

Balneotherapy for rheumatoid arthritis (Review)

Verhagen AP, Bierma-Zeinstra SMA, Boers M, Cardoso JR, Lambeck J, de Bie R, de Vet HCW



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[Intervention Review]

Balneotherapy for rheumatoid arthritis

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Editorial group: Cochrane Musculoskeletal Group.

Publication status and date: Edited (no change to conclusions), published in Issue 4, 2008.

Review content assessed as up-to-date: 21 August 2007.

Citation: Verhagen AP, Bierma-Zeinstra SMA, Boers M, Cardoso JR, Lambeck J, de Bie R, de Vet HCW. Balneotherapy for rheumatoid arthritis. *Cochrane Database of Systematic Reviews* 2004, Issue 1. Art. No.: CD000518. DOI: 10.1002/14651858.CD000518.

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ABSTRACT

Background

Balneotherapy (spa therapy or mineral baths) for patients with arthritis is one of the oldest forms of therapy. One of the aims of balneotherapy is to soothe the pain, improve joint motion and as a consequence to relieve patients' suffering and make them feel well. In this update we included one extra study.

Objectives

To assess the effectiveness of balneotherapy for rheumatoid arthritis.

Search methods

We searched the following databases up to October 2006: CENTRAL (Issue 3, 2006), PubMed, CINAHL, the database from the Cochrane 'Rehabilitation and Related Therapies' Field and Pedro. We also performed reference checking and personal communications with authors to retrieve eligible studies.

Selection criteria

Randomised controlled trials comparing balneotherapy with any other intervention or with no intervention.

Included patients were all suffering from definite or classical rheumatoid arthritis as defined by the American Rheumatism Association Criteria or by the criteria of Steinbrocker. At least one of the WHO/ILAR core set of endpoints for RA clinical trials had to be among the main outcome measures.

Data collection and analysis

Two authors independently assessed quality and extracted data. Disagreements were solved by consensus.

Balneotherapy for rheumatoid arthritis (Review)

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Main results

One extra study is included in this update. Now seven trials (412 patients) were included in this review. Most trials reported positive findings on their main outcomes, but were methodologically flawed to some extent. A 'quality of life' outcome was reported by two trials. None of the trials performed an intention-to-treat analysis and only two performed a comparison of effects between groups.

Pooling of the data was not performed because of heterogeneity of the studies, multiple outcome measurements, and the overall poor data presentation.

We found a significant benefit of mineral baths compared to Cyclosporine A at eight weeks on pain in one study (RR=2.4; 95%CI: 1.4,3.8).

Overall there is insufficient evidence that balneotherapy is more effective than no treatment, that one type of bath is more effective than another, or that one type of bath is more effective than mudpacks, exercises or relaxation therapy.

Authors' conclusions

Silver level evidence was found for one study in favour of mineral baths compared to drug treatment at eight weeks. Insufficient evidence was found for all other comparisons. However the scientific evidence is insufficient because of poor methodological quality. Therefore, the noted "positive findings" should be viewed with caution. Because of the methodological flaws, an answer about the apparent effectiveness of balneotherapy cannot be provided at this moment.

PLAIN LANGUAGE SUMMARY

Balneotherapy or spa-therapy for Rheumatoid Arthritis

This summary of a Cochrane review presents what we know from research about the effect of Balneotherapy for Rheumatoid Arthritis (RA).

The review shows that in people with RA:

- Radon-carbon dioxin baths compared with carbon dioxin baths may not lead to any difference in pain on the short-term, only possibly at 6 months.
- Tap water baths compared to land exercises or relaxation may not lead to any difference in pain.
- Mineral baths compared with taking the drug Cyclosporine A may lead to a significant difference in pain at 8 weeks, but may also lead to some side effects .
- Sulfur baths or Dead Sea baths compared to no treatment may not lead to any difference in the way people feel overall.

Swollen or tender joints, inflammation (acute phase reactants), the doctor's assessment of overall well-being, x-rays of joints and other laboratory tests were not measured in these studies.

Not enough data was provide to tell whether mineral baths would improve how people feel overall compared with taking the drug Cyclosporine A.

Not enough data was provided to tell whether physical disability would improve with various forms of balneotherapy.

What is RA and what is Balneotherapy?

In rheumatoid arthritis, your immune system, which normally fights infection, attacks the lining of your joints. This makes your joints swollen, stiff and painful. The small joints of your hands and feet are usually affected first. There is no cure for RA at present, so the treatments aim to relieve pain and stiffness and improve your ability to move.

Balneotherapy (also called mineral baths or spa-therapy) is an ancient and popular therapy. It involves spending time in an indoor pool filled with mineral water at temperature of between 31 to 36 degrees Celsius (88 to 97 degrees Fahrenheit). Different types of mineral water can be used in this therapy, for example, radon or carbon dioxin.

BACKGROUND

Bathing in water (balneotherapy or spa therapy) has been frequently used in classical medicine as a cure for diseases. Water from mineral and thermal springs was particularly valued (Jackson 1990). In Homeric times, baths were applied primarily to cleanse and refresh. At the time of Hippocrates, bathing was regarded as more than a simple hygienic measure, it was considered beneficial in the cure for most illnesses (Goldby 1993; Jackson 1990; Jagger 1984). The Romans used water for the therapeutic treatment of orthopaedic conditions (Fam 1991; Goldby 1993; Jackson 1990). After the Roman era, spa therapy fell into disuse, but in the sixteenth century baths were rediscovered (Palmer 1990). Since then, spa therapy has been practiced continuously in the management of musculoskeletal conditions (Becker 1994; Behrend 1979; Sukenik 1994a).

Spa therapy is a very popular form of treatment for all forms of arthritis in many European countries and in Israel (Fam 1991; Machtey 1982; Nicholas 1994). Spa therapy often takes place at centres with thermal baths or seawater baths, in most West European countries (Cosh 1982), and Turkey (Karagülle 2004). Today, spa therapy remains useful for physical therapists, and patients with rheumatoid arthritis (RA) make favourable claims on its behalf (Behrend 1979).

The term balneotherapy comes from the Latin word "balneum" (bath). The term is classically used for bathing in thermal or mineral waters (Johnson 1990). We will use the term balneotherapy since bathing for therapeutic use very often happens in spas. The water (thermal water, seawater or tap water) is generally used at a temperature of around 34 degrees Celsius (Simon 1981). The hydrostatic force (Archimedes' principle) brings about a relative pain relief by reducing loading (Simon 1981); the water reduces gravity on painful and rheumatic joints.

The aim of balneotherapy is to: improve the range of joint motion and muscle strengthening, relieve muscle spasm, maintain or improve functional mobility, soothe pain and as a consequence to relieve patients' suffering and let them feel well (Jagger 1984; Machtey 1982; Sukenik 1994a). Sometimes bathing is combined with an exercise treatment. It is repeatedly noted that the development of rheumatology as a science began at spas (Calin 1988; Palmer 1990).

The effectiveness of balneotherapy in the management of patients with arthritis is subject to considerable debate. Some authors attribute the effects to biomechanical changes, such as joint unloading, relaxation, increased muscle function and increased general condition (Becker 1994; Golland 1981). Others think that the effect of balneotherapy is due to physiological changes such as increased diuresis and haemodilution (O'Hare 1985; Sukenik 1994a). However, it is important to point out that due to the spa-environment, psychological effects cannot be ruled out (Brosseau 2002).

This article presents a systematic review on the effectiveness of balneotherapy in patients with rheumatoid arthritis.

OBJECTIVES

The primary objective was to perform a systematic review on the effectiveness of balneotherapy in patients with rheumatoid arthritis in terms of pain, stiffness, range of motion, activities of daily living and quality of life.

METHODS

Criteria for considering studies for this review

Types of studies

Studies were eligible if they were randomised controlled trials (RCTs).

Types of participants

Patients had rheumatoid arthritis (RA) with definite or classical rheumatoid arthritis (RA) as defined by the ARA criteria (Ropes 1958) (these criteria have changed over time) or studies using the criteria of Steinbrocker (Steinbrocker 1949).

Types of interventions

Balneotherapy had to be the intervention under study, and had to be compared with another intervention or with no intervention. Balneotherapy is defined as: bathing in water (e.g. mineral baths, sulphur baths, Dead Sea baths). This water may contain minerals (added or natural).

Types of outcome measures

The World Health Organisation (WHO) and the International League Against Rheumatism (ILAR) determined in 1992 a core set of eight endpoints in clinical trials concerning patients with RA (Boers 1994). Below is a list of the WHO/ILAR core set of endpoints. At least one of these endpoints had to be among the main outcome measures. Studies were excluded when only laboratory variables were reported as outcome measures.

WHO/ILAR core set of endpoints for RA clinical trials included the following:

1. Pain
2. Patient global assessment
3. Physical disability
4. Swollen joints
5. Tender joints

6. Acute phase reactants
7. Physician global assessment
8. Radiographs of joints (in studies of 1 or more years duration)

Search methods for identification of studies

Using the Cochrane search strategy, studies were found by screening the PubMed database from 1966 to October 2006, CINAHL up to October 2006, the Cochrane Central Register of Controlled Trials CENTRAL (The Cochrane Library, Issue 3, 2006), the database from the Cochrane 'Rehabilitation and Related Therapies' Field and the Pedro database up to October 2006. We also performed reference checking and personal communications with authors was carried out to retrieve eligible studies.

In PubMed the following subject specific search strategy was combined with all three levels of the optimal trial search strategy as defined by the Cochrane Handbook:

#1: (rheumatoid arthritis OR rheumatoid arthritis)

#2: (balneotherapy OR balneology OR spa therapy OR water therapy OR hydrotherapy OR thalassotherapy)

#1 AND #2

No language restrictions were applied, but studies not reported in English, Dutch, Danish, Swedish, Norwegian, German, or French are awaiting assessment (see list of studies awaiting assessment). First titles and abstracts of identified published articles were reviewed in order to determine the relevancy of the articles. Two reviewers (APV and JL) performed the search independently.

Data collection and analysis

The effectiveness of balneotherapy is presented and discussed based upon the methodological quality. Methodological quality is assessed by means of the "Delphi list" for quality assessment of RCTs as seen below (Verhagen 1998).

All criteria have a "yes", "no", "don't know" answer format. Equal weights were applied to all nine Delphi criteria. In this review the quality components of the studies were determined independently by two of these review authors (HdV, RdB, APV) followed by a consensus meeting. If disagreements persisted a third review author made a final decision.

Table 1: Methodological criteria list

1. Was a method of randomisation performed?
2. Was the treatment allocation concealed?
3. Were the groups similar at baseline regarding the most important prognostic indicators?
4. Were eligibility criteria specified?
5. Was the outcome assessor blinded?
6. Was the care provider blinded?
7. Was the patient blinded?

8. Were point estimates and measures of variability presented for the primary outcome measures?

9. Did the analysis include an intention-to-treat analysis?

DATA EXTRACTION

Two reviewers (JC, APV) independently extracted data using a standardized form regarding the interventions, type of outcome measures, follow-up, loss to follow-up, and outcomes.

ANALYSIS

We calculated an inter-observer reliability of the overall quality assessment using IntraClass Correlation Coefficients (ICC). ICCs > 0.7 are considered as good agreement, between 0.5 and 0.7 as moderate, and < 0.5 as poor agreement.

The results of each RCT was expressed, when possible, as relative risks (RR) with corresponding 95 percent confidence intervals for dichotomous data, and as standardized or weighted mean differences with 95 percent confidence intervals for continuous data (Lau 1997). Results of studies that provided data and were considered clinically homogeneous (for which the participants, interventions and outcome measures were considered to be sufficiently similar), were combined, using a random effects model. Studies fulfilling the randomisation criteria and performing at least blinding of the outcome assessor were regarded of high quality. The studies were qualitatively summarised using a synthesis as described by the CMSG-guidelines.

Pre-planned stratified analyses were:

- a) Trials comparing balneotherapy with no treatment or waiting list controls.
- b) Trials comparing different types of balneotherapy
- c) Trials comparing balneotherapy with other treatment(s) (e.g., exercises, oral medication)

GRADING OF EVIDENCE

We used the grading system described in the 2004 book Evidence-based Rheumatology (Tugwell 2004) and recommended by the 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 >80% follow up (imputations based on methods such as Last Observation Carried Forward (LOCF) are acceptable).
 - Concealment of treatment allocation.

Gold

At least one randomised clinical trial 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 > 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).

CLINICAL RELEVANCE TABLES

Clinical relevance tables were compiled under 'Additional tables' to improve the readability of the review. Absolute benefit was calculated as the improvement in the intervention group minus the improvement in the control group, in the original units. Relative difference in the change from baseline was calculated as the absolute benefit divided by the baseline mean of the control group. NNT was calculated using the Wells calculator software available at the CMSG editorial office. The minimal clinically important difference (MCID) for each outcome was determined to be 15% for input into the calculator.

RESULTS

Description of studies

See: [Characteristics of included studies](#); [Characteristics of excluded studies](#).

Results of the search

For this update two authors (JL, APV) independently performed the search for the update. In total 8 additional references (+ one through reference checking) were selected based on title and abstract. Of these, 7 studies were excluded because: a) awaiting assessment based on language (n=2); b) the design was not an RCT (n=2); c) did not concern patients with RA (n=2), and d) did not receive balneotherapy (n=1). Finally one extra study could be included in this review.

Included studies

The final selection based on consensus resulted in 7 trials being included in this review of which four were of Israeli origin although written in English ([Elkayam 1991](#); [Sukenik 1990a](#); [Sukenik 1990b](#); [Sukenik 1995](#)).

Participants

A total of 412 patients were enrolled, and the number of patients in the intervention groups varied from 8 to 34 (see table of included studies). When mentioned the percentage of males is between 5 and 40% and the mean age varied between 39 and 62.4 years.

Intervention

In all but one study ([Hall 1996](#)) the intervention included mineral baths, and in one study the intervention was in combination with mudpacks ([Sukenik 1990b](#)). All patients continued their medication during balneotherapy. One study mentioned standardized exercise therapy ([Hall 1996](#)), and in another study relaxation exercises were allowed ([Yurtkuran 1999](#)). Two studies included a control group receiving no treatment ([Sukenik 1990b](#); [Sukenik 1995](#)), and in one study the control group received drug therapy ([Yurtkuran 1999](#)).

Outcome measures

All studies used a number of outcome measures including pain and function. Most outcome measures used are not included in the WHO/ILAR core set. Often a standard set of outcome measures was used such as: duration of morning stiffness, 15 m walk time, hand grip strength, Ritchie index, patient or physician assessed severity of disease, laboratory variables. In two studies ([Franke 2000](#); [Hall 1996](#)) a 'quality of life' instrument (AIMS or AIMS2) was used. All studies were single or double blinded, and the overall follow-up period was 3 months, only one study reported a 6 months follow-up.

Risk of bias in included studies

The results of the assessment of methodological quality are shown in the additional table (additional [Table 1](#)) and the notes section of the table of included studies.

Only two studies used a concealed randomisation procedure and had outcome assessor blinded ([Franke 2000](#); [Hall 1996](#)). In the other studies a considerable amount of information concerning study design was lacking or unclear.

Blinding of the observer/outcome assessor is mentioned in six studies ([Franke 2000](#); [Hall 1996](#); [Sukenik 1990a](#); [Sukenik 1990b](#); [Sukenik 1995](#); [Yurtkuran 1999](#)), blinding of care giver in one ([Franke 2000](#)), and blinding of the patient in three studies ([Elkayam 1991](#); [Franke 2000](#); [Sukenik 1990a](#)), but success of blinding was never evaluated.

Concerning the quality assessment the ICC between two reviewers appeared to be high: 0.80 (95% CI: 0.50 - 0.96).

Effects of interventions

All studies included patients with RA as defined by the ARA criteria or Steinbrocker, although the severity of RA differed slightly between the studies. Three studies consisted of two treatment groups; the other had three or four treatment groups. To answer the study

question concerning the effectiveness of balneotherapy in patients with rheumatoid arthritis, RCTs with comparisons of effects between groups are adequate, but only two studies performed a between group analysis. Moreover, the data presented in the papers, even after communication with the authors, was too scarce to enable 'between group' analysis in most other studies. All studies used different interventions or comparison treatments, and a wide variety of outcome measures, therefore interventions and outcome measures were considered heterogeneous. Safety and side effects of balneotherapy were assessed in one study (Yurtkuran 1999), only one patient complained of headache. In this study most side effects were found in the control treatment (Cyclosporine A); between four and 16 percent of participants experienced side effects (Yurtkuran 1999).

Trials comparing balneotherapy with placebo or no treatment/ waiting list controls

Two studies included a control group receiving no treatment (Sukenik 1990b; Sukenik 1995). In both studies the patients were aware of the fact that they did not receive baths as a treatment. In both low quality and low powered studies, a short-term improvement was mentioned in all treatment groups compared to the control group on most outcome measures (see table of included studies). The authors' conclusion of improvement was based on pre-post analysis.

Trials comparing different types of balneotherapy

Four studies (Elkayam 1991; Franke 2000; Sukenik 1990a; Sukenik 1995) compared balneotherapy to Dead Sea salt baths (Sukenik 1990a; Sukenik 1995), mineral baths (Elkayam 1991) or radon-carbon dioxide baths (Franke 2000) with other forms of baths (NaCl baths, Sulphur baths, tap water, carbon dioxide baths, respectively). Only the study of Franke et al can be considered as of high quality. According to our calculations, overall there was no evidence of statistically significant reduction at short-term or long-term in pain (WMD: -10; 95%CI: -20.7,0.7) and quality of life (WMD: 0.26; 95%CI: -0.3, 0.8). Franke et al. mentioned only a significant reduction of pain improvement at 6-months follow-up (not at end of treatment or 3 months follow-up) in favour of Radon Carbon dioxide baths (RR=2.3; 95%CI: 1.1,4.7), and a statistically significant improvement of morning stiffness at 3-months follow-up (RR=3; 95%CI: 1.1,8.3). All other studies were of low quality showing conflicting results. The authors of original studies mentioned a short-term improvement in all treatment groups on most outcome measurements, but a more profound effect in the groups receiving mineral baths. The studies are of low power, performed a pre-post analysis and only presented point estimates.

Trials comparing balneotherapy with other treatments (e.g., exercises, oral medication)

In one study Sulphur baths were compared with mudpacks, or a combination of Sulphur baths and mudpacks (Sukenik 1990b). In one study 'balneotherapy' (seated immersion) was compared

to hydrotherapy (exercises in water), land exercises or relaxation therapy (Hall 1996). Here balneotherapy was performed with tap water at 36 degrees Celsius.

Both studies mentioned a short-term improvement in all treatment groups on their main outcome measures. The study of Sukenik et al. was of low quality, low power, performed a pre-post analysis and presented only point estimates. The study of Hall 1996 could be considered of high quality, and no statistically significant differences could be found on all outcome measures.

In one study balneotherapy was compared to drug therapy (Cyclosporine A (CsA) 3.5 mg/kg) (Yurtkuran 1999). Both groups showed clinically relevant improvement on pain and global improvement at eight weeks. We found a statistically significant benefit of mineral baths concerning overall improvement at 8 weeks. It seems there is a significant difference in favour of mineral baths concerning grip strength, but we noticed severe baseline differences and we had some difficulties interpreting the measure of variability mentioned in the study; therefore we did not calculate the effect concerning grip strength.

Clinical relevance tables for important outcomes are available in additional tables: Table 2; Table 3; Table 4; Table 5; Table 6; Table 7

DISCUSSION

This review evaluated the effectiveness of balneotherapy in patients with RA. We found silver level evidence of benefit of mineral baths when compared to drug treatment concerning overall improvement at 8 weeks. There is however insufficient evidence for balneotherapy when compared to no treatment or other forms of balneotherapy or other treatments. Unfortunately, most studies showed methodological flaws. When information concerning trial design, especially on strategies to avoid bias, is lacking, possible bias in the trial cannot be excluded. Therefore, a robust analysis of the effectiveness of balneotherapy cannot be presented.

Our review might very well suffer from selection bias based on language. Several studies were found presented in Hebrew, Japanese or in one of the Eastern European languages. Often the English abstract was not able to provide us information about the design of the study. These studies are all awaiting assessment.

We used the 'Delphi list' for quality assessment (Verhagen 1998). Overall this criteria list can be regarded as a reliable and valid instrument (Verhagen 2001). Nevertheless misclassification is always a possibility. The quality assessment in this review appeared to be reliable.

Rheumatoid arthritis (RA) is a chronic, progressive and disabling disease and has great impact on quality of life. When evaluating balneotherapy the outcome measures used and the follow-up period chosen should be adequate. The main aim of balneotherapy

is to maintain or improve functional mobility, soothe pain and to let the patients feel well. Often a standard set of outcome measures was used but only twice was a 'quality of life' instrument used. In daily life patients are trying to deal with pain by using coping strategies. Pain (often assessed by the patient) was reported as an outcome measure in the methods sections of most of the studies, but the results were seldom reported. Sukenik (Sukenik 1990a; Sukenik 1990b; Sukenik 1995) and Elkayam et al (Elkayam 1991) reported a patient self-assessment of the severity of disease on a seven or ten-point scale, and mentioned statistically significant improvement in all groups using a pre/post analysis.

A 'quality of life' assessment was reported in only two studies (Franke 2000; Hall 1996). This is surprising because one of the aims of balneotherapy, or therapy for chronic patients in general, is to improve health related 'quality of life'. Therefore the question can be raised whether these outcome measures were specific and responsive enough to be able to measure treatment effect. Also the follow-up period seemed to be rather short. Positive effects of spa therapy are found in patients with M Bechterev even after 40 weeks follow-up (van Tubergen 2001)

We noted heterogeneity of intervention 'balneotherapy'. Once balneotherapy consisted of tap water, once mineral baths (38 degrees Celsius, daily for 20 min) + mud packs (for 20 min), once radon/carbon dioxide baths (15 times in 4 weeks, for 20 min), twice Dead Sea baths (daily for 20-30 min), twice Sulphur baths (daily for 20 min), once a combination of Dead Sea and Sulphur baths and once a combination of Sulphur Baths + mud packs (see table of included studies). This makes it difficult to determine what the most effective form of balneotherapy is or even what is the essential element (minerals) in the water, which is responsible for the effectiveness.

Our conclusion of this review that a firm conclusion on the effectiveness of balneotherapy in patients with RA cannot be drawn is consistent with the conclusion of two other reviews (Brosseau 2002; Karagille 2004). The conclusions of the Brosseau 2002 review and ours are slightly different, mainly because we refrained from pooling because of heterogeneity, the poor methodological quality and the sparse data-presentation. Although their selection criteria were broad, they also included controlled trials without randomisation and editorials; we both conclude that the poor methodological quality and scarce data presentation makes it impossible to draw firm conclusions.

The 'spa environment' is an important factor in treatment results (Balint 1993; Sukenik 1994a). Many factors may contribute positively to the reported effects (Fam 1991), such as change of environment, the 'spa-scenery', the absence of (house) work duties, physical and mental relaxation, the non-competitive atmosphere with similarly suffering companions, physical therapy etc. As such,

spa benefits could perhaps be attributed also to the effects of factors unrelated to the "water" therapy *per se*.

AUTHORS' CONCLUSIONS

Implications for practice

Balneotherapy for patients with arthritis is one of the oldest forms of therapy. We found silver level evidence of benefit of mineral baths when compared to drug treatment at 8 weeks. One cannot ignore the positive findings reported in most studies, however, there is insufficient evidence to support the claims of positive findings in most studies. The scientific evidence is insufficient because of the poor methodological quality, the absence of an adequate statistical analysis, and for the patient, the absence of essential outcome measures (pain, quality of life).

Implications for research

1. Large, high quality research is needed, focusing on appropriate allocation concealment, blinding and an adequate data presentation and analysis. The design and reporting of future trials should conform to the CONSORT-statement.
2. New research should use outcome measures that are relevant to the patients, and adequate and responsive to the treatment under study. Follow-up should be of sufficient length to assess long-term effects.
3. New research should provide full data on outcome measures, including the mean and standard deviation or 95% confidence interval.
4. Future research should examine the effect of balneotherapy not only in pragmatic trials comparing various interventions with each other, but also in more explanatory trials comparing the intervention with a no treatment control group. When possible, the beneficial effect of the 'spa-environment' should be considered as a confounder or effect modifier and should be accounted for in the design of the trial.

We conclude that performing randomised studies with high methodological quality concerning the effectiveness of balneotherapy is both possible and necessary to provide strong evidence on the effects of balneotherapy.

ACKNOWLEDGEMENTS

We would like to thank the consumers association of water therapy. Their questions formed the basis of this review.

REFERENCES

References to studies included in this review

- Elkayam 1991** *{published data only}*
Elkayam O, Wigler I, Tishler M, Rosenblum I, Caspi D, Segal R, Fishel B, Yaron M. Effect of spa therapy in Tiberias in patients with rheumatoid arthritis and osteoarthritis. *Journal of Rheumatology* 1991;**18**:1799–803.
- Franke 2000** *{published data only}*
Franke A, Reiner L, Pratzel HG, Franke T, Resch KL. Long term efficacy of radon spa therapy in rheumatoid arthritis; a randomized sham-controlled study and follow-up. *Rheumatology* 2000;**39**:894–902.
- Hall 1996** *{published data only}*
Hall J, Skevington SM, Maddison PJ, Chapman K. A randomized and controlled trial of hydrotherapy in rheumatoid arthritis. *Arthritis Care and Research* 1996;**9**:206–15.
- Sukenik 1990a** *{published data only}*
Sukenik S, Neumann L, Buskila D, Kleiner-Baumgarten A, Zimlichman S, Horowitz J. Dead Sea salt baths for the treatment of rheumatoid arthritis. *Clinical and Experimental Rheumatology* 1990a;**8**:353–7.
- Sukenik 1990b** *{published data only}*
Sukenik S, Neumann L, Flusser D, Kleiner-Baumgarten A, Buskila D. Balneotherapy for rheumatoid arthritis at the Dead Sea. *Israeli Journal of Medicine and Science* 1995;**31**:210–4.
- Sukenik 1995** *{unpublished data only}*
Sukenik S, Buskila D, Neumann L, Kleiner-Baumgarten A, Zimlichman S, Horowitz J. Sulphur baths and mud pack treatment for rheumatoid arthritis at the Dead Sea area. *Annals of Rheumatic Diseases* 1990b;**49**:99–102.
- Yurtkuran 1999** *{published data only}*
* Yurtkuran M, Yurtkuran MA, Dilek K, Güllülü M, Karakoc Y, Özbek L, Bingöl Ü. A randomized, controlled study of balneotherapy in patients with rheumatoid arthritis. *Physicalischer Rehabilitation Kurort Medicine* 1999;**9**:92–6.

References to studies excluded from this review

- Baldwin 1972** *{published data only}*
Baldwin J. Pool therapy compared with individual home exercise therapy for juvenile rheumatoid arthritic patients. *Physiotherapy* 1972;**58**:230–1.
- Buskila 2001** *{published data only}*
Buskila D, Abu-Shakra M, Neumann L, Odes L, Shneider E, Flusser D, Sukenik S. Balneotherapy for fibromyalgia at the Dead Sea. *Rheumatology International* 2001;**20**:105–8.
- Danneskiold-S 1987** *{published data only}*
Danneskiold-Samsoe B, Lyngberg K, Risum T, Telling M. The effect of water exercise therapy given to patients with rheumatoid arthritis. *Scandinavian Journal of Rehabilitation Medicine* 1987;**19**:31–5.

- Elkayam 2000** *{published data only}*
Elkayam O, Ophir J, Brenner S, Paran D, Wigler I, Efron D, Even-Paz Z, Politi Y, Yaron M. Immediate and delayed effects of treatment at the Dead Sea in patients with psoriatic arthritis. *Rheumatology International* 2000;**19**:77–82.
- Estefan 1999** *{published data only}*
* Estefan MY, El-Shabrawy O, Erian EY, Raslan H, Morcos SW. Environmental recuperation in “Safaga” on the Red Sea Coast was effective for rheumatoid arthritis. *Journal of Clinical Rheumatology* 1999;**5**(2):109–11.
- Fioravanti 2000** *{published data only}*
Fioravanti S, Bisogno S, Nerucci F, Cicero MR, Locunolo S, Marcolongo R. Assessment of the effectiveness and tolerability of mud-packs therapy with fluorurate radioactivity water on gonarthrosis. A comparative study versus short wave therapy [Valutazione dell'efficacia e della tollerabilità della fangobalneoterapia radioattiva nella gonartrosi]. *Minerva Medicine* 2000;**91**:291–8.
- Forestier 1970** *{published data only}*
Forestier F, Augy S. Rhumatismes et thermalisme une expérience contrôlée de 65 cas. *Presse Thermale Climatique* 1970;**107**:200–5 (French).
- Gambichler 2001** *{published data only}*
Gambichler T, Rapp S, Senger E, Altmeyer P, Hoffmann K. Balneophototherapy of psoriasis: highly concentrated salt water versus tap water: a randomized, one-blind, right/left comparative study. *Photodermatology Photoimmunology & Photomedicine* 2001;**17**:22–5.
- Green 1993** *{published data only}*
Green J, McKenna F, Redfern EJ, Chamberlain MA. Home exercises are as effective as outpatient hydrotherapy for osteoarthritis of the hip. *British Journal of Rheumatology* 1993;**32**:812–5.
- Guillemin 2001** *{published data only}*
Guillemin F, Virion JM, Escudier P, de Talancé N, Weryha G. Effects on osteoarthritis of spatherapy at Bourbonne-les-Bains. *Joint Bone Spine* 2001;**68**:499–503.
- Halevy 2001** *{published data only}*
Halevy S, Giryas H, Friger M, Grossman N, Karpas Z, Sarov B, Sukenik S. The role of trace elements in psoriatic patients undergoing balneotherapy with Dead Sea bath salts. *Israel Medical Association Journal* 2001;**3**:828–32.
- Hill 1999** *{published data only}*
Hill S, Eckett MJH, Paterson C, Harkness EF. A pilot study to evaluate the effects of floatation spa treatments on patients with osteoarthritis. *Complementary Therapies in Medicine* 1999;**7**:235–8.
- Klemm 1971** *{published data only}*
Klemm C, Fricke R, Schattenkirchner M, Treiber W, Mathies H. [Effects and side effects of 3-chlor-4-allyloxy-phenylacetic acid (Mervan) in therapeutic study of rheumatic diseases.]. *Rheumaforsch* 1971;**30**:17–25.

Landewe 1992 {published data only}

Landewe RBM, Peeters R, Verreusel RLP, Masek BA, Goei The HS. [No difference in effectiveness measured between treatment in a thermal bath and in an exercise bath in patients with rheumatoid arthritis.]. *Nederlands Tijdschrift voor Geneeskunde* 1992;**139**:173-7 (Dutch).

Neumann 2001 {published data only}

Neumann L, Sukenik S, Bolotin A, Abu-Shakra M, Amir M, Flusser D, Buskila D. The effect of balneotherapy at the Dead Sea on the quality of life of patients with fibromyalgia syndrome. *Clinical Rheumatology* 2001;**20**:15-9.

Nguyen 1997 {published data only}

Nguyen M, Revel M, Dougados M. Prolonged effects of 3 weeks therapy in a Spa resort on lumbar spine, knee and hip osteoarthritis: follow-up after 6 months. A randomized controlled trial. *British Journal of Rheumatology* 1997;**36**: 77-91.

Nicholls 1990 {published data only}

Nicholls E, Ahern M, Simionato E, Bovill I. Assessment of hydrotherapy as a therapeutic modality in rheumatic diseases. Proceedings 3rd Int Physiotherapy Congress, Hong Kong: Link Printing Pty Ltd, 1990, 1990:630-5.

Rijswijk 1992 {published data only}

Rijswijk MH van. [A prospective study of the effectiveness of thermal bath treatments in patients with rheumatoid arthritis.]. *Nederlands tijdschrift voor geneeskunde* 1992;**136**: 163-4 (Dutch).

Steiner 1979 {published data only}

Steiner FJE, Valkenburg HA, Stadt RJ van der, Stoyanova-Drenska M, Zant J. [Balneology treatment of patients with rheumatoid arthritis.]. *Nederlands tijdschrift voor geneeskunde* 1979;**123**:661-4 (Dutch).

Strauss-Blasche 2000 {published data only}

Strauss-Blasche G, Ekmekcioglu C, Klammer N, Markt W. The change of well-being associated with spa therapy. *Forschende Komplementärmedizin und Klassische Naturheilkunde* 2000;**7**:269-74.

Sukenik 1994 {published data only}

Sukenik S, Giryas H, Halevy S, Neumann L, Flusser D, Buskila D. Treatment of psoriatic arthritis at the Dead Sea. *Rheumatology* 1994b;**21**:1305-9.

Sukenik 2001 {published data only}

Sukenik S, Baradin R, Codish S, Neumann L, Flusser D, Abu-Shakra M, Buskila D. Balneotherapy at the Dead Sea area for patients with psoriatic arthritis and concomitant fibromyalgia. *Israel Medical Association Journal* 2001;**3**: 147-50.

Svarcova 1990 {published data only}

Svarcova J von, Hofta T, Kouba A, Trnavsky K, Zvorov J. Beeinflussung der Schmerzsymptomatik im Fussbereich bei Patienten mit Rheumatoid-Arthritis durch unterschiedliche Physiotherapiemittel. *Zeitschrift für Physiotherapie* 1990;**42**: 109-12 (German).

Sylvester 1990 {published data only}

Sylvester KL. Investigation of the effect of hydrotherapy in the treatment of osteoarthritic hips. *Clinical Rehabilitation* 1989;**4**:223-8.

Szucz 1989 {published data only}

Szucz L, Ratko I, Lesko T, Szoor I, Genti G, Balint G. Double blind trial on the effectiveness of the Puspokladany thermal water on arthrosis of the knee joints. *The Roy Soc Health J.* 1989;**109**:7-9.

van Tubbergen 2001 {published data only}

van Tubbergen A, Landewé R, van der Heijde D, Hidding A, Wolter N, Asscher M, Falkenbach A, Genth E, Goei Thé H, van der Linden S. Combined spa-exercise therapy is effective in patients with ankylosing spondylitis: a randomized controlled trial. *Arthritis Care and Research* 2001;**45**:430-8.

Wigler 1996 {published data only}

Wigler I, Elkayam O, Paran D, Yaron M. Spa therapy for gonarthrosis: a prospective study. *Rheumatology International* 1995;**15**:65-8.

Youn 1998 {published data only}

Youn AI, Kim BK, Suh DH. The effectiveness of modified Ingram therapy compared with severity of psoriasis. *The Journal of Dermatology* 1998;**25**:112-7.

Özcelik 2000 {published data only}

Özcelik S, Polat HH, Akyol M, Yalcin AN, Özcelik D, Marufinah M. Kangal hot spring with fish and psoriasis treatment. *The Journal of Dermatology* 2000;**27**:386-90.

References to studies awaiting assessment

Athanasiu 1972 {published data only}

Athanasiu P, Petrescu A, Surdan C, Moisa I. [Effect of mineral water and balneological treatment with iodated and sulfated water on rickettsial, pararickettsial and adenoviral antibodies in patients with associated pulmonary and rheumatic chronic diseases.]. *Studii si cercetari de virusologie* 1972;**23**:9-12 (Romanian).

Horvath 1967 {published data only}

Horvath G. [Effect of hyperthermic baths in diseases of the locomotive system.]. *Fysiatrický a reumatologický vestník* 1967;**45**:277-80 (Czech).

Kabanov 1965 {published data only}

Kabanov SE. [Effectiveness of the treatment of dystrophic (non-infective) polyarthritis in Sochi-Matseta spa with special reference to remote results.]. *Voprosy reumatizma* 1965;**5**:52-8 (Russian).

Lazowski 1966 {published data only}

Lazowski Z, Gutowska-Grzegorzcyk G, Romicka A, Marchwicki I. [Tentative assessment of rehabilitation with particular consideration of the effects of balneotherapy on the course of rheumatoid arthritis in children.]. *Reumatologia* 1966;**4**:321-9. (Polish).

Litvinenko 1977 {published data only}

Litvinenko AG, Perminov IA, Poluden' EP, Oprenko BI, Pavlova ES. [Evaluation of efficacy of balneotherapy

- methods in patients with rheumatoid polyarthritis.]. *Vrachebnoe delo* 1977;5:101-4. (Russian).
- Mackiewicz 1966** *{published data only}*
Mackiewicz S, Sternalova L. [Evaluation of the balneological treatment of children with progressive juvenile polyarthritis.]. *Fysiatrický a reumatologický vestník* 1966;44:324-7. (Czech).
- Mar'iasis 1987** *{published data only}*
Mar'iasis ED, Militenko SA, Shalygina IE. [Therapeutic efficacy of dry-air radon baths in the rehabilitation of patients with psoriatic arthritis.]. *Voprosy kurortologii, fizioterapii, i lechebnoi fizicheskoi kultury* 1987;6:37-9. (Russian).
- Nobunaga 1992** *{published data only}*
Nobunaga M. Balneotherapy of patients with rheumatoid arthritis. 1992; 3-8. (Japanese with English abstract, unable to trace the journal or congress it is published. **3-8**. (Japanese with English abstract, unable to trace the journal or congress it is published. The original report is in the authors possession).
- Perel'muter 1976** *{published data only}*
Perel'muter DL, Trofimova TM, Drinevskii NP, Mel'nikov AA, Kotikov VE. [Effectiveness of step-by-step treatment of patients in early stage of rheumatoid arthritis at the AMS] USSR Institute of Rheumatism and in Eupatoria health resort.. *Voprosy reumatizma* 1976;3:27-31. (Russian).
- Pshetakovskii 1971** *{published data only}*
Pshetakovskii IL. [Effect of radon water therapy at the Khmel'nik health resort on the cardiovascular system in patients with rheumatoid arthritis.]. *Voprosy kurortologii, fizioterapii, i lechebnoi fizicheskoi kultury* 1971;36:222-6. (Russian).
- Rybnikov 1965** *{published data only}*
Rybnikov NI, Novitskii GA. [Vascular changes as indices of the effectiveness of treatment of polyarthritis of various etiology with the radon-containing mineral waters of Chmielnik.]. *Voprosy kurortologii, fizioterapii, i lechebnoi fizicheskoi kultury* 1965;30:462-3. (Russian).
- Sukenik 1990** *{published data only}*
Sukenik S. [Balneological (spa)therapy for rheumatic diseases.]. *Harefuah* 1990;119:167-170. (Hebrew).
- Sukenik 1995b** *{published data only}*
Sukenik S, Mayo A, Neumann L, Flusser D, Kleiner-Baumgarten A, Buskila D. [Dead Sea bath salts for osteoarthritis of the knee.]. *Harefuah* 1995; 129: 100-3, 159,158. **129**:100-3,159,158. (Hebrew).
- Susta 1975** *{published data only}*
Susta A, Pavelka K, Bremova A, Salavcova V, Svandova H, Richter M. [Controlled clinical trial with Benetazone (Spofa) during spa treatment.]. *Fysiatr Revmatol Vestn* 1975; 53: 3-11. **53**:3-11. (Czech).
- Taletene 1984** *{published data only}*
Taletene IP, Gaigalene BA. [Effect of combined chrisanol and balneological treatment on the clinical indicators and permeability of the synovial membrane in patients with rheumatoid arthritis.]. *Vopr Kurortol Fizioter Lech Fiz Kult* 1984; 2: 28-31. **2**:28-31. (Russian).
- Timofeev 1973** *{published data only}*
Timofeev AV, Shautsukova LK, Shautsukova LZ. [Mathematical evaluation of the effectiveness of balneotherapy and the differential diagnosis of rheumatoid and rheumatic polyarthritis.]. *Vestn Akad Med Nauk SSSR* 1973; 28: 85-7. **28**:85-7. (Russian).
- Veinpalu-Elu 1979** *{published data only}*
Veinpalu-Elu, Trink RF, Veinpalu LE. [Factors affecting the results of the overall treatment of rheumatoid arthritis at mud therapy health resorts.]. *Vopr Kurortol Fizioter Lech Fiz Kult* 1979; 1: 27-31. **1**:27-31. (Russian).
- Zaitseva 1979** *{published data only}*
Zaitseva VI, Bersudskaia SL, Gudilina VG, Petrova VI, Khakimdzhanov AKh. [Experience with the balneological treatment of rheumatoid arthritis at a Republic hospital.]. *Vopr Kurortol Fizioter Lech Fiz Kult* 1979; 1: 51-3. **1**:51-3. (Russian).
- Zavadiak 1976** *{published data only}*
Zavadiak M. [Effectiveness of treatment of patients with rheumatoid polyarthritis at the balneologic resort Siniak.]. *Vrach Delo* 1976; 10: 105-9. **10**:105-9. (Russian).

Additional references

- Balint 1993**
Balint G, Bender T, Szabó E. Spa treatment in arthritis (correspondence). *Journal of Rheumatology* 1993;**20**:1623-5.
- Becker 1994**
Becker BE. The biologic aspects of hydrotherapy. *Journal of the Back and Musculoskeletal Rehabilitation* 1994;**4**:255-64.
- Behrend 1979**
Behrend T. The balneotherapy of rheumatoid arthritis. *Rheumatology and Rehabilitation* 1979, (Suppl):86-7.
- Boers 1994**
Boers M, Tugwell P, Felson DT, et al. World Health Organization and International League of Associations for rheumatology endpoints for symptom modifying antirheumatic drugs in rheumatoid arthritis clinical trials. *Journal of Rheumatology* 1994, (suppl 41):86-9.
- Brosseau 2002**
Brosseau L, Robinson V, Leonard G, Casimiro L, Pelland L, Wells G, Tugwell. Efficacy of balneotherapy for rheumatoid arthritis: a meta-analysis. *Physical Therapy Reviews* 2002;**7**:67-87.
- Calin 1988**
Calin A. Royal National Hospital for rheumatic diseases-Bath. A 250th birthday party (editorial). *Journal of Rheumatology* 1988;**15**:733-4.
- Cosh 1982**
Cosh JA. The rheumatologist and the spa: a personal review. *The Royal Society of Health Journal* 1982;**102**:189-92.

Fam 1991

Fam AG. Spa treatment in arthritis: a rheumatologist's view (editorial). *Journal of Rheumatology* 1991;**18**:1775–7.

Goldby 1993

Goldby LJ, Scott DL. The way forward for hydrotherapy (editorial). *British Journal of Rheumatology* 1993;**32**:771–3.

Golland 1981

Golland A. Basic hydrotherapy. *Physiotherapy* 1981;**67**: 258–62.

Jackson 1990

Jackson R. Waters and spas in the classical world. *Medical History (suppl)* 1990;**10**:1–13.

Jagger 1984

Jagger M, Zmood D. Hydrotherapy by physiotherapists in a community health centre. *Australian Family Physician* 1984;**13**:878–81.

Johnson 1990

Johnson RH. Arthur Stanley Wohlmann, the first government balneologist in New Zealand. *Medical History Supplement* 1990;**10**:114–26.

Karagülle 2004

Karagülle MZ, Karagülle M. Balneotherapy and Spathery of rheumatic diseases [Balneotherapie und Kurorttherapie rheumatischer Erkrankungen in der Türkei: Ein systematischer Review]. *Forschende Komplementärmedizin Klassische Naturheilkunde* 2004;**11**:33–41.

Lau 1997

Lau J, Ioannidis JP, Schmid CH. Quantitative synthesis in systematic reviews. *Annals of Internal Medicine* 1997;**127** (9):820–6.

Machtey 1982

Machtey I. Dead Sea balneology in osteoarthritis. In: *Machtey I, ed. Second International Seminar on Treatment of Rheumatic Diseases I*. Boston. John Wricht PGS Inc, 1982: 161–6.

Nicholas 1994

Nicholas JJ. Physical modalities in rheumatological rehabilitation; review article. *Archives of Physical Medicine and Rehabilitation* 1994;**75**:994–1001.

O'Hare 1985

O'Hare JP, Heywood A, Summerhayes C, et al. Observations on the effect of immersion in bath spa water. *British Medical Journal* 1985;**291**:1747–51.

Palmer 1990

Palmer R. "In this our lightye and learning tyme": Italian baths in the era of the renaissance. *Medical History (suppl)* 1990;**10**:14–22.

Ropes 1958

Ropes MW, Bennett GA, Cobb S, Jacox R, Jessar RA. Revision of diagnostic criteria in rheumatoid arthritis. *Bulletin of Rheumatic Diseases* 1958;**9**:175–6.

Simon 1981

Simon L, Blotman F. Exercise therapy and hydrotherapy in the treatment of the rheumatic diseases. *Clinic in Rheumatic Diseases* 1981;**7**:337–47.

Smidt 2002

Smidt N, Assendelft WJ, van der Windt DA, Hay EM, Buchbinder R, Bouter LM. Corticosteroid injections for lateral epicondylitis: a systematic review. *Pain* 2002;**96**(1-2):23–40.

Steinbrocker 1949

Steinbrocker O, Traeger CH, Batterman RC. Therapeutic criteria in rheumatoid arthritis. *Journal of the American Medical Association* 1949;**140**:659–62.

Sukenik 1994a

Sukenik S. Spa treatment for arthritis at the Dead Sea area. Editorial. *Israelian Journal of Medical Science* 1994a;**30**: 919–21.

Tugwell 2004

Tugwell P, Shea B, Boers M, Brooks P, Simon L, Strand V, et al. *Evidence-Based Rheumatology*. BMJ Books, 2004.

van Tubergen 2001

van Tubergen A, Landewe R, van der Heijde D, Hidding A, Wolter N, Asscher M, Falkenbach A, Genth E, The HG, van der Linden S. Combined spa-exercise therapy is effective in patients with ankylosis spondylitis: a randomised controlled trial. *Arthritis and Rheumatism* 2001;**45**(5):430–8.

van Tulder 2003

van Tulder M, Furlan A, Bombardier C, Bouter L, Editorial Board of the Cochrane Collaboration Back Review Group. Updated method guidelines for systematic reviews in the Cochrane Collaboration Back Review Group. *Spine* 2003; **28**:1290–9.

Verhagen 1998

Verhagen AP, de Vet HCW, de Bie RA, Kessels, AGH, Boers M, Bouter LM, Knipschild PG. 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**:1235–41.

Verhagen 2001

Verhagen AP, de Vet HCW, de Bie RA, Boers M, van den Brandt PA. The art of quality assessment of RCTs included in systematic reviews. *Journal of Clinical Epidemiology* 2001; **54**(7):651–4.

* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Elkayam 1991

Methods	RCT. Blinding: Patient
Participants	Physician / rheumatologist, Israel, n=41. RA as defined by ARA.
Interventions	I: Mineral baths + mud packs, n=19. 5% male, mean age 57.7 yr, mean DOC 13 yr. C: tap water baths, n=22. 14% male, mean age 60.3 yr, mean DOC 12.9 yr. Treatment duration: 2 wks. follow-up: 12 wks.
Outcomes	Morning stiffness, 15 min walking time, patient and physician severity assessment, joint tenderness, handgrip strength and laboratorium variables
Notes	Only point estimates, no measures of variability presented. Quality score: 4

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Franke 2000

Methods	RCT. Blinding: patient, care giver and observer.
Participants	In-patient rehabilitation centre, Bad Brambeck, Germany, n=60. RA as defined by ARA.
Interventions	I: radon-carbon dioxide baths, n=30. 27% male, mean age: 58 yr; mean DOC 11 yr. C: carbon dioxide baths, n=30. 20% male, mean age 58 yr; mean DOC 9.9 yr. Treatment duration: 4 wks, 6 mo follow-up.
Outcomes	Pain (VAS), global status (AIMS), functional status, morning stiffness and laboratory variables
Notes	1 drop-out, 3 incomplete follow-up. No side effects. Quality score: 8

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Hall 1996

Methods	RCT. Blinding: observer
Participants	Outpatient clinic hospital, Bath UK, n=148. Chronic RA; Steinbrocker class I, II and III.
Interventions	I: Seated immersion, n=35. 40% male, mean age 55.8 yr, mean DOC 9.7 yr. C1: Hydrotherapy, n=35. 23% male, mean age 58.5 yr, mean DOC 11.9 yr. C2: Land exercise, n=34. 31% male, mean age 58.7 yr, mean DOC 12.2 yr. C3: Relaxation, n=35. 28% male, mean age 59.8 yr, mean DOC 12.2 yr. Treatment duration: 4 wks, 3 mo follow-up.
Outcomes	Pain (McGill), ROM, grip strength, joint tenderness, morning stiffness, global status (AIMS2) and patient and therapist self assessment
Notes	9 drop-outs. Pre-post analysis. Quality score: 6

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Sukenik 1990a

Methods	RCT. Blinding: patient and observer
Participants	Outpatient clinic Soroka, Israel, n=30. RA as defined by ARA.
Interventions	I: Dead Sea salt baths, n=15. 13% male, mean age 57 yr, mean DOC 13.4 yr. C: Sodium chloride baths, n=15. 26% male, mean age 58.4 yr, mean DOC 11 yr. Treatment duration: 2 wks, follow-up: 3 mo.
Outcomes	Larger improvement mostly in I compared to C, on morning stiffness, 15 m walk time, hand grip strength, Ritchie index, number of active joints, activities of daily living, patient self assessment
Notes	Pre-post analysis, only point estimated presented. 4 cases of mild side effects in I (thermal reaction). Quality score: 4

Risk of bias

Item	Authors' judgement	Description
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Sukenik 1990a (Continued)

Allocation concealment?	Unclear	B - Unclear
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Sukenik 1990b

Methods	RCT. Blinding: observer
Participants	Outpatient clinic Soroka, Israel, n=40. RA as defined by ARA.
Interventions	I: Sulphur baths, n=10. 10% male, mean age 56.8 yr, mean DOC 10.3 yr. C1: Mudpacks, n=10. 30% male, mean age 49 yr, mean DOC 6.4 yr. C2: Mudpacks+sulphur baths, n=10. 10% male, mean age 52.3 yr, mean DOC 8.2 yr. C3: No-treatment control, n=10. 30% male, mean age 52.4 yr, mean DOC 8.5 yr. Treatment duration: 2 wks, follow-up 3 mo.
Outcomes	Functional status, morning stiffness, 15 min walking time, hand grip strength, patient assessment disease severity, joint tenderness, number of active joints and laboratory variables
Notes	Pre-post analysis, only point estimates presented. 3 mild cases of side effects (thermal reaction). Quality score: 4.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Sukenik 1995

Methods	RCT. Blinding: observer
Participants	Outpatient clinic, Soroka, Israel, n=36. RA as defined by ARA.
Interventions	I: Baths in Dead Sea, n=9. 11% male, mean age 61.6 yr, mean DOC 10.9 yr. C1: Sulphur baths, n=9. 11% male, mean age 57.8 yr, mean DOC 15.1 yr. C2: Dead Sea baths+sulphur baths, n=10. 20% male, mean age 58.3 yr, mean DOC 18.5 yr. C3: No-treatment control, n=8. 12% male, mean age 62.4 yr, mean DOC 11.3 yr. Treatment duration: 2 wks, follow-up 3 mo.
Outcomes	Functional status, morning stiffness, 15 min walking time, hand grip strength, patient assessment disease severity, joint tenderness and number of active joints
Notes	Pre-post analysis, only point estimates presented Quality score: 3.

Sukenik 1995 (Continued)

<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Yurtkuran 1999

Methods	RCT. Blinding: observer
Participants	Outpatient clinic Bursa, Turkey, n=57. RA as defined by ARA.
Interventions	I: Mineral baths, n=32. 19% male, mean age 44 yr, mean DOC 15.5 yr. C: drug (Cyclosporine A; 3.5 mg/kg) treatment, n=25. 16% male, mean age 39 yr, mean DOC 12 yr. Treatment duration I: 3 weeks; C: 2 months
Outcomes	Pain (VAS), grip strength, global evaluation, laboratory variables
Notes	Pre-post analysis, measures of variability are unclear (SEM or SD)

<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

RCT = randomised clinical trial; ARA = American Rheumatism Association, DOC = duration of complaints, AIMS = arthritis impact measurement scales, ROM = range of motion, SEM = standard error of means, SD = standard deviation.

Characteristics of excluded studies [ordered by study ID]

Study	Reason for exclusion
Baldwin 1972	Not an RCT
Buskila 2001	No patients with RA
Danneskiold-S 1987	Not an RCT
Elkayam 2000	No patients with RA
Estefan 1999	Letter to the editor

(Continued)

Fioravanti 2000	No patients with RA
Forestier 1970	Not an RCT
Gambichler 2001	No patients with RA
Green 1993	No patients with RA
Guillemin 2001	Not an RCT, no patients with RA
Halevy 2001	No patients with RA
Hill 1999	Not an RCT, no patients with RA
Klemm 1971	Outcome measures inappropriate
Landewe 1992	Not an RCT
Neumann 2001	No patients with RA
Nguyen 1997	No patients with RA
Nicholls 1990	No patients with RA
Rijswijk 1992	Not an RCT
Steiner 1979	Not an RCT
Strauss-Blasche 2000	Not an RCT, no patients with RA
Sukenik 1994	Not an RCT
Sukenik 2001	Not an RCT, no patients with RA
Svarcova 1990	Not an RCT
Sylvester 1990	No patients with RA
Szucz 1989	Not an RCT
van Tubbergen 2001	No patients with RA
Wigler 1996	No patients with RA
Youn 1998	Not an RCT, no patients with RA
Özcelik 2000	Not an RCT, no patients with RA

DATA AND ANALYSES

Comparison 4. Radon Carbon Dioxide baths versus Carbon Dioxide baths

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Pain	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
1.1 End of treatment	1		Mean Difference (IV, Random, 95% CI)	Not estimable
1.2 3 month follow-up	1		Mean Difference (IV, Random, 95% CI)	Not estimable
1.3 6 month follow-up	1		Mean Difference (IV, Random, 95% CI)	Not estimable
2 AIMS	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 3 month follow-up	1		Mean Difference (IV, Random, 95% CI)	Not estimable
2.2 6 month follow-up	1		Mean Difference (IV, Random, 95% CI)	Not estimable
3 Pain improvement	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
3.1 End of treatment	1		Risk Ratio (M-H, Random, 95% CI)	Not estimable
3.2 3 month follow-up	1		Risk Ratio (M-H, Random, 95% CI)	Not estimable
3.3 6 month follow-up	1		Risk Ratio (M-H, Random, 95% CI)	Not estimable
4 Morning stiffness improvement	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
4.1 End of treatment	1		Risk Ratio (M-H, Random, 95% CI)	Not estimable
4.2 3 month follow-up	1		Risk Ratio (M-H, Random, 95% CI)	Not estimable
4.3 6 month follow-up	1		Risk Ratio (M-H, Random, 95% CI)	Not estimable

Comparison 6. Tap water baths versus exercises

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Pain	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
1.1 Affect MPQ, End treatment	1		Mean Difference (IV, Random, 95% CI)	Not estimable
1.2 AIMS2 pain, End of treatment	1		Mean Difference (IV, Random, 95% CI)	Not estimable
1.3 Affect MPQ, Follow-up 3 months	1		Mean Difference (IV, Random, 95% CI)	Not estimable
1.4 AIMS2 pain, follow-up 3 months	1		Mean Difference (IV, Random, 95% CI)	Not estimable
2 Grip strength	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 End of treatment	1		Mean Difference (IV, Random, 95% CI)	Not estimable
2.2 Follow-up, 3 months	1		Mean Difference (IV, Random, 95% CI)	Not estimable
3 Morning stiffness	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
3.1 End of treatment	1		Mean Difference (IV, Random, 95% CI)	Not estimable
3.2 Follow-up, 3 months	1		Mean Difference (IV, Random, 95% CI)	Not estimable

Comparison 7. Tap water baths versus relaxation

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Pain	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
1.1 Affect MPQ, end of treatment	1		Mean Difference (IV, Random, 95% CI)	Not estimable
1.2 AIMS2 pain, end of treatment	1		Mean Difference (IV, Random, 95% CI)	Not estimable
1.3 Affect MPQ, follow-up 3 months	1		Mean Difference (IV, Random, 95% CI)	Not estimable
1.4 AIMS2 pain, follow-up 3 months	1		Mean Difference (IV, Random, 95% CI)	Not estimable
2 Grip strength	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 End of treatment	1		Mean Difference (IV, Random, 95% CI)	Not estimable
2.2 Follow-up 3 months	1		Mean Difference (IV, Random, 95% CI)	Not estimable
3 Morning stiffness	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
3.1 End of treatment	1		Mean Difference (IV, Random, 95% CI)	Not estimable
3.2 Follow-up 3 months	1		Mean Difference (IV, Random, 95% CI)	Not estimable

Comparison 9. Mineral baths versus drug therapy (CsA)

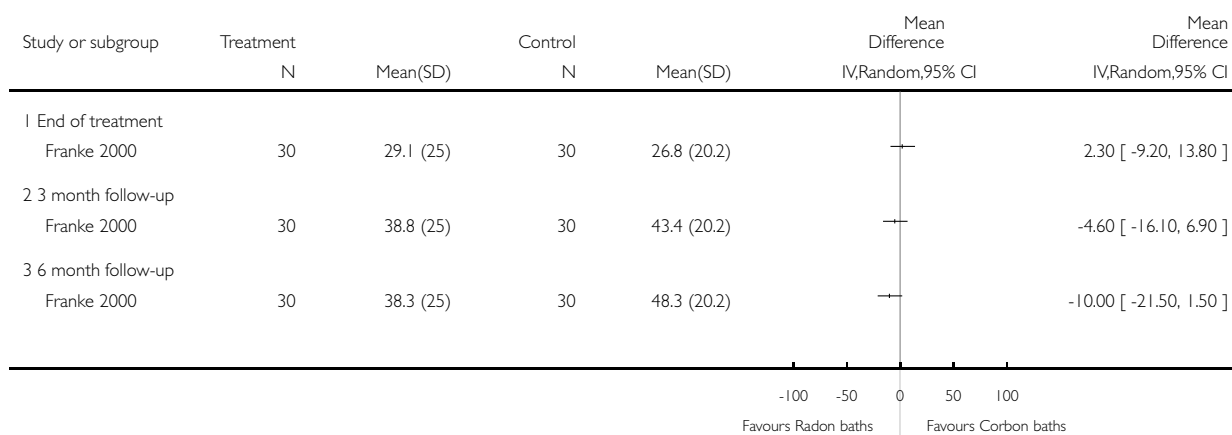
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Improvement	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
1.1 8 weeks	1		Risk Ratio (M-H, Random, 95% CI)	Not estimable
2 Pain	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 4 weeks follow-up	1		Mean Difference (IV, Random, 95% CI)	Not estimable
2.2 8 weeks follow-up	1		Mean Difference (IV, Random, 95% CI)	Not estimable
3 Morning stiffness	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
3.1 4 weeks follow-up	1		Mean Difference (IV, Random, 95% CI)	Not estimable
3.2 8 weeks follow-up	1		Mean Difference (IV, Random, 95% CI)	Not estimable

Analysis 4.1. Comparison 4 Radon Carbon Dioxide baths versus Carbon Dioxide baths, Outcome 1 Pain.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 4 Radon Carbon Dioxide baths versus Carbon Dioxide baths

Outcome: 1 Pain

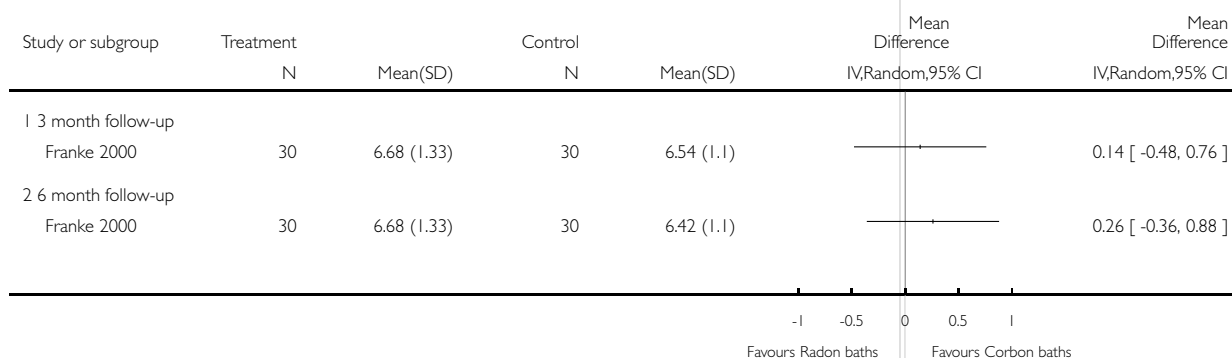


Analysis 4.2. Comparison 4 Radon Carbon Dioxide baths versus Carbon Dioxide baths, Outcome 2 AIMS.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 4 Radon Carbon Dioxide baths versus Carbon Dioxide baths

Outcome: 2 AIMS

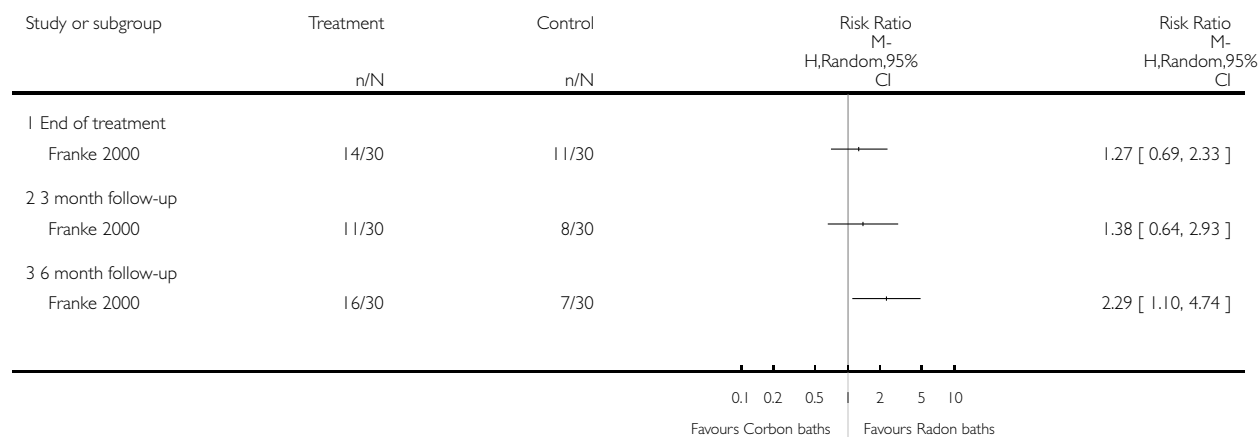


Analysis 4.3. Comparison 4 Radon Carbon Dioxide baths versus Carbon Dioxide baths, Outcome 3 Pain improvement.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 4 Radon Carbon Dioxide baths versus Carbon Dioxide baths

Outcome: 3 Pain improvement

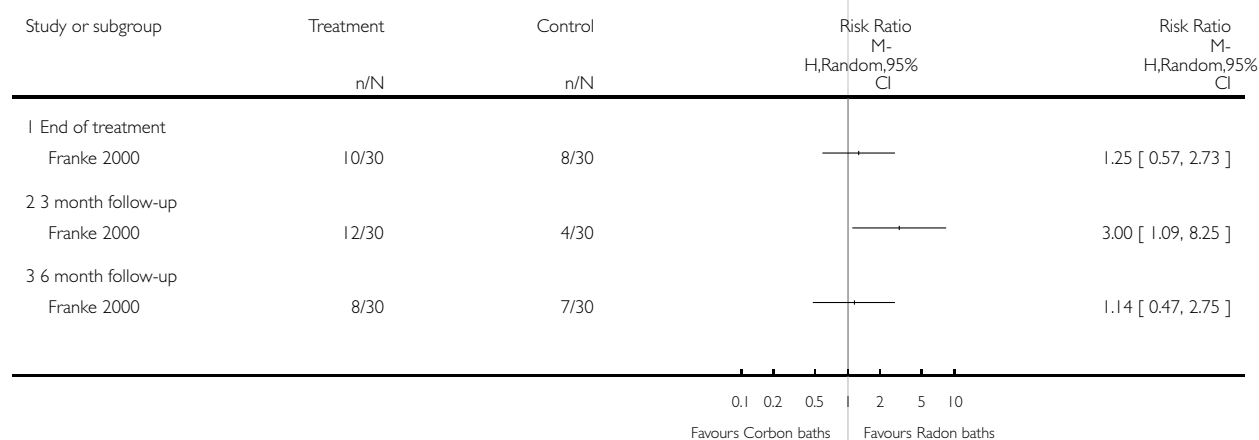


Analysis 4.4. Comparison 4 Radon Carbon Dioxide baths versus Carbon Dioxide baths, Outcome 4 Morning stiffness improvement.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 4 Radon Carbon Dioxide baths versus Carbon Dioxide baths

Outcome: 4 Morning stiffness improvement

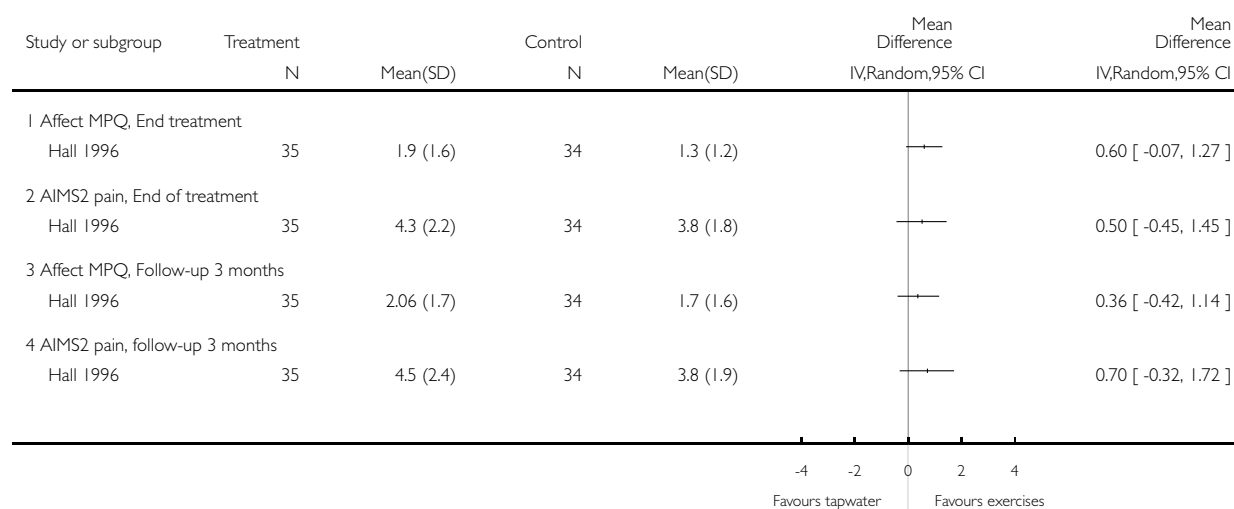


Analysis 6.1. Comparison 6 Tap water baths versus exercises, Outcome 1 Pain.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 6 Tap water baths versus exercises

Outcome: 1 Pain

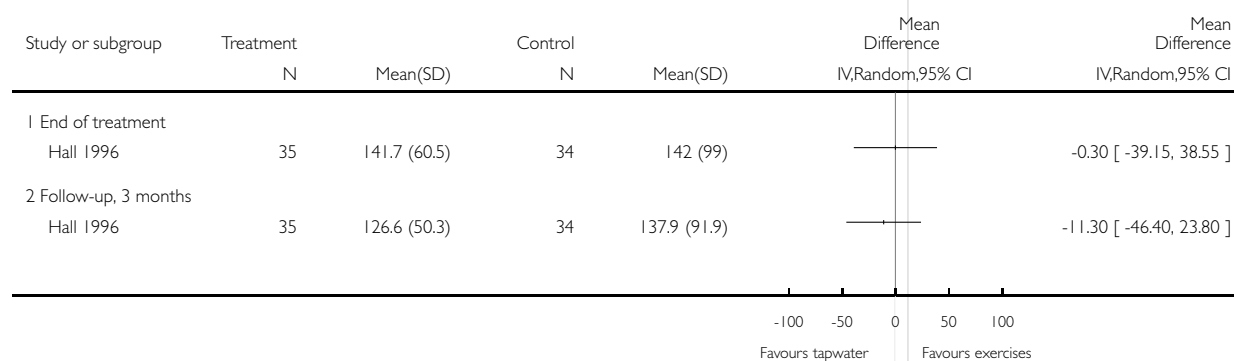


Analysis 6.2. Comparison 6 Tap water baths versus exercises, Outcome 2 Grip strength.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 6 Tap water baths versus exercises

Outcome: 2 Grip strength

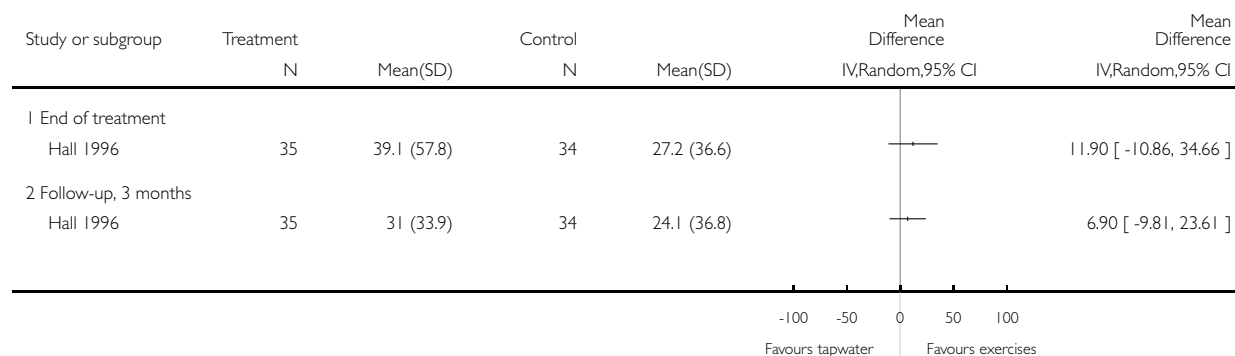


Analysis 6.3. Comparison 6 Tap water baths versus exercises, Outcome 3 Morning stiffness.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 6 Tap water baths versus exercises

Outcome: 3 Morning stiffness

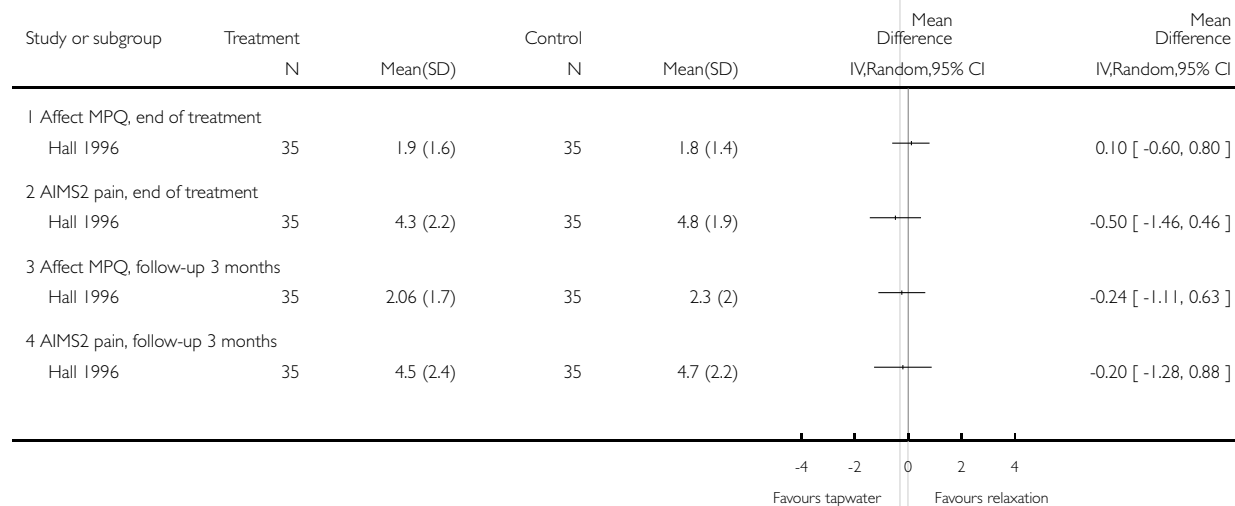


Analysis 7.1. Comparison 7 Tap water baths versus relaxation, Outcome 1 Pain.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 7 Tap water baths versus relaxation

Outcome: 1 Pain

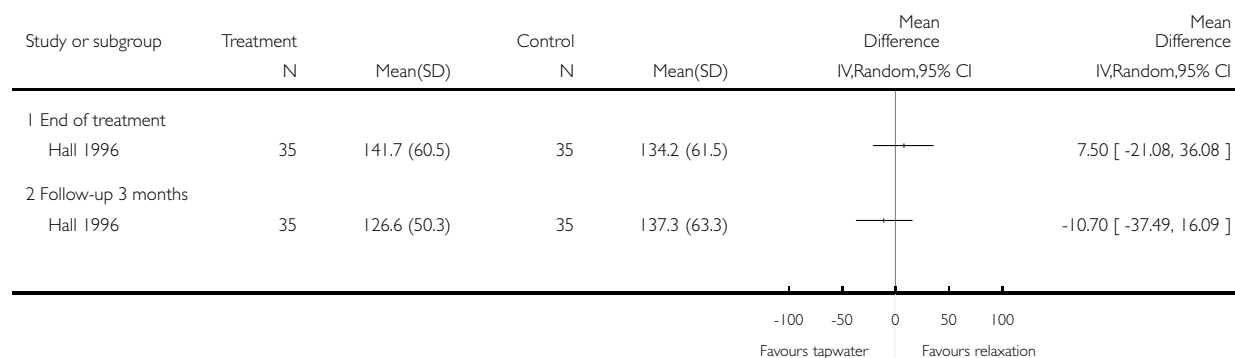


Analysis 7.2. Comparison 7 Tap water baths versus relaxation, Outcome 2 Grip strength.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 7 Tap water baths versus relaxation

Outcome: 2 Grip strength

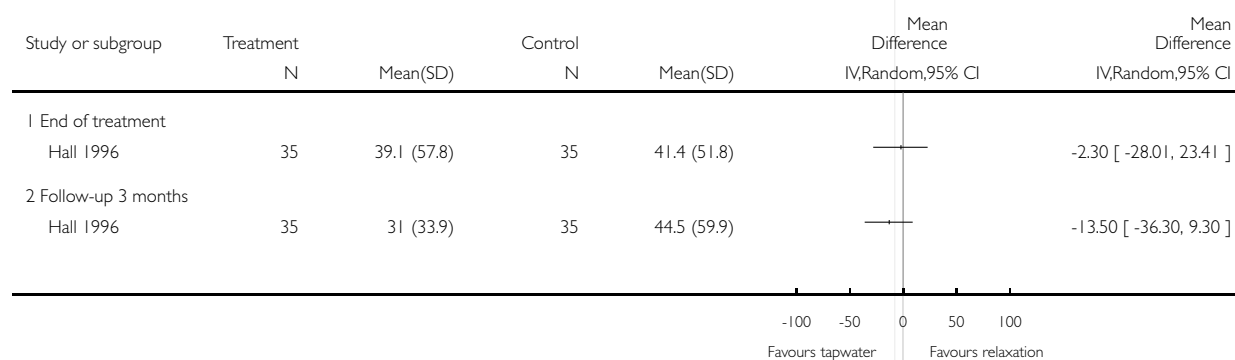


Analysis 7.3. Comparison 7 Tap water baths versus relaxation, Outcome 3 Morning stiffness.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 7 Tap water baths versus relaxation

Outcome: 3 Morning stiffness

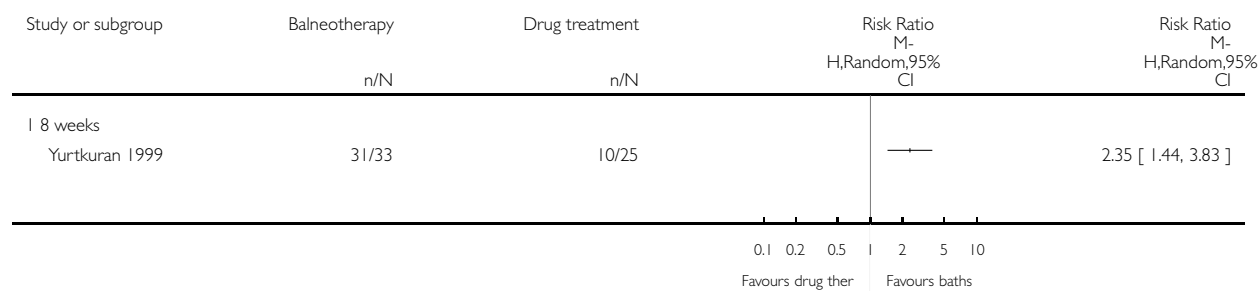


Analysis 9.1. Comparison 9 Mineral baths versus drug therapy (CsA), Outcome 1 Improvement.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 9 Mineral baths versus drug therapy (CsA)

Outcome: 1 Improvement

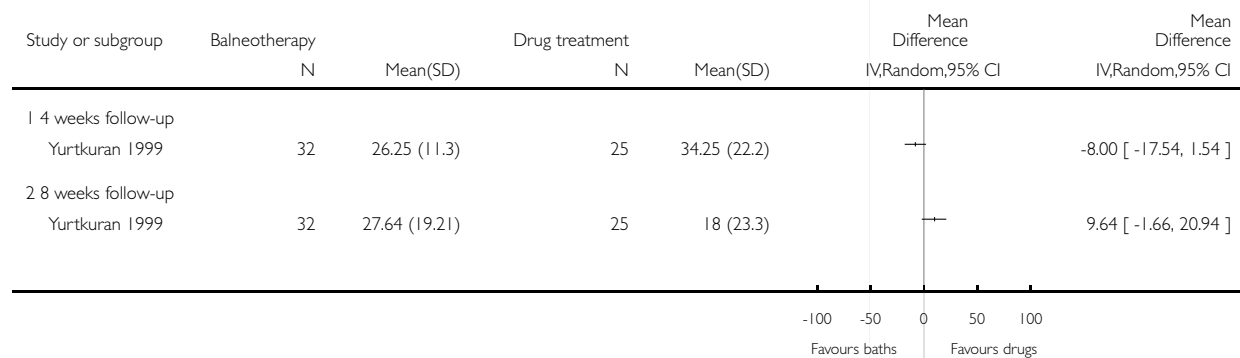


Analysis 9.2. Comparison 9 Mineral baths versus drug therapy (CsA), Outcome 2 Pain.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 9 Mineral baths versus drug therapy (CsA)

Outcome: 2 Pain

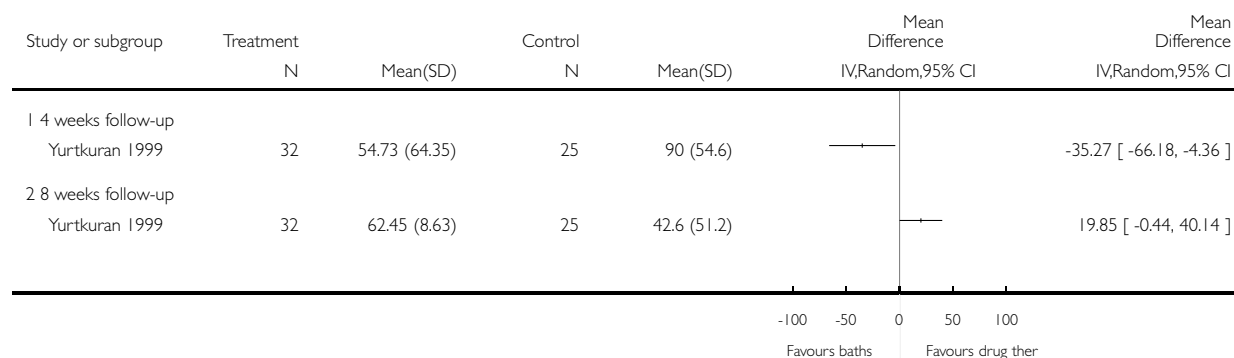


Analysis 9.3. Comparison 9 Mineral baths versus drug therapy (CsA), Outcome 3 Morning stiffness.

Review: Balneotherapy for rheumatoid arthritis

Comparison: 9 Mineral baths versus drug therapy (CsA)

Outcome: 3 Morning stiffness



ADDITIONAL TABLES

Table 1. Methodological quality

Study	Randomisation	Concealment of R	Baseline similarity	Eligibility criteria	Blinded outcome ass	Blinded care provid	Blinded patients	Data presentation	Intention to treat
Elkayam '91	Yes	Unclear	Yes	Yes	Unclear	Unclear	Yes	No	No
Franke '00	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear
Hall '96	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Unclear
Sukenik '90a	Yes	Unclear	Yes	No	Yes	Unclear	Yes	No	Unclear
Sukenik '90b	Yes	Unclear	Yes	Yes	Yes	Unclear	No	No	Unclear
Sukenik '95	Yes	Unclear	No	Yes	Yes	No	No	No	No
Yurtkuran '99	Yes	Unclear	No	Yes	Yes	No	No	Yes	Unclear

Table 2. Clinical relevance table: pain at follow-up

Study	Treatment group	Outcome	N	Baseline mean	End of study mean	Absolute benefit	Relative difference	Stat sign
Franke 2000	E: Radon carbon dioxide	Pain (100 mm VAS)	30	44.8 (SD 25)	38.3 (SD 25)	10 (0.10%)	24.4 %	Not sign
	C: Carbon dioxide		30	38.6 (SD 20.2)	48.3 (SD 20.2)			
Hall 1996	E: tap water bath	Pain (affect MPQ)	35	2.4 (SD 1.9)	2.06 (SD 1.7)	0.36	16 %	Not sign
	C: land exercises		34	2.1 (SD 1.6)	1.7 (SD 1.6)			
Hall 1996	E: tap water bath	Pain (affect MPQ)	35	2.4 (SD 1.9)	2.06 (SD 1.7)	-0.24	12 %	Not sign
	C: relaxation		35	1.6 (SD 1.5)	2.3 (SD 2)			
Yurtkaran 2000	E: mineral baths	Pain (100 mm VAS)	32	37.6 (SD 22.6)	27.6 (SD 19.2)	9.6 (0.096%)	25.3 %	Not sign
	C: drug treatment (CsA)		25	38.5 (SD 24.9)	18 (SD 23.3)			
Legend:	sign = significance							

Table 3. Clinical relevance table: patient severity of disease at follow-up

Study	Treatment group	Outcome	N of patients	Baseline mean	End of study mean	Absolute benefit	Relative difference	Stat significance
Sukenik 1990b	E: Sulphur baths	patient severity of disease	10	5.0	6.3	0.6	12 %	Unclear
	C: No treatment		10	5.5	5.7			
Sukenik 1995	E: Dead Sea salt baths	patient severity of disease	9	5.9	6.22	1.59	30 %	Unclear

Table 3. Clinical relevance table: patient severity of disease at follow-up (Continued)

	C: No treatment		8	4.63	4.63			
Sukenik 1995	E: Sulphur baths	patient severity of disease	9	5.11	6.78	2.15	44 %	Unclear
	C: No treatment		8	4.63	4.63			
Legend:	unclear = insufficient data to determine statistical significance (e.g. no standard deviations provided)							

Table 4. Clinical relevance table: morning stiffness at follow-up

Study	Treatment group	Outcome (scale)	N of patients	Baseline mean	End of study mean	Absolute change	Relative % change	Stat significance
Elkayam 1991	E: Mineral baths	Morning stiffness (in minutes)	19	40	38	15	45 %	Unclear
	C: tap water baths		22	25	23			
Hall 1996	E: Seated immersion	Morning stiffness (in minutes)	35	40.9 (SD 50.5)	31 (SD 33.9)	- 13.5	-30%	Not sign
	C: Relaxation		35	50.3 (SD 58.9)	44.5 (SD 59.9)			
Hall 1996	E: Seated immersion	Morning stiffness (in minutes)	35	40.9 (SD 50.5)	31 (SD 33.9)	- 4.3	-11%	Not sign
	C: Hydrotherapy		35	39 (SD 48.6)	35.3 (SD 49.3)			

Table 4. Clinical relevance table: morning stiffness at follow-up (Continued)

Sukenik 1990a	E: Dead Sea salt baths	Morn- ing stiffness (in minutes)	15	61.3	45.7	- 55.8	- 75 %	Unclear
	C: Sodium chloride baths		15	85.8	101.5			
Sukenik 1990b	E: Sulphur baths	Morn- ing stiffness (in minutes)	10	95	41	- 24	- 27 %	Unclear
	C: No treatment control		10	86	65			
Sukenik 1995	E: Sulphur baths	Morn- ing stiffness (in minutes)	9	55.6	11.9	- 3.8	- 4.8 %	Unclear
	C: No treatment		8	100.0	15.7			
Sukenik 1995	E: Dead Sea salt baths	Morn- ing stiffness (in minutes)	9	78.3	11.4	- 4.3	- 4.8 %	Unclear
	C: No treatment		8	100.0	15.7			
Yurtkaran 1999	E: Mineral baths	Morn- ing stiffness (in minutes)	32	93.7 (SD 78.1)	62.5 (SD 8.6)	-10.1	- 9.9 %	Not sign
	C: Drug treatment (CsA)		25	111.0 (SD 62.8)	42.6 (SD 51.2)			
Franke 2000	E: radon carbon dioxide	Morn- ing stiffness (numbers improved)	30	0	22	1	RR=1.14 (0.47-2.75)	Not sign
	C: carbon dioxide		30	0	23			
Legend:	unclear = insufficient data to de-							

Table 4. Clinical relevance table: morning stiffness at follow-up (Continued)

	termine statistical significance (e.g. no standard deviations provided) N = # of patients Sign = significance							
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Table 5. Clinical relevance table: 15 m walk time at follow-up

Study	Treatment group	Outcome	N of patients	Baseline mean	End of study mean	Absolute benefit	Relative difference	Stat sign
Elkayam 1991	E: Mineral baths	15 m walking time	19	13.7	14.4	0.2	1.4 %	Unclear
	C: Tap water Baths		22	14.3	14.2			
Sukenik 1990a	E: Dead Sea salt baths	15 m walking time	15	12.7	11.3	- 6.8	- 55 %	Unclear
	C: Sodium chloride baths		15	12.1	18.1			
Sukenik 1990b	E: Sulphur baths	15 m walking time	10	14.7	13.2	0.3	2.1 %	Unclear
	C: No treatment		10	13.7	12.9			
Sukenik 1995	E: Dead Sea salt baths	15 m walking time	9	13.9	11.6	- 6.3	- 42 %	Unclear
	C: No treatment control		8	16.4	16.9			
Sukenik 1995	E: Sulphur baths	15 m walking time	9	13.4	13.2	- 3.7	- 25 %	Unclear

Table 5. Clinical relevance table: 15 m walk time at follow-up (Continued)

	C: No treatment control		8	16.4	16.9				
Legend:	unclear = insufficient data to determine statistical significance (e.g. no standard deviations provided) Sign = significance N = # of patients								

Table 6. Clinical relevance table: handgrip strength at follow-up

Study	Treatment group	Outcome	N of patients	Baseline mean	End of study mean	Absolute benefit	Relative difference	Stat sign
Sukenik 1990a	E: Dead Sea salt baths	Hand grip strength	15	114.6	117.7	- 4.2	- 3.5 %	Unclear
	C: Sodium chloride bath		15	125.2	113.5			
Sukenik 1990b	E: Sulphur baths	Hand grip strength	10	118	129	- 1	- 0.8 %	Unclear
	C: No treatment		10	124	128			
Sukenik 1995	E: Dead Sea salt baths	Hand grip strength right hand	9	100.6	131.7	6.2	5.1 %	Unclear
	C: No treatment		8	141.3	137.5			
Sukenik 1995	E: Sulphur baths	Hand grip strength, right hand	9	111.7	143.3	- 5.8	- 4.3 %	Unclear

Table 6. Clinical relevance table: handgrip strength at follow-up (Continued)

	C: No treatment		8	141.3	137.5			
Yurtkaran 1999	E: Mineral bath	Hand grip strength (mmHg)	32	14.5 (SD 7.8)	15.4 (SD 7.3)			
	C: drug treatment (CsA)		25	55 (SD 45)	64 (SD 38)			
Hall 1996	E: tap water baths	Grip strength (mmHg)	35	134.8 (SD 62.5)	126.6 (SD 50.3)	11.3	8.1 %	Not sign
	C: land exercises		34	143.9 (SD 92)	137.9 (SD 91.9)			
Hall 1996	E: tap water baths	Grip strength (mmHg)	35	134.8 (SD 62.5)	126.6 (SD 50.3)	10.7	7.8 %	Not sign
	C: relaxation		35	137.5 (SD 71.1)	137.3 (SD 63.3)			
Legend:	unclear = insufficient data to determine statistical significance (e.g. no standard deviations provided) Sign = significance N = # of patients							

Table 7. Clinical relevance table: ADL at follow-up

Study	Treatment group	Outcome	N of patients	Baseline mean	End of study mean	Absolute benefit	Relative difference	Stat significance
Sukenik 1990b	E: Sulphur baths	ADL	10	2.8	3.2	0	0 %	Unclear

Table 7. Clinical relevance table: ADL at follow-up (Continued)

	C: No treatment		10	2.6	3.2			
Sukenik 1995	E: Dead Sea salt baths	ADL	9	3.0	3.89	0.89	29.6 %	Unclear
	C: No treatment		8	3.0	3.0			
Sukenik 1995	E: Sulphur baths	ADL	9	2.89	3.56	0.56	19 %	Unclear
	C: No treatment		8	3.0	3.0			
Legend:	unclear = insufficient data to determine statistical significance (e.g. no standard deviations provided) Sign = significance N = # of patients							

WHAT'S NEW

Last assessed as up-to-date: 21 August 2007.

Date	Event	Description
21 May 2008	Amended	Converted to new review format. CMSG ID C010-R

HISTORY

Review first published: Issue 3, 1999

Date	Event	Description
23 August 2007	New search has been performed	In this update we included one extra study comparing mineral baths with drug treatment (Cyclosporine A) including 57 patients. In this study mineral baths are shown to be more beneficial. The strength of the evidence of this systematic review however remains limited
28 August 2003	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

Arianne Verhagen (APV) and Henrica de Vet (HCWdV) initiated the review and APV wrote the first draft of the review. APV developed the search strategy and APV and Sita Bierma (SMABZ) performed study selection, analysis and wrote the review. Rob de Bie (RAdB) and HCWdV performed the quality assessment, Jefferson Cardoso (JC) and APV performed data-extraction. In this update Johan Lambeck (JL) helped with the search and selection of studies.

SMABZ, RAdB, JC, Maarten Boers (MB) and HCWdV all critically reviewed successive drafts of the review. APV is the guarantor of the review.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- Erasmus MC, Rotterdam, Netherlands.

External sources

- No sources of support supplied

NOTES

In this update (August 2007) we included one extra study comparing mineral baths with drug treatment (Cyclosporine A) including 57 patients. In this study mineral baths are shown to be more beneficial. The strength of the evidence of this systematic review however remains limited.

INDEX TERMS

Medical Subject Headings (MeSH)

*Balneology; *Hydrotherapy; Arthritis, Rheumatoid [*therapy]; Osteoarthritis [*therapy]; Randomized Controlled Trials as Topic

MeSH check words

Humans