risk of bias (Hidding 1993), one to have moderate risk (Analay 2003), and one to have high risk of bias (Helliwell 1996).

- **Pain**
  - Hidding 1993 found no significant differences in pain between the groups. Analay 2003 measured pain at rest and during activity and found no significant differences between the groups after treatment or after three months. Helliwell 1996 combined pain and stiffness in one variable. Weighted mean difference (WMD) between the inpatient group and the home exercise group was -3.90 cm (95% CI -7.7 to -0.06). The absolute benefit was 3.9 cm; and considering the mean baseline value at 8.1 cm, the relative difference in change from baseline for the supervised group compared to the home exercise group was 48% immediately after treatment. However, six months after the intervention there were no significant differences between the three treatment groups regarding pain and stiffness. Thus, it is reasonable to state that there was moderate quality evidence for no difference in pain intensity between the groups.

- **Stiffness**
  - No significant differences in stiffness were found between the groups after nine months in the study of Hidding 1993. In the study of Analay 2003, duration of morning stiffness in minutes was measured. The authors reported statistically significant improvement after treatment and after three months. However, between-group analyses showed no significant differences at the two measurement points (WMD -16.13; 95% CI -45.22 to 12.96 and -11.50; 95% CI -32.84 to 9.84) respectively. The quality of evidence for no group difference was considered to be moderate.

- **Spinal mobility**
  - Hidding 1993 found a statistically significant difference for thoraco-lumbar mobility in favour of the additional group physiotherapy. Mean difference of change in thoracolumbar flexion between the two groups was 0.4 cm (CI 95% 0.1 to 0.7) after the nine month intervention period. Considering the baseline mean at 5.3 cm, the RPD was 7.5% in favour of the supervised group physiotherapy. This group also performed slightly better on the other spinal mobility outcomes but the results were not statistically significant. Chest
expansion and Schober (lumbar flexion) were measured after treatment in two studies (Analay 2003; Helliwell 1996) and pooled analyses showed no significant differences between the groups for these two measures. A significant difference in Schober was found between the groups at three months in the study of Analay 2003 with an absolute benefit of 0.6 cm and RPD 18%. Furthermore, no difference in cervical rotation between the supervised group program and the home exercise group, after treatment or six months after treatment, was found in the study of Helliwell 1996. In the study of Analay 2003 no difference between the groups was found on finger-tip-to-floor-distance or tragus to wall distance. In conclusion, the quality of evidence for small differences on some measures of spinal mobility was considered to be moderate.

- Physical function
  - Hidding 1993 and Analay 2003 found no significant differences in self-reported physical function measured at nine and three months respectively. The quality of evidence for no group differences was moderate.

- Patient global assessment
  - The supervised group reported significantly better scores on the patient global assessment in the study of Hidding 1993. Mean change difference between the two groups after the nine months intervention period was 1.46 cm (CI 95% 1.05 to 1.87); the relative difference was not calculated due to insufficient reporting of baseline data. Patient global assessment was not measured in the studies of Analay 2003; Helliwell 1996. The quality of evidence for a difference in favour of group physiotherapy was considered to be moderate.

- Main comparison 2 - different modalities or applications of physiotherapy
  - 2 b) Trials comparing the effectiveness of spa therapy with weekly group physiotherapy
    - One study with low risk of bias was included (Van Tubergen 2001). The two spa-exercise groups were considered clinically similar and thus they were combined to perform one group (intervention group: IG) which was compared to weekly group physiotherapy alone (control group: CG). The authors expressed the primary outcomes (BASFI, BAS-G, pain intensity and morning stiffness) as a pooled index of change (PIC). Both the pooled index and the individual variables were reported.

- Pain
  - Significant effects of the spa-exercise intervention were found regarding pain. At one month WMD was -1.07 (CI 95% -2.02 to -0.12), and at four months WMD was -1.09 (CI 95% -2.04 to -0.14). Absolute benefit at one and four months was 0.9 cm and RPD 18% in favour of the spa-exercise group. After seven months, the authors still reported a significant difference between the IG and the CG on the pooled index (PIC). However, no significant differences in pain were found at seven or ten months when regarded as an individual variable. It may be reasonable to conclude that there was moderate quality evidence for a clinically relevant effect of the spa-exercise intervention on pain.

- Stiffness
  - Stiffness was measured as duration of morning stiffness, in minutes. Significant differences between the spa-exercise groups and the control group were not found. Thus, the quality of evidence for no group differences was moderate.

- Spinal mobility
  - Spinal mobility was not measured in this study.

- Physical function
• Physical function was measured with BASFI and included in the pooled index of change. Evaluated as a separate variable the WMD was not significant but the absolute benefit was 24% and 17% at one and four months respectively and may thus be considered as clinically relevant (Philadelphia Panel). The quality of evidence for no group differences was moderate.

• Patient global assessment
  Significant positive effects of the spa-exercise interventions were found for patient global assessment at one month (WMD -0.93; 95% CI -1.78 to -0.09), four months (WMD -0.93; 95% CI -1.84 to -0.02) and seven months (WMD -1.00; CI -2.02 to 0.02). The absolute benefit was 1.3 cm, 1.4 cm and 1.4 cm respectively; the RPD, in favour of the spa-exercise groups, was 27% at one month and 29% at four and seven months. At ten months no differences between the groups were found. There was moderate quality evidence for a clinically relevant effect in favour of an additional combined spa-exercises course.

Discussion
Six studies met the inclusion criteria of this review, with a total of 561 patients with AS. Two of the studies were assessed to have low risk of bias, two studies were assessed to have moderate, and two to have high risk of bias. We can conclude from this review that patients with AS had some beneficial effects from individualised home exercise programs compared to no intervention. Furthermore, supervised group physiotherapy programs were better than individualised home exercise regimes, and a three week combined spa-exercise intervention was better than weekly group physiotherapy alone.

• Nearly all the studies in this review included more than 70% men in the participant groups. Among the exclusion criteria were patients using DMARDs, patients with peripheral joint involvement, severe co-morbidity and diagnosis of AS more than 20 years ago. Thus, the applicability of the results to women and severely affected AS patients may be limited.

• The main goal of the six trials in this review was to study the effectiveness of physiotherapy in the management of AS. However, the interventions were often poorly described so that the exact content of the programs remained partly unclear and the external validity was thereby unclear. Another problem related to the external validity was the somewhat unusual interventions in some of the included trials, such as treatment programs in spa-resorts. Although the spa-exercise intervention showed favourable cost-effectiveness and cost-utility ratios compared to self-exercising and group-exercising (Van Tubergen 2002), spa-resorts are not easily available in many parts of the world and the generalisability of the results may, therefore, be limited.

In order to improve the clinical relevance of the review, relative percentage differences (RPD) were calculated wherever possible. According to the Philadelphia Panel, an improvement of 15% relative to a control group can be considered as clinically relevant (Philadelphia Panel). By employing this method we might interpret the difference in spinal mobility (RPD 37%) in favour of the home exercise program (compared to no intervention), measured after the four months intervention period, as clinically relevant. Furthermore, the difference in combined pain and stiffness (RPD 48% after intervention) and spinal flexion (RPD 18% at three months) in favour of supervised group physiotherapy are clinically relevant results. Finally, the differences in pain (RPD 18% at four months), physical function (RPD 24% and 17% at one and four months) and patient global assessment (RPD 27% at one month, and 29% at four and seven months) in favour of combined spa-exercise therapy compared to weekly supervised group physiotherapy alone are considered clinically relevant.
We also employed a recently developed systematic and explicit method to indicate the extent to which one can be confident that the effect estimates were correct (Grade Working Group); assessments of the quality of evidence were done for each comparison and outcome. By considering study design, study quality, similarity of estimates of effect across studies and directness (the extent to which people, interventions and outcome measures are similar to those of interest) we found that the quality of evidence for the comparisons in this review was moderate to low. Thus, further research is recommended to confirm these effect estimates.

The studies reported improvement in spinal mobility for different parts of the spinal column. Helliwell 1996 showed a significant improvement in cervical rotation but not in chest expansion or modified Schober. Hidding 1993 found significant improvement in thoraco-lumbar mobility, and minor not significant improvements in other spinal mobility measures. Kraag 1990 measured spinal mobility as finger-tip-to-floor distance (FFD) and found a significant improvement in favour of the intervention group; the modified Schober test did not show significant improvement. In the study of Analay 2003, the two groups did not differ in spinal mobility measures. The varying results for the different measures of spinal mobility may indicate that the mobilising exercises have to be specific and a general effect of exercising on spinal mobility is not to be expected. Furthermore, measures of spinal extension range of motion are lacking in the included studies and future trials should aspire to include more specific spinal mobility movements and measurements.

Compared to the previous version of this review, two substantial changes have been made. Firstly, three new studies with a total of 320 patients have been included. Secondly, the clinical relevance of the effect sizes and the quality of evidence has been assessed according to systematic and explicit methods (Philadelphia Panel; Grade Working Group). These changes have reinforced the tendency toward positive effects of physiotherapy in terms of exercise programs in the management of AS. However, more research is needed, especially on other commonly used modalities of physiotherapy.

The trials included in this review compared therapeutic exercises applied in group settings to exercises performed individually. Thus, the comparisons may provide information on the effect of the group setting rather than the effect of the specific content of the exercise programs. The fact that the patients who participated in the groups (both inpatients and outpatients) improved more than the patients who did exercises on their own may be ascribed to the contribution of non-physical factors, such as mutual encouragement, increased motivation and exchange of experiences with fellow sufferers. These are important factors for the total wellbeing of the AS patients but does not give evidence to decide the most appropriate and effective exercise program.

The random allocation of patients in physiotherapy studies may lead to reduced effectiveness of the interventions. Physiotherapy interventions are often time consuming and compliance is dependent on highly motivated patients. Helliwell 1996 addressed this problem in their study, considering that the great number of drop-outs may have been due to lack of motivation and a time consuming treatment program which the patients had not chosen. With use of intention-to-treat analyses, the great number of non-compliance will influence the treatment effects negatively. It can be assumed that, in order to avoid non-compliance or poor recruitment, physiotherapy researchers may have a tendency to compare active and quite similar interventions. Significant differences of clinically relevant treatment effects may, therefore, be hard to obtain.

Publication bias is discussed as a problem when developing systematic reviews. Research has suggested that studies with positive results are more likely to be published than studies with negative results (Dickersin 1987). Furthermore, the literature search for this review identified reports of two possibly eligible studies published as conference abstracts, which did not provide sufficient data to be included (Ahmad 2000, Pickering 2000). Due to the small number of included
studies and insufficient data reporting, the possible extent of publication bias could not be further explored in this review.

This review identified and summarised data from all available RCTs investigating the effects of physiotherapy in the management of AS. Trials meeting the inclusion criteria were few, heterogeneous and investigated a limited range of the relevant physiotherapy modalities. The absence of standardised interventions and outcome measurement tools, together with inadequate data reporting, made the comparison of different trials difficult and did not allow any pooling of data. In addition, the methodological quality was varied, limiting the usefulness of the review to guide clinical practice. However, systematic reviews also illuminate areas of poor knowledge, lead to the development of new hypothesis and constitute a valuable guide for further research.

**Reviewers' conclusions**

**Implications for practice**

The results of this review give moderate evidence for benefits of supervised group physiotherapy compared to individualised home programs; and combined spa-exercises compared to supervised group physiotherapy in the management of patients with AS. There was also weak evidence for preferring individualised home program compared to no intervention. However, it must be emphasised that small numbers of participants, heterogeneous interventions and outcome measures, together with deficient reporting of data in these studies did not provide strong evidence.

No randomised trials investigating relevant physiotherapy interventions other than exercise programs were found through this systematic search strategy. Trials investigating other commonly used physiotherapy approaches such as different hands-on techniques and specific education and information programs are still lacking. Accordingly, we still do not know which particular treatment protocol should be recommended in the management of AS. To improve practice and decision making, it is, therefore, important to conduct trials which compare different physiotherapy modalities, types and intensity of training and exercise programs as well as duration and frequency of these interventions.

**Implications for research**

More trials are needed in this field. Other commonly used physiotherapy interventions (e.g. different hands-on techniques such as manual therapy, electrotherapy, information and education programs) should be investigated. New trials should compare different treatment and exercise programs; aspire to an accurate description of the content, dose and application of the interventions; and make use of standardised, validated outcome measures suitable for assessing effects of physiotherapy interventions.

**Acknowledgements**

Louise Falzon at the editorial office of the Cochrane Musculoskeletal Group conducted the literature searches for this updated version. The authors of the primary studies are acknowledged for their cooperation. Opinions and interpretations expressed in this review do not necessarily represent those of the institutions with which the authors are affiliated.

**Potential conflict of interest**
### Characteristics of included studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Analay 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Methods</strong></td>
<td>Concealment of allocation: METCo-intervention: UNCLEAR Exclusions or losses to follow-up: METOutcome assessment: MET</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td>The study was carried out in Turkey, included 45 participants, aged between 18 and 55 years, 84% men.Inclusion criteria: AMOR criteria, able to participate in exercise groupExclusion criteria: systemic organic involvement, hip and knee deformities, treated by physiotherapy last three months or practising regular exercises, receiving DMARDS</td>
</tr>
<tr>
<td><strong>Interventions</strong></td>
<td>Group 1: Intensive exercise program, 6 weeks, 3 days pr week, supervised. The exercise program included stretching, mobilization and strengthening exercises, aerobic exercises and postural and respiratory exercises. Group 2: The control group was encouraged to practice an individualised home exercise program 3 days pr week for 6 weeks. They were called by phone every week.</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Allocation concealment A</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Study</th>
<th>Helliwell 1996</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Methods</strong></td>
<td>Concealment of allocation: NOT METCo-intervention: UNCLEAR Exclusions or losses to follow-up: NOT METOutcome assessment: NOT MET</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td>The study was carried out in the UK, included 44 participants with a mean age 38.9 years, 89% men. Inclusion criteria:Fulfilling the New York criteriaExclusion criteria: participated in inpatient program within last year, peripheral joint involvement, unable to exercise.Participants were divided into two disease severity groups (A and B, group B including patients with most severe disease) on the basis of anthropometric measures</td>
</tr>
<tr>
<td><strong>Interventions</strong></td>
<td>Group 1: 3 weeks inpatient, supervised group physiotherapy, 5 days / week, 1 hour group exercise + hydrotherapy 3 times pr week+ occasionally massage and interference (included nine patients in severity group A and six patients in group B)Group 2: outpatient hydrotherapy and home-exercise: 6 weeks, 2 times pr week hydrotherapy + home exercise program (included 12 patients in severity group A and 3 in group B)Group 3: Home exercises: 6 weeks home exercise regime (included 9 patients in severity group A and 5 in group B)</td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td>1: Anthropometric measures: cervical rotation, chest expansion, Schober test2. Subjective scores: Pain and stiffness (combined, VAS)Points of assessment: two times prior to treatment, after treatment, 2, 4 and 6 months after treatment</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td></td>
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<tr>
<td>Allocation concealment</td>
<td>Study</td>
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<thead>
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<th>Study</th>
<th>Methods</th>
</tr>
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<tbody>
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<td></td>
<td></td>
<td>Concealment of allocation: UNCELEARCo-intervention: UNCELEARTerences or losses to follow-up: UNCELAROutcome assessment: UNCELEAR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The study was carried out in Canada, included 53 participants between 19-73 years, 79% men. The participants were divided into two age-groups: 18-35 years (n= 27) and 36 or over (n=26). Inclusion criteria:Fulfilling the New York criteria + stable clinical status and drug therapy, absence of corticosteroid therapy for at least 3 months and immunosuppressive therapy for at least 6 monthsExclusion criteria: patients with more than 10% loss of hip flexion+ contravening treatment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group 1: Home physiotherapy program. One-to-one design, educational strategy, disease information and exercises. The treatment objectives were: disease education, pain control, improved posture and function. Planned visits were 8-16 during the intervention period of 4 monthsGroup 2: control group, no intervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main outcome: finger-tip-to-floor-distance Secondary outcomes: the Toronto Activities of Daily Living Questionnaire, occiput-wall-distance, Schober test, pain (VAS), morning stiffness and sleep pattern Points of assessments: baseline and after intervention (4 months).</td>
</tr>
<tr>
<td></td>
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<td>Allocation concealment</td>
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<th>Study</th>
<th>Methods</th>
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<td></td>
<td>Concealment of allocation: UNCELEARCo-intervention: UNCELEARTerences or losses to follow-up: UNCELAROutcome assessment: UNCELEAR</td>
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<td></td>
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</tr>
</tbody>
</table>
losses to follow-up: NOT MET
Outcome assessment: UNCLEAR

Participants
The study was carried out in the UK, included 155 participants aged between 16-65 years, 67% men. Inclusion criteria: members of the National AS Society or outpatients of the Royal National Hospital for Rheumatic Diseases. Exclusion criteria: not described

Interventions
Group 1: The 6 months home-based intervention, delivered by mail, consisted of: an exercise/ educational video, an educational booklet, an exercise progress wall chart and exercise reminder stickers. Group 2: control group, no intervention

Outcomes
Physical function (BASFI), disease activity (BASDAI), global well-being (BAS-G), exercise self efficacy (ESE), arthritis self efficacy (SES), quantity of AS exercise. Points of assessments: baseline and after intervention (6 months)

Notes
Allocation concealment: B

Study
Van Tubergen 2001

Methods
Concealment of allocation: MET
Co-intervention: MET
Exclusions or losses to follow up: MET
Outcome assessment: MET

Participants
The study was carried out in The Netherlands, Germany and Austria, included 120 participants (3 groups of 40). Group 1 included 67% men, mean (SD) age in the group was 48 (10), group 2 included 70% men, mean (SD) age 49 (9) and group 3 (control-group) included 85% men, and the mean (SD) age in the group was 48 (10). Inclusion criteria: fulfilling the New York criteria, pain and stiffness or functional limitations for at least 3 months before entry and being able to stay away from home and work for 3 weeks. Exclusion criteria: inability or unwillingness to participate in weekly group physical therapy, pregnancy, claustrophobia, severe comorbidity and/or AS for more than 20 years

Interventions
Group 1: Spa-exercise therapy Austria
Group 2: Spa-exercise therapy Netherlands
The 3 weeks standardized spa-exercise therapy consisted of group physical exercises, walking, correction therapy (lying supine), hydrotherapy, sports and sauna.
Group 3: control group, staying home receiving weekly physiotherapy and drug treatment as usual. Weekly group physiotherapy consisted of 1 hour exercises, 1 hour sports and 1 hour hydrotherapy. After the intervention period, all patients from the 3 groups engaged in weekly group physiotherapy sessions for another 37 weeks follow-up period

Outcomes
Main outcomes: Physical function (BASFI), pain, duration of morning stiffness, aggregated in a pooled index (PIC)
Secondary outcomes: disease activity (BASDAI), general health and functioning (HAQ-S), night pain, quality of life (ASQoL), intake of NSAIDs
Points of assessment: baseline (2 weeks before spa therapy) and 1, 4, 7 and 10 months after start of spa-exercise therapy

Notes
Allocation concealment: A

Characteristics of excluded studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Reason for exclusion</th>
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<tr>
<td>Ammer 1997</td>
<td>A systematic review of physiotherapy spondylarthropathies. The criteria of study</td>
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<tr>
<td>Reference</td>
<td>Description</td>
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<td>--------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Backlund, 1998</td>
<td>A five year follow-up study on spinal mobility in AS patients, independent of interventions. The criteria of intervention and study design not met.</td>
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<tr>
<td>Bakker et al 1994</td>
<td>A study of cost effectiveness of supervised group physiotherapy. Based on data from an included RCT (Hidding 1993)</td>
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<tr>
<td>Band 1997</td>
<td>A pre-post study of an inpatient management program, the criteria of study design not met.</td>
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<tr>
<td>Bulstrode 1986</td>
<td>A controlled pre-post study of the effect of daily passive stretching of the hip-joint. The criteria of study design not met.</td>
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<tr>
<td>Falkenbach 2003</td>
<td>A cross-sectional, retrospective study of exercise habits. The criteria of intervention and study design not met.</td>
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<tr>
<td>Fisher 1990</td>
<td>The objective was to establish the relation between restriction of chest expansion, lung function and work capacity. The criteria of intervention</td>
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<tr>
<td>Gall 1994</td>
<td>A review of effects of exercise in AS. The criteria of study design not met.</td>
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<tr>
<td>Hafstrom 2003</td>
<td>A pre-post study of physiotherapy in subtropic climate. The criteria of participants and study design not met.</td>
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<td>Heikkila 2000</td>
<td>Based on data from Viitanen 1995. The criteria of study design not met.</td>
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<tr>
<td>Hidding 1994</td>
<td>A follow-up study of an included RCT (Hidding 1993)</td>
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<td>Hidding 1995</td>
<td>A study of the effect of group physiotherapy. Pre-post design, the criteria of study design not met.</td>
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<tr>
<td>Hider 2002</td>
<td>A study of the effect of exercising on body image. The criteria of outcome measures and study design not met.</td>
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<td>Horslev-Petersen 1985</td>
<td>A long term study of the effect of exercises. The criteria of study design not met.</td>
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<td>O'Driscoll 1978</td>
<td>A study of effect of an inpatient program on neck mobility. The criteria of study design not met.</td>
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<tr>
<td>Rasmussen 1989</td>
<td>A description of a training program and preliminary results. The criteria of study design not met.</td>
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<td>Russell 1992</td>
<td>A pre-post study of physical training. The criteria of study design not met.</td>
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<td>Santos 1998</td>
<td>A screening study to evaluate how much exercise AS patients perform on a regular basis. The criteria of intervention and study design not met.</td>
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<td>Seckin 2000</td>
<td>A cross-sectional study of the relationship between pulmonary function and exercise tolerance. The criteria of study design and intervention not</td>
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<td>Stenstrom 1997</td>
<td>A randomised controlled trial, comparing two methods of muscle training in patients with rheumatic diseases. The criteria of participants not met.</td>
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<td>A cross-sectional study of exercise habits, the criteria of study design not met.</td>
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<td>Tegelberg 1988</td>
<td>A study of effect of physical training on the stomatognathic system in patients with RA and AS. The criteria of outcome measures not met.</td>
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<td>Tishler 1995</td>
<td>A pre-post pilot study of the effects of spa therapy. The criteria of study design not met.</td>
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<td>Tomlinson 1986</td>
<td>Pre-post study of an in-patient physiotherapy course. The criteria of study design not met.</td>
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</table>
A prospective, longitudinal study of exercising. The criteria of study design not met.

An evaluation of cost-effectiveness of a spa-exercise course, based on data from an included RCT (van Tubergen 2001).

A review on evidence for benefits of physical therapy and spa therapy. The criteria of study design not met.

A retrospective analysis of the efficacy of in-patient physiotherapy, the criteria of study design not met.

A follow-up study of an inpatient physiotherapy program. The criteria of study design not met.

A follow-up study of functional changes before and after an inpatient course. The criteria of study design not met.

A study of the effect of corticotrophin. Criteria of intervention and study design not met.

Additional tables

Table 01 Pain and stiffness, after treatment

<table>
<thead>
<tr>
<th>Study</th>
<th>Treatment Group</th>
<th>Outcome (Scale)</th>
<th>No. of patients</th>
<th>Baseline Mean</th>
<th>End-of-study Mean</th>
<th>Absolute Benefit</th>
<th>Relative Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helliwell 1996</td>
<td>Supervised group physiotherapy</td>
<td>VAS (0-200)</td>
<td>15</td>
<td>81</td>
<td>41</td>
<td>39</td>
<td>48% (I)</td>
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<td></td>
<td>Control group</td>
<td></td>
<td>14</td>
<td>81</td>
<td>80</td>
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Table 02 Pain, 4 weeks

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<th>Study</th>
<th>Treatment Group</th>
<th>Outcome (Scale)</th>
<th>No. of Patients</th>
<th>Baseline Mean</th>
<th>End-of-Study Mean</th>
<th>Absolute Benefit</th>
<th>Relative Difference</th>
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</thead>
<tbody>
<tr>
<td>Van Tubergen 2001</td>
<td>Spa exercise therapy</td>
<td>VAS (0-10)</td>
<td>80</td>
<td>4.6</td>
<td>3.6</td>
<td>0.9</td>
<td>18% (I)</td>
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<tr>
<td></td>
<td>Control group</td>
<td></td>
<td>40</td>
<td>4.8</td>
<td>4.7</td>
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Table 03 Pain, 16 weeks

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<th>Treatment Group</th>
<th>Outcome (Scale)</th>
<th>No. of Patients</th>
<th>Baseline Mean</th>
<th>End-of-Study Mean</th>
<th>Absolute Benefit</th>
<th>Relative Difference</th>
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<tbody>
<tr>
<td>Van Tubergen 2001</td>
<td>Spa exercise therapy</td>
<td>VAS (0-10)</td>
<td>80</td>
<td>4.6</td>
<td>3.3</td>
<td>0.9</td>
<td>18.5% (I)</td>
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<td>Control group</td>
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<td>40</td>
<td>4.8</td>
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Table 04 Finger-tip-to-floor, 4 months

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<th>No. of</th>
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<th>Absolute</th>
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<tr>
<td>Study</td>
<td>Treatment Group</td>
<td>Outcome</td>
<td>No. of Patients</td>
<td>Baseline Mean</td>
<td>End-of-study Mean</td>
<td>Absolute Benefit</td>
<td>Relative Difference</td>
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<tr>
<td>Kraag 1994</td>
<td>Home exercise/educational program</td>
<td>Control group</td>
<td>53</td>
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<td>Analay 2003</td>
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<td>Control group</td>
<td>Modified Schobers test (cm)</td>
<td>23</td>
<td>4.38</td>
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<td>Control group</td>
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<td>3.7</td>
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<td>Van Tubergen 2001</td>
<td>Spa exercise therapy</td>
<td>Control group</td>
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<td>5.3</td>
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Table 10 Patient Global Assessment (BAS-G), 28 weeks

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<tr>
<th>Study</th>
<th>Treatment Group</th>
<th>Outcome (Scale)</th>
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<th>End-of-study Mean</th>
<th>Absolute Benefit</th>
<th>Relative Difference</th>
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</thead>
<tbody>
<tr>
<td>Van Tubergen 2001</td>
<td>Spa exercise therapy Control group</td>
<td>BAS-G (0-10)</td>
<td>80</td>
<td>5.3</td>
<td>3.5</td>
<td>1.4</td>
<td>29% (I)</td>
</tr>
</tbody>
</table>

References

References to studies included in this review

**Analay 2003** *{published data only}*


**Helliwell 1996** *{published and unpublished data}*


**Hidding 1993** *{published data only}*


**Kraag 1990** *{published data only}*


**Sweeney 2002** *{published data only}*


**Van Tubergen 2001** *{published and unpublished data}*

* indicates the major publication for the study

References to studies excluded from this review

Ammer 1997


Backlund, 1998


Bakker et al 1994


Band 1997


Bulstrode 1986


Falkenbach 2003


Fisher 1990


Gall 1994


Hafstrom 2003

Heikkila 2000


Hidding 1994

* Hidding A, van der Linden S, Gielen X., de Witte L, Dijkmans B, Moolenburgh D. Continuation of group physical therapy is necessary in ankylosing spondylitis: results of a randomized controlled trial. Arthritis Care and Research 1994;7(2):90-6.

Hidding 1995


Hider 2002


Horslev-Petersen 1985


Kraag 1994


O'Driscoll 1978


Rasmussen 1989


Russell 1992

Santos 1998


Seckin 2000


Stenstrom 1997


Sundstrom 2002


Tegelberg 1988


Tegelberg 1996


Tishler 1995


Tomlinson 1986


Uhrin 2000


Van Tubergen 2002

**Van Tubergen 2002 b**


**Viitanen 1992**


**Viitanen 1995**


**Viitanen 2001**


**Wordsworth 1983**


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Amor 1991


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Hidding A 1993


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Van der Linden 1984


Van der Linden 1990


Van Tubergen 2002


Will 1990


Graphs

Graphs and Tables

To view a graph or table, click on the outcome title of the summary table below.

<table>
<thead>
<tr>
<th>Outcome title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
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</thead>
<tbody>
<tr>
<td>01 SES pain, (scale not reported) 6 months</td>
<td>1</td>
<td>155</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>0.56 [0.20, 0.92]</td>
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<td>02 Physical function (BASFI), VAS (cm), 6 months</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>-0.30 [-1.09, 0.49]</td>
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<td>03 Patient global (BAS-G), VAS (cm)</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
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<td>Effect size</td>
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<tr>
<td><strong>04 Self-reported disease activity (BASDAI, VAS (cm), 6 months)</strong></td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>0.20 [-0.46, 0.86]</td>
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<tr>
<td><strong>02 Group physiotherapy (in-patient) versus individualised home exercises</strong></td>
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<tr>
<td>01 Pain and stiffness, VAS (cm), after treatment</td>
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<td>29</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>-3.90 [-7.74, -0.06]</td>
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<tr>
<td>02 Pain and stiffness, VAS (cm), 6 months</td>
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<td>-3.50 [-9.70, 2.70]</td>
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<tr>
<td>03 Pain (at rest), VAS (cm), after treatment</td>
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<td>05 Pain (at rest), VAS (cm), 3 months</td>
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<tr>
<td>07 Morning stiffness (minutes), after treatment</td>
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<tr>
<td>08 Morning stiffness (minutes), 3 months</td>
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<td>09 Cervical rotation (CR), degrees, after treatment</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>21.40 [-19.64, 62.44]</td>
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<tr>
<td>10 Cervical Rotation (CR), degrees, 6 months</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>3.60 [-49.29, 56.49]</td>
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<tr>
<td>11 Chest expansion (cm), after treatment</td>
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<td>74</td>
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<td>12 Chest expansion (cm), 6 months</td>
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<td>13 Schober (cm), after treatment</td>
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<td>14 Schober (cm), 3 months</td>
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<td>2.00 [0.15, 3.85]</td>
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<tr>
<td>Outcome title</td>
<td>No. of studies</td>
<td>No. of participants</td>
<td>Statistical method</td>
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<tr>
<td>15 Schober (cm), 6 months</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
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<td>16 Finger-tip-to-floor-distance (FFD), (cm), after treatment</td>
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<td>45</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
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<tr>
<td>17 Finger-tip-to-floor-distance (FFD), (cm), 3 months</td>
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<td>45</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>-1.85 [-11.09, 7.39]</td>
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<tr>
<td>18 Tragus to wall distance (cm), after treatment</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
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<tr>
<td>19 Tragus to wall distance (cm), 3 months</td>
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<td>45</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
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<tr>
<td>20 Physical function (BASFI), VAS (cm), after treatment</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>-7.31 [-18.25, 3.63]</td>
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<tr>
<td>21 Physical function (BASFI), VAS (cm), 3 months</td>
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<td>45</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>-4.13 [-14.17, 5.91]</td>
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</table>

### 03 Spa-therapy in addition versus weekly group PT alone

<table>
<thead>
<tr>
<th>Outcome title</th>
<th>No. of studies</th>
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<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Pain VAS (cm), 4 weeks</td>
<td>1</td>
<td>120</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>-1.07 [-2.02, -0.12]</td>
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<tr>
<td>02 Pain VAS (cm), 16 weeks</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
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<tr>
<td>03 Pain VAS (cm), 28 weeks</td>
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<tr>
<td>04 Pain VAS (cm), 40 weeks</td>
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<tr>
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<tr>
<td>07 Physical function (BASFI), VAS (cm), 28 weeks</td>
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<td>120</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>-0.10 [-0.96, 0.76]</td>
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<tr>
<td>08 Physical function (BASFI) VAS (cm), 40 weeks</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>0.07 [-0.74, 0.88]</td>
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<tr>
<td>09 Patient global VAS (cm), 4 weeks</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
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<tr>
<td>10 Patient global VAS (cm), 16 weeks</td>
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<tr>
<td>12 Patient global VAS (cm), 40 weeks</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>-0.04 [-1.02, 0.94]</td>
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<tr>
<td>13 Self-reported disease activity (BASDAI) VAS (cm), 4 weeks</td>
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<td>120</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>-0.26 [-1.05, 0.53]</td>
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<td>14 Self-reported disease activity (BASDAI) VAS (cm) 16 weeks</td>
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<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>-0.59 [-1.40, 0.22]</td>
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<tr>
<td>15 Self-reported disease activity (BASDAI) VAS (cm), 28 weeks</td>
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<td>120</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>0.14 [-0.59, 0.87]</td>
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<tr>
<td>16 Self-reported disease activity (BASDAI) VAS (cm), 40 weeks</td>
<td>1</td>
<td>120</td>
<td>Weighted Mean Difference (Fixed) 95% CI</td>
<td>0.03 [-0.73, 0.79]</td>
</tr>
</tbody>
</table>

Cover sheet

Physiotherapy interventions for ankylosing spondylitis

Reviewer(s) Dagfinrud H, Hagen KB, Kvien TK

Contribution of Reviewer(s) HD planned and initiated the review, searched for RCT's, assessed the trials, extracted data, contacted authors of RCT's and drafted and re-drafted the update of the review.

KBH planned and initiated the review, contacted authors of RCT's and assessed the trials and extracted data.

TKK contributed substantially in the updating process with comments and interpretation of the data.

HD is the guarantor for the review.

Issue protocol first published Information not supplied by reviewer

Issue review first published 2000 issue 1
Compared to the previous version of this review, two substantial changes have been made. First, three new studies with a total of 320 patients have been included. Secondly, the clinical relevance of the effect sizes and the quality of evidence have been assessed according to systematic and explicit methods (Philadelphia Panel, Grade Working Group). These changes have reinforced the tendency toward positive effects of physiotherapy in terms of exercise programs in the management of AS.

Information not supplied by reviewer

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CD002822

Cochrane Musculoskeletal Group

MUSKEL

The National Foundation for Postgraduate Physiotherapists NORWAY
Synopsis

- How well does physical therapy work for treating ankylosing spondylitis and how safe is it?
  - To answer this question, scientists working with the Cochrane Musculoskeletal Group found and analyzed 6 studies testing over 550 people who had ankylosing spondylitis. Studies compared people who did exercises at home, went to group exercise programmes, went to a spa resort for physiotherapy or had no therapy at all. These studies provide the best evidence we have today.

- What is ankylosing spondylitis and how can physical therapy help?
  - Ankylosing spondylitis (AS) is a type of arthritis usually in the joints and ligaments of the spine. It may also affect shoulders, hips, or other joints and cause tendonitis. Pain and stiffness occurs and limits movement in the back and affected joints. The disease course is highly variable; it may last for long periods, and be quite severe. Physiotherapy is thought to be an important treatment for AS to maintain or improve movement in the spine, improve fitness and decrease pain.

- How well does physical therapy work?
  - Two studies compared home exercises to no therapy at all. They found that home exercises improve movement in the spine and fitness more than no therapy at all. But home exercises did not improve pain or stiffness more than no therapy. Home exercises were done for 4 to 6 months and were tailored to the individual by a physiotherapist.
  - Three studies compared home exercises to supervised group exercises outside the home. They found that group exercises improve movement in the spine and overall well-being. But group exercises did not improve fitness more than home exercises. Exercises were done for 3 weeks to 9 months and included exercises such as physical training, strengthening, aerobic exercises, hydrotherapy, sports activities and stretching.
  - One study compared two groups of people who both did weekly group exercises for 10 months but one of the groups also went to a spa resort for 3 weeks of physiotherapy. Spa therapy plus weekly group exercises improves pain, fitness and overall well-being more than just weekly group exercises. But spa therapy plus weekly group exercises did not improve stiffness more than group exercises - and movement of the spine was not measured.

- Did physical therapy harm patients?
  - Harms to the patients were not reported in the studies.

- What is the bottom line?
  - Physiotherapy or exercises are helpful to people with ankylosing spondylitis.

There is "silver" level evidence that home exercises are better than no exercises and improve movement in the spine and fitness. Group exercises are better than home exercises and improve pain, stiffness, movement in the spine and overall well-being. Adding a few weeks of exercising at a spa resort to weekly group exercises is better than just weekly group exercises.

We still need more information about the different types of physiotherapy and exercise, and how long and how often physiotherapy should be done for the most improvement.
Keywords

Humans; Ambulatory Care; Hospitalization; *Physical Therapy Techniques; Randomized Controlled Trials; Self Care; Spondylitis, Ankylosing[*rehabilitation]