



## Hot sand baths (psammotherapy): A systematic review

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### ABSTRACT

**Introduction:** Psammotherapy is a traditional practice in which hot sand baths are employed for therapeutic purposes. This systematic review aims to investigate the potential efficacy of psammotherapy in the treatment of any disease.

**Methods:** Medline via PubMed, Embase, Web of Science, Cochrane Library, and Google Scholar were searched for articles describing studies on the efficacy of psammotherapy in patients with different health conditions. Articles were screened by the two author independently and, in case of disagreements, items were discussed until consensus was reached. All relevant clinical outcomes (symptom and pain relief, modifications in any functional and laboratory parameter, changes in drug consumption, variations of quality of life) were extracted from included studies.

**Results:** After article screening and selection, three studies were included in the review. One study involved patients with chronic obstructive pulmonary disease, while in the other two studies patients with rheumatoid arthritis were recruited. Included trials indicate that psammotherapy might be useful for the management of studied diseases.

**Discussion:** Based on available data, no conclusions can be driven on the clinical efficacy of psammotherapy. However, very limited evidence suggests that hot sand baths might be useful in improving symptoms and functionality of patients with some rheumatic and respiratory chronic illnesses. Further studies are encouraged to better assess the clinical efficacy of hot sand baths.

### 1. Introduction

Psammotherapy is a traditional therapeutic practice in which baths with hot sand are used for the treatment of several chronic conditions, mainly rheumatic musculoskeletal diseases.<sup>1,2</sup> Psammotherapy is defined as an “external thermal therapy that uses dry heat”<sup>2</sup> and may be classified as a balneological intervention, along with balneotherapy, mud therapy, and hay baths.<sup>3</sup> Psammotherapy has long been practiced in several coastal and desert regions, mainly depending on local traditions and availability of sand as a natural resource, and evidence of its use dates back to ancient Rome.<sup>4</sup> Sand baths are still practiced today in several countries, including Italy,<sup>5</sup> Portugal,<sup>6</sup> Japan,<sup>7</sup> China,<sup>8</sup> Iran,<sup>9</sup> Morocco,<sup>10</sup> and Egypt.<sup>11</sup>

Psammotherapy is a multicomponent treatment which combines the action of high-temperature thermal therapy with the effects of a chemophysical and bioclimatic therapy.<sup>1,2</sup> Sand baths are often administered outdoor and each session lasts 20–40 min, followed by a resting “reaction” period of 20 min.<sup>1,2</sup> Patients lay in 2 x 1 m sand holes with a depth of 20–30 cm and are covered with a 3–7 cm layer of dry hot sand

which is ready to use when its temperature under the surface reaches 50–60 °C due to solar heating.<sup>1</sup> Head, neck and sometimes even the anterior part of the thorax are not covered with sand.<sup>1,11</sup> Psammotherapy is sometimes combined with other spa treatments such as thalassotherapy, namely sea water baths, even thanks to the availability of both hot sand and sea water in maritime regions.<sup>1,2,6</sup> Sand composition varies according to geologic and environmental characteristics, although it is usually rich in silicate and carbonate minerals containing elements like calcium, potassium, sodium, aluminum, silicon, magnesium, and iron.<sup>1,6</sup>

Although few studies have been carried out to assess the efficacy of psammotherapy, its traditional indications are osteoarthritis, traumatic injury outcomes, articular or extra-articular chronic rheumatic conditions, osteoporosis, gout, and fibromyalgia syndrome.<sup>1,26</sup>

This systematic review aims to investigate whether psammotherapy as an integrative practice has some demonstrated therapeutic effects in the treatment of any disease (Fig. 1).

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<b>P</b> - Population	→ All patients with a diagnosed disease, regardless of their specific health condition. Studies with healthy subjects were excluded.
<b>I</b> - Intervention	→ Psammothrapy, that is administration of hot sand baths.
<b>C</b> - Comparison	→ All types of comparison, including no comparison.
<b>O</b> - Outcomes	→ All relevant clinical outcomes (symptom and pain relief, modifications in any functional and laboratory parameter, changes in drug consumption, variations of quality of life).
<b>S</b> - Study type	→ All study types.

Fig. 1. PICOS criteria for inclusion and exclusion of studies.

## 2. Materials and methods

The PRISMA guidelines were followed for this review<sup>12</sup>

Medline via PubMed, Embase, Web of Science, Cochrane Library, and Google Scholar were systematically searched for articles describing studies on the clinical efficacy of psammothrapy in patients with different health conditions. Since the number of studies about hot sand baths is limited, all eligible articles were included, regardless of study design. Articles were excluded if they described tests with laboratory animals, if they only reported trials assessing physiological changes induced by psammothrapy in healthy volunteers, or if full text was not provided. However, physiological studies and laboratory tests with animal models were mentioned in the discussion of the review to better hypothesize an explanation of the effects of sand baths in patients with a diagnosed disease. For the same reasons, abstracts of articles without any retrievable full-text version were described in the first part of the discussion. PICOS (Population, Intervention, Comparison, Outcomes, Study type) criteria for inclusion and exclusion of studies were summarized in a box (Fig. 1).

The following keywords were used to retrieve relevant articles: “psammothrapy”, “sand therapy”, “sand-therapy”, “sand bath\*”. Further details are provided in regard with search strategies used for each database:

- PubMed: (((sand therapy[Title/Abstract]) OR sand-therapy[Title/Abstract]) OR psammothrapy[Title/Abstract]) OR sand bath\*[Title/Abstract]
- Embase: psammothrapy OR 'sand bath\*' OR 'sand therapy' OR 'sand-therapy'
- Web of Science: TOPIC: ("sand bath\*") OR TOPIC: (psammothrapy). Refined by: DOCUMENT TYPES: (ARTICLE). Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI.
- Cochrane Library: sand bath\* OR psammothrapy OR sand therapy OR sand-therapy
- Google Scholar: “psammothrapy”; “sand bathing” AND “osteoarthritis”

Databases were searched up to July 2018. Articles were screened by the two authors independently and, in case of disagreements, items were discussed until consensus was reached. Details on study selection process were reported in a flowchart (Fig. 2). After study selection, data were collected from all included articles, summarized in a table (Table 1), critically appraised and discussed. References of included articles were also screened to retrieve all relevant studies on the topic.

The risk of bias for each included study was independently assessed by the two authors following the criteria of the Cochrane risk-of-bias tools and taking into consideration differences in study designs.<sup>13–14</sup> Disagreements were discussed until consensus was reached. Performance bias was not considered a key domain because psammothrapy requires the patient’s participation and direct involvement. Studies

were considered at high risk of bias when there was a high risk of bias in at least one key domain or unclear risk of bias in at least two key domains. Studies were considered at unclear risk of bias if only one key domain had unclear risk of bias. If all the key domains had low risk of bias, the risk of bias of the entire study was reported to be low too. Results of the risk-of-bias assessment were reported in two tables (Table 2a and Table 2b), depending on study design, namely Table 2a for Randomized Controlled Trials (RCTs) and Table 2b for non-Randomized studies (non-RCTs).

## 3. Results

After database searching, 289 articles were retrieved and screened. Three (3) articles matched inclusion criteria and were critically assessed.<sup>11,15–16</sup>

Specific characteristics of sand baths were heterogeneous across included studies, as reported in Table 1.

In a randomized controlled trial, hot sand baths followed by massage with olive oil were beneficial for patients with rheumatoid arthritis in terms of pain and disability improvement.<sup>11</sup> In another trial, psammothrapy was associated with a reduction in respiratory dysfunction, inflammation and drug intake among patients with chronic obstructive pulmonary disease.<sup>15</sup> Another study suggested beneficial effects of psammothrapy for patients with rheumatoid arthritis.<sup>16</sup>

Overall risk of bias was high in two studies<sup>15–16</sup> and unclear in one study.<sup>11</sup>

## 4. Discussion

Globally, included studies indicate that psammothrapy may be useful for the management of two chronic diseases, namely rheumatoid arthritis and chronic obstructive pulmonary disease.<sup>11,15–16</sup> However, in the RCT conducted by Allam et al., a limited number of participants was involved (30 patients with rheumatoid arthritis) and sand baths were followed by physical therapy (massage with olive oil), so it was difficult to accurately distinguish to what extent each single component of the treatment contributed to the overall positive result.<sup>11</sup> In the study performed by Dilixat et al., 70% of the 30 patients with RA undergoing psammothrapy reported functional benefits, although the reduction after treatment in the number of patients with altered serum levels of C-reactive protein (CRP) was not statistically significant (the low number of participants might have contributed to this result).<sup>16</sup> In the RCT conducted by Nurov, involving patients with chronic obstructive pulmonary disease, improvements were reported in both hemodynamic parameters and pulmonary function, and 63% of participants had a reduction in their respiratory medication intake.<sup>15</sup> Since empirical evidence from traditional practice mostly supports the use of psammothrapy for musculoskeletal conditions,<sup>1–2</sup> its potential benefits for respiratory illnesses need to be confirmed by further investigations to better study the action of hot sand baths in patients with non-musculoskeletal diseases. Traditionally, sand therapy still plays an important

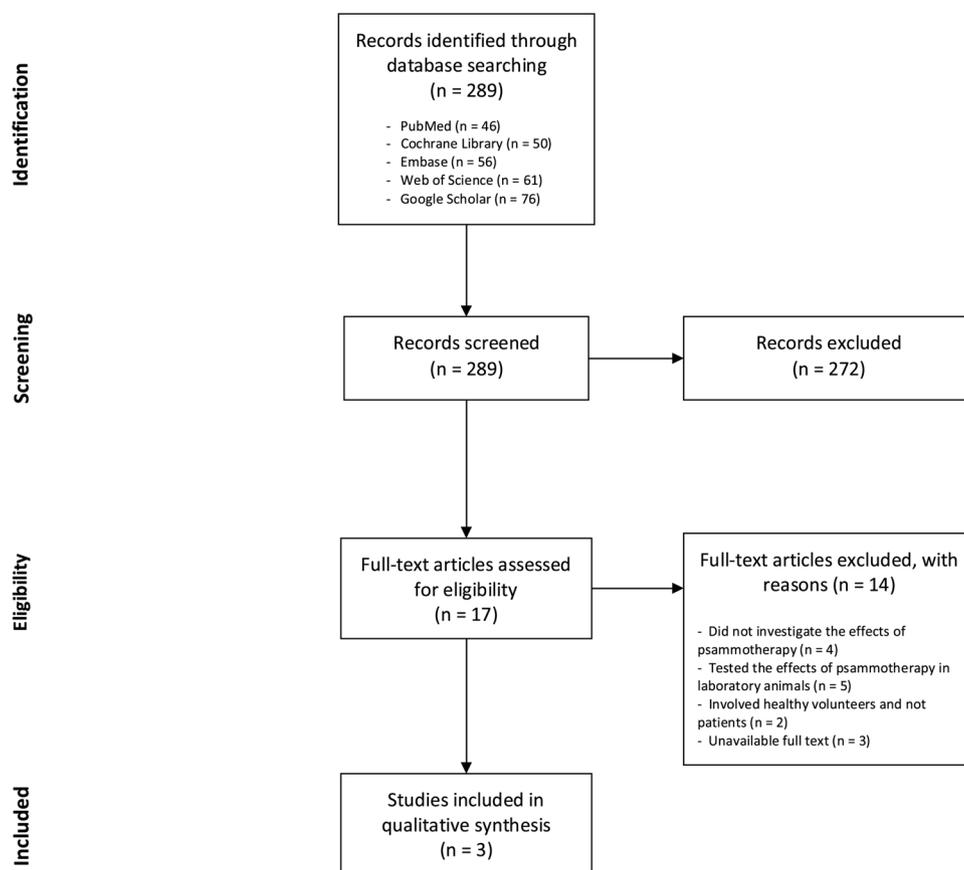


Fig. 2. Flowchart describing search and selection process of articles included in the review.<sup>12</sup>

role in ethno-medicinal systems like Uyghur Medicine (China) for the management of musculoskeletal problems, and some studies have shown significant functional and pain improvement in patients with osteoarthritis (especially of the knee) treated with psammotherapy.<sup>17–19</sup> In these studies, sand therapy comprised 10 daily sessions of 30-min sand baths, alone<sup>17</sup> or in combination with other treatments.<sup>19</sup> Another aspect to take into consideration when critically appraising data from all mentioned trials is that the number and length of sand bath sessions varied across studies, thus negatively affecting study heterogeneity. Available evidence on psammotherapy is therefore very limited and, although encouraging, doesn't allow to precisely determine whether hot sand baths are effective for treating any health condition. However, psammotherapy might be useful in some rheumatic or respiratory chronic diseases.

Important factors which can determine the effects of psammotherapy on the cutaneous, musculoskeletal, cardiovascular and neuro-vegetative systems are hypothesized to be the chemo-physical characteristics of different types of sand, electric charges of single elements, solar ray absorption, reflection and filtration by sand crystals, and skin brushing of sand grains.<sup>1–2</sup> Interaction between sand and skin microbiome may play a role too. Placebo effects, namely the patient-physician relationship, the rituality of the treatment, and characteristics of the setting, can also be important in enhancing the overall therapeutic effect of sand baths.<sup>20–21</sup>

Studies with animal models seem to confirm that sand baths may be useful in the treatment of chronic rheumatic diseases, promoting blood circulation and decreasing joint inflammation in rabbits with knee osteoarthritis.<sup>22</sup> Further evidence from studies about physiological changes induced by psammotherapy highlight that hot sand baths can significantly improve body temperature, blood flow and reduce peripheral arterial resistance,<sup>8,15,23</sup> therefore hypothesizing potential benefits for patients with diseases like knee osteoarthritis.<sup>25–26</sup>

Moreover, psammotherapy can ease the diffusion of sand minerals to deeper skin layers, where they can exert their action, and facilitate their absorption, thanks to the capability of hot and occlusive sand baths of increasing skin permeability.<sup>27–28</sup> In fact, it is hypothesized that, during psammotherapy, the acidic body sweat can dissolve sand carbonate bioclasts and calcareous algae, thus enriching the liquid biofilm at the body-sand interface with elements like calcium and magnesium, whose absorption is improved by hot seawater baths which usually follow psammotherapy sessions.<sup>29</sup> Beneficial effects on respiratory illnesses of sand baths may also depend on their broncho-dilating and anti-inflammatory effects<sup>11</sup> and on the patient exposure to marine aerosol, naturally rich in vaporized seawater, ions and other volatile compounds.<sup>1,2,30</sup>

Given that psammotherapy can be considered as a balneological intervention<sup>3</sup> and that scarce evidence has been collected on its specific mechanisms of action, it can be useful to refer to studies about biochemical effects of spa therapy with hot mineral waters and muds, especially in patients affected by rheumatic diseases.<sup>31–33</sup> Spa therapy seems capable of increasing plasma  $\beta$ -endorphin levels,<sup>31</sup> and modulate cortisol levels in such a way as to improve stress resilience<sup>34–35</sup> without disrupting its circadian rhythm.<sup>36</sup> Mud therapy can also reduce inflammatory mediators such as prostaglandin E2 (PGE2), leukotriene B4 (LTB4), interleukin-1 $\beta$  (IL-1 $\beta$ ), and tumour necrosis factor- $\alpha$  (TNF- $\alpha$ ).<sup>31</sup> It is possible that modulation of inflammatory response and interleukin production in response to spa therapy may be due to modifications of microRNA expression induced by thermal and mechanical balneotherapeutic stimuli, as observed in a study involving patients with osteoarthritis.<sup>32</sup> Effects of spa therapy on mediators which simulate cartilage metabolism, like insulin-like growth factor-1 (IGF1), have also been observed,<sup>31</sup> as well as a positive action on the oxidant/antioxidant system, with a reduction in the release of reactive oxygen (ROS) and nitrogen (RNS) species.<sup>31,37</sup> Mud baths have been also associated with a

**Table 1**  
Characteristics of included studies about the effects of psammotherapy in different health conditions.

Reference	Study design	Patients	Intervention	Results (variations after psammotherapy)
Allam et al. <sup>11</sup>	RCT	30 patients with RA	7 daily sessions of 20-min sand baths followed by massage with olive oil	Significant improvement ( $p < 0.05$ ) in pain level, functional disability and quality of life (measured with the Health Assessment Questionnaire).
Nurov <sup>15</sup>	RCT	134 patients with COPD	7-10 daily sessions of 30-min sand baths	Improvement in hemodynamic parameters, respiratory function (clinical and spirometric indices) and inflammation. Reduction of COPD drug intake in 63% of patients.
Dilixat et al. <sup>16</sup>	Non-RCT	30 patients with RA	15-min sand baths 4-5 times a day for 15-20 days	70.0% of patients with RA had an improvement in joint pain, stiffness and swelling. The number of patients with altered serum levels of CRP and RA factor decreased, although this reduction was not statistically significant.

Keys: COPD: Chronic Obstructive Pulmonary Disease; CRP: C-Reactive Protein; OA: Osteoarthritis; RA: Rheumatoid Arthritis; RCT: Randomized Controlled Trial.

**Table 2a**  
Risk of bias of included studies (RCTs).

Reference	Selection bias (random sequence generation)	Selection bias (allocation concealment)	Performance bias (blinding of participants and personnel)	Detection bias (blinding of outcome assessment)	Attrition bias (incomplete outcome data)	Reporting bias (selective reporting)	Other bias	Overall risk of bias
Allam et al. <sup>11</sup>	L	L	H*	U	L	L	L	U
Nurov <sup>15</sup>	U	U	H*	U	U	L	L	H

Keys: L, Low risk of bias; U, Unclear risk of bias; H, High risk of bias.

\* Performance bias was not considered a key domain because psammotherapy requires the patient's participation and direct involvement.

**Table 2b**  
Risk of bias of included studies (non-RCTs).

Reference	Bias due to confounding	Bias in selection of participants into the study	Bias in classification of interventions	Bias due to deviations from intended intervention	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of the reported result	Overall risk of bias
Dilixat et al. <sup>16</sup>	U	U	L	U	L	U	L	H

Keys: L, Low risk of bias; U, Unclear risk of bias; H, High risk of bias.

reduction in serum levels of adiponectin and resistin, hormonal substances possibly involved in the progression of chronic diseases like osteoarthritis.<sup>33</sup> It would be useful to assess whether all these biochemical and hormonal changes occur even in response to hot sand baths to better understand their possible mechanisms of action in chronic rheumatic diseases.

During each session of psammotherapy, the patient's body temperature (measured from the right axilla) tends to rise by approximately 1 °C (from 37 °C to 38 °C), then it decreases due to sweating and usually recovers 10 min after each treatment.<sup>16</sup> Recent studies have highlighted the role of whole body hyperthermia in the treatment of diseases like major depressive disorder.<sup>38</sup> From this point of view, sand bath tubs may be engineered in order to keep the body and sand temperature under control over time, thus transforming psammotherapy into a whole body hyperthermia treatment. Given that sand baths can produce a whole body heat stress response, caution is advised before undergoing psammotherapy due to cardiovascular changes triggered by its application.<sup>23</sup> Therefore, it is recommended to be medically checked before taking hot sand baths to exclude any health condition which may contraindicate this practice. In addition to this, sand has to be microbiologically checked and strict hygienic rules need to be applied to prevent skin infections. Moreover, sand temperature has to be carefully monitored to safely exert any potentially therapeutic effect, since when it is lower than 50.0 °C no physiological body changes are measured, while if it is higher than 64.4 °C it can cause injuries and skin burns.<sup>39</sup>

## 5. Limitations

Included studies involved a limited number of participants, were at unclear-to-high risk of bias, and were highly heterogeneous in terms of study design and characteristics of intervention. Evidence on the topic is scarce and, although all efforts were made to retrieve all relevant data, full texts of some articles were not available. Therefore, publication bias cannot be excluded.

## 6. Conclusions

Overall, evidence from included articles is very limited and, although encouraging, doesn't actually allow to draw any conclusion on the efficacy of this traditional therapy in clinical practice. However, considering results of all studies discussed in the review, it can be hypothesized that psammotherapy might be useful in some health conditions, mainly chronic illnesses such as rheumatic and respiratory diseases. Further studies are advised to better investigate the therapeutic potential of sand baths.

## Additional information

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