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Spa therapy and rehabilitation of musculoskeletal pathologies: a proposal for best practice in Italy

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Abstract

Spa therapy is a heterogeneous collection of treatments and methods based on natural resources. It is often considered as an option in the common therapeutic approach to many musculoskeletal disorders, as well as respiratory, vascular, and dermatological disorders. The objective of this paper is to highlight possible interactions between rehabilitation and spa medicine in the field of musculoskeletal disorders, through an analysis of the scientific literature, in order to give the practitioner the ability to integrate good clinical practice in the field of rehabilitation through practical application involving spa therapies. The literature search was conducted using Medline, PEDro, Cochrane Database, and Google Scholar. Only studies published in English and works concerning the implementation of spa thermal treatment in neuro-musculoskeletal diseases were included. Specifically, the publications analyzed dealt with the treatment of diseases such as arthritis, rheumatic arthritis, ankylosing spondylitis, and low back pain through the use of thermal spa therapies. In conjunction with its widespread use in clinical practice, many studies in the literature suggest the effectiveness of crenobalneotherapy for a number of musculoskeletal disorders, generally those which are chronic and debilitating, finding significant clinical improvement both in terms of pain and functional limitations. Some of the guidelines formulated by national and international bodies on the treatment of specific diseases, such as the Italian Rheumatology Society (SIR) and the Osteoarthritis Research Society International (OARSI) guidelines, recognize the value of thermal medicine as a complement, but not a replacement, for conventional therapy (pharmacological or not).

Keywords Thermal therapy · Rehabilitation · Best practice · Pain

Introduction

Thermal medicine makes use of methods based on natural resources for preventive, therapeutic, and rehabilitative treatment. It is based on the use of mineral waters, gas, and mud baths, in the form of hydroponic therapy and inhalations.

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As a particular example, it highlights the possibility of performing hydrokinesitherapy through immersion in thermal mineral water, which consists of performing exercises in water, first as segmental movements, then associated or alternated with global and functional exercises, such as isometric or isotonic muscle stretching, walking, and swimming (Masiero et al. 2008; Batterham et al. 2011).

Among the most popular treatments within the field of crenobalneotherapy, balneotherapy and peloid therapy are usually highlighted (Gutenbrunner et al. 2010).

The first of these uses thermal mineral waters, whose particular properties depend on their composition in terms of cations (Na, K, Ca, Mg) and anions (SO_4, Cl, HCO_3) (Bender et al. 2005), which can be highly variable. This composition determines an initial qualitative distinction between sulfurous, salty, and bicarbonate waters. Another factor to consider is temperature, according to which one can distinguish hypothermal (< 35 °C), isothermal (35–36 °C), and hyperthermal (> 36 °C) waters (Gutenbrunner et al. 2010).

Peloid therapy employs a mixture of mineral and organic or inorganic material derived from geological and/or biological processes (Bender et al. 2005; Tefner et al. 2013), such as volcanic mud, clays, and marine and lake mud (Gutenbrunner et al. 2010), in the form of baths or local wraps (Gyarmati et al. 2017).

With regard to the specific biological effects of these therapies, the properties of the thermal waters depend largely on their mineral salt composition. For instance, salt-bromine-iodine waters have anti-inflammatory and immunomodulatory properties and determine the release of beta endorphins and a reduction in the levels of PG-E2, LT-B4,-1, and TNF-A (Fioravanti et al. 2011, Fioravanti et al. 2017a, 2017b, Bender et al. 2007). It has also been shown that repeated peloid therapy cycles can modulate the expression of microRNA (miR-155, miR181a, miR146a, and miR-223) that is specifically hyper-expressed in osteoarthritis and can reduce serum levels of adipocytokines such as adiponectin and resistin (Fioravanti et al. 2015; Giannitti et al. 2017). The warmth of the water has analgesic effects, stimulating the skin's thermoreceptors, indirectly reducing muscle tone, which results in antispasmodic action, and improving the range of active and passive movement (Becker 2009). This, in turn, increases the density of chondrocytes, collagen, and proteoglycans, which, in addition to the aforementioned reduction in the serum levels of inflammatory cytokines, leads to a reduction in muscle stiffness and an increase in the elasticity of ligament tissues that are rich in collagen (Güngen et al. 2012). Furthermore, the heat absorbed by the mud is preserved for a long period of time and is released slowly, resulting in a prolonged thermal effect (Odabasi et al. 2008).

Traditionally, crenobalneotherapy has been used as a treatment for musculoskeletal disorders in many countries worldwide that possess a wealth of thermal spas (Gutenbrunner et al. 2010; Tenti et al. 2015). This heterogeneous set of pathologies includes both acute-onset and chronic diseases, such as low back pain, ankylosing spondylitis, fibromyalgia, osteoarthritis, osteoporosis, and rheumatoid arthritis. These diseases have in common the development of painful symptoms at the joint level and anatomical-functional limitations, and sometimes have a systemic involvement, resulting in a reduced quality of life and an increased risk of morbidity and mortality (Busija et al. 2010; National Collaborating Centre for Chronic Conditions - UK 2008).

Among the disorders already mentioned, osteo-articular and muscular disorders of degenerative, rheumatic, post-traumatic, or postoperative origin may benefit from these types of therapeutic and rehabilitative non-pharmacological approaches (Verhagen et al. 2012), also in association with the benefits produced by rehabilitation and hydrotherapy (Forestier et al. 2017). Crenobalneotherapy represents a widely used solution for chronic musculoskeletal disorders, also taking into account the issues raised by the often prolonged use of drugs required for pharmacological therapy, which have various side effects, issues which are often compounded by the lack of viable therapeutic strategies, or their failure in certain circumstances (Fortunati et al. 2016), as well as by the implications of the disease and of the treatments themselves, including psychological ones (Vincent et al. 2015).

Osteoarthritis is the most common musculoskeletal disorder, which has shown an increasing overall prevalence in recent decades, especially in connection with increasing lifespans and the prevalence of associated risk factors such as obesity (Zhang and Jordan 2010). As a correlate of its multifactorial pathogenesis, due to a combination of genetic or congenital (Valdes and Spector 2008), local biomechanical, and metabolic predisposing factors (Paoloni et al. 2017), the management of osteoarthritis involves a multidisciplinary therapeutic approach. Current indications for the non-surgical treatment of osteoarthritis include systemic or topical drug therapies, as well as non-pharmacological treatments, including functional exercises, diet, and lifestyle changes (Hochberg et al. 2012; McAlindon et al. 2014).

Recent evidence from the literature demonstrates the effectiveness of balneotherapy as a therapeutic aid in osteoarthritis, in terms of reducing pain and stiffness and improving joint function and range of motion (Masiero et al. 2018), as well as in terms of reduced healthcare costs (Ciani et al. 2017; Verhagen et al. 2007; Fioravanti et al. 2003).

Specifically, according to a 2007 Cochrane review (Verhagen et al. 2007), Silver Level evidence has emerged regarding the beneficial effects of balneotherapy. However, the results of the studies conducted are still not sufficient to make strong recommendations, because of poor methodological quality, due mainly to the lack of adequate methods for statistical data analysis and the presentation of results.

In 2013, for the first time, balneotherapy was recommended in the Osteoarthritis Research Society International (OARSI) guidelines for the treatment of multiple-area osteoarthritis with comorbidities, together with biomechanical treatments, intraarticular injections of corticosteroids, and the oral intake of NSAIDs and antidepressants (McAlindon et al. 2014).

However, the EULAR guidelines do not recommend crenobalneotherapy in the therapeutic management of musculoskeletal disorders (Combe et al. 2017, Forestier and Erol 2014).

In recent years, a number of systematic reviews and many randomized trials have been conducted that have demonstrated the effectiveness of crenobalneotherapy for rheumatological diseases and for musculoskeletal pain in general (Morer et al. 2017; Erol et al. 2015). In addition, in 2017, a Consensus Conference was held in Italy, in accordance with the Delphi method, on the topic of the appropriateness and effectiveness of thermal therapy in the treatment of musculoskeletal diseases (Paoloni et al. 2017). Furthermore, several randomized

controlled trials have been conducted on the effectiveness of crenobalneotherapy in the treatment of the following diseases: osteoarthritis, both generalized (Erol et al. 2015) or affecting particular joints, out of which the most frequently affected areas are the knee (Antonelli et al. 2018, Forestier et al. 2016), hip (Kovács et al. 2016), shoulder (Tefner et al. 2015), and hand (Gyarmati et al. 2017; Fortunati et al. 2016); low back pain (Gáti et al. 2018; Nguyen et al. 2017); other rheumatic diseases like fibromyalgia, ankylosing spondylitis, and rheumatoid arthritis (Forestier et al. 2017); and, finally, during the post-surgical period after orthopedic surgery in various joints, including the hip, knee, and shoulder (Vincent et al. 2015).

However, the mechanisms that determine the beneficial effects of thermal water and mud, based on mechanical, thermal, and biochemical factors, have not yet been completely elucidated (Fioravanti et al. 2017a, 2017b), and, generally speaking, the main international guidelines still show skepticism towards this therapeutic approach Verhagen et al. 2007), also in terms of the cost-benefit ratio (Hilingsmann et al. 2013).

Materials and methods

The literature search was conducted using Medline, PEDro, Cochrane Database, and Google Scholar, using the keywords "rehabilitation AND mud OR spa therapy OR balneotherapy OR crenobalneotherapy" and restricting the search to the works published in the last 5 years (2013–2018). Only articles that specifically dealt with the topic of rehabilitation in the spa environment were selected.

Reviews, meta-analyses, and *randomized control trials* (RCTs) were considered in the analysis, highlighting the differences between the studies and the possible limitations and critical issues. Only studies published in English which dealt with the implementation of thermal spa treatment in neuro-musculoskeletal-type disorders were included. Specifically, publications that addressed the treatment of diseases such as arthritis, inflammatory arthropathy, and low back pain were taken into account. The results of an Italian Consensus Conference regarding the appropriateness and effectiveness of thermal therapy in rehabilitation were also considered, as well as the paper produced by the Technical Table on Thermal Treatment organized in connection with the "2016-2018 Programming and Development Document of the Italian Ministry of Health," in order to better understand the guidelines for the integration of thermal therapy and rehabilitation in Italy.

Results

For reasons of simplicity, the results have been grouped into sections according to the pathology considered and/or the body area concerned. In addition, the different types of thermal treatment involved were identified, in order to clarify the specifics of the relevant recommendations.

Knee Osteoarthritis

In the latest guidelines of the OARSI on the non-surgical management of knee osteoarthritis, published in 2014, balneotherapy is considered as an appropriate treatment for the sub-phenotype that includes multijoint osteoarthritis and associated comorbidities, while its recommendation status is uncertain for patients with severe comorbidities and for patients with knee osteoarthritis without comorbidities (McAlindon et al. 2014).

In a 2013 review, Davids et al. reported the results of 25 studies performed on patients with osteoarthritis in 2012, assessing the effectiveness of different types of rehabilitation treatment. Among the works analyzed, only two RCTs assessed the effectiveness of thermal therapy, in the form of balneotherapy, in patients with arthritis of the knee and hand. In both studies, a reduction in pain after treatment was demonstrated, although these were only short-term positive effects (Davis and MacKay 2013).

In a 2014 review, Tenti et al. analyzed the results of 12 RCTs conducted to test the efficacy and tolerability of balneotherapy and peloid therapy in patients with knee osteoarthritis. The data from the studies demonstrates the beneficial effects of spa therapy on pain, function, and quality of life for up to 6–9 months after treatment. Therefore, authors conclude that spa treatment does not replace conventional treatment but can be associated with it or serve as an alternative to drug treatment in patients with poor compliance to medication, given the relative lack of side effects (Tenti et al. 2015).

In a 2016 systematic review, Forestier et al. analyzed the best evidence on the clinical effects of crenobalneotherapy in the therapeutic management of osteoarthritis of the knee. The treatments used (crenobalneotherapy, peloid therapy, hot showers, water exercises under supervision) are shown to have benefits in terms of improved function and the reduction of pain, although the studies gave conflicting results regarding the effects of these treatments on quality of life and on the intake of drugs. The benefits continued for up to 3–6 months and in some cases up to 9 months after treatment (Forestier et al. 2016).

In 2017, Comer et al. published a systematic review on non-inflammatory joint pain. Out of 3824 studies, only 4 met the selection criteria. Of these, only one study examined spa therapy as a rehabilitative therapeutic intervention, with evidence classified as weak. The study examined reported a statistically significant reduction in pain and improved function (measured by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score) immediately after the end of treatment but not at the follow-up after 8 months. In

addition, a reduction was shown in the Oswestry Disability Index after 3 weeks. With regard to the quality of life, evaluated by means of several indices, there was an improvement only in the short term (3 weeks), which was no longer found in measurements taken at 8 weeks, for which the data did not show a statistically significant effect (Comer et al. 2018).

In a systematic review published in 2018, Antonelli et al. evaluated the effects of balneotherapy and spa therapy on quality of life in patients with knee osteoarthritis. Seventeen studies met the inclusion criteria. Among these, 14 trials showed significant improvements in at least one item of the various tests administered for the evaluation of quality of life after spa treatment, as compared to the control group that underwent standard treatment (physical + pharmacological therapy). With regard to the intake of drugs (NSAIDs and/or analgesics), 8 studies out of the 10 analyzed reported a significant reduction in the use of analgesic therapy on a need basis in the group that received spa treatment compared with the control group (Antonelli et al. 2018).

In 2016, Xiang et al. published a meta-analysis with the objective of evaluating the effects of peloid therapy in patients with osteoarthritis of the knee. Ten RCTs were analyzed, involving a total of 1010 patients treated between 2002 and 2013. At the 4-month follow-up, no statistically significant differences were found between the treatment group and the control group in terms of improved joint function. However, the authors highlighted the poor quality of the publications analyzed and their high heterogeneity (Xiang et al. 2016).

In 2017, Matsumoto and Hagino (Matsumoto and Hagino 2017) conducted a meta-analysis to evaluate the beneficial effects of balneotherapy on reducing pain and stiffness and improving joint function in patients with knee osteoarthritis. Eight clinical trials were selected, published between 2004 and 2016, for a total of 359 treatment cases and 375 control group patients. The meta-analysis showed improvements in the WOMAC score on follow-up, a period which varied between 2 and 12 months among the studies considered. The authors of this study likewise emphasized the heterogeneity of the selected works and the resulting poor quality and reliability of the results (Matsumoto and Hagino 2017).

Hip Osteoarthritis

Regarding osteoarthritis of the hip, there were no specific guidelines, reviews, or meta-analyses that met our selection criteria.

A single-blind RCT published in 2016 by Kovacs et al. evaluated the benefits of balneotherapy with sulfurous waters, together with exercise, in patients with coxarthrosis. The treatment group ($n = 21$) was compared with a control group ($n = 20$) who were prescribed only exercise. Evaluations were performed before treatment, at the end of treatment, and at 12 weeks. The WOMAC index was measured to assess pain, stiffness, and joint function, and the EQ-5D questionnaire was administered to evaluate the quality of life. In the results, the group treated with exercise associated with balneotherapy showed a significant difference at the end of the treatment in terms of reduction of joint stiffness compared with the control group, and significantly reduced pain and improved functionality were also in evidence at 12 weeks. Likewise, the quality of life assessments still showed a significant improvement at 12 weeks. However, the number of patients enrolled is small enough to render the significance of the results rather weak (Kovács et al. 2016).

Hand Osteoarthritis

In 2015, the Italian research group of Fortunati et al. conducted a systematic review of the studies about osteoarthritis of the hand, finding, among the 327 studies examined, three RCTs, out of which two concerned the effects of balneotherapy and one examined peloid therapy (Fortunati et al. 2016).

In the first two studies, the parameters measured, although assessed using different evaluation systems, were pain, grip and grasp strength, the number of sore and/or swollen joints, the duration of morning joint stiffness, and the quality of life. The treatment cycle included 15 sessions of thermal baths, lasting 20 min each, over a period of 3 weeks.

The parameters were measured at the start, shortly after the end of the course of balneotherapy treatment, and at 13 and 24 weeks, respectively. The control groups underwent magnetic therapy and non-mineral water baths, respectively. The effectiveness of balneotherapy in patients undergoing a balneotherapy treatment cycle compared to the control groups was confirmed by improvements in both the subjective and objective parameters that were measured. However, due to the studies' methodological deficiencies, only weak evidence can be drawn from them (Fortunati et al. 2016).

An RCT conducted by Faulkner et al. on the effects of peloid therapy took into account pain level, duration of morning stiffness, and quality of life, as well as the use of medication. Patients underwent a cycle of 12 sessions of local body wraps over 2 weeks, lasting 20 min each, followed by 15 min of thermal baths. Improvement was seen in all parameters compared to the control group, from time 0 to the last follow-up, which was conducted at 48 weeks. The evidence was still weak, due to limitations resulting from the lack of methodological rigor and the insufficient sample size (Fioravanti et al. 2017a, 2017b; Fioravanti et al. 2014).

According to the guidelines of the Italian Rheumatology Society (SIR), published in 2013 (Manara et al. 2013), balneotherapy appears to reduce pain and improve grip strength in patients with hand osteoarthritis (level Ib—randomized controlled trial). As regards the effectiveness of the local application of heat and other forms of physical therapy (for example, laser, magnetic, or ultrasound therapy), the

SIR's recommendation is based on expert opinion (level IV—review by expert group). The studies included in the systematic review offered in support of this recommendation consist of seven RCTs, all performed on patients with hand osteoarthritis, lasting from 3 to 13 weeks, which analyzed the effectiveness of different types of treatment. Out of these, four RCTs were taken from a 2011 systematic review on the effects of rehabilitation treatments on pain, joint function, and overall physical condition in patients with osteoarthritis of the hand (Manara et al. 2013).

Table 1 summarizes the recommendations and the respective levels of evidence for thermal therapy in cases of osteoarthritis, grouped by anatomical area.

Low back pain

A recent review by Karagülle and Karagülle (2015) examined the effects of balneotherapy on low back pain, taking into account the latest evidence from eight selected RCTs, out of which only three were rated as being of good quality according to the evaluation scale used (Jadad score ≥ 3). The only study with the maximum score (Jadad score = 5) was conducted on 71 patients by the Hungarian research group of Kulish et al.; as part of this latter study, the treatment group underwent a cycle of at least 17 sessions of balneotherapy lasting 20 min during the course of 3 weeks. A common outcome in all trials was a significant improvement of the clinical profile in terms of pain, spinal mobility, degree of disability, quality of life, and the use of analgesics. However, the duration, frequency and number of sessions, the type and duration of the treatment, and the length of follow-up (up to a maximum of 6 months, in some cases not assessed) were very different from one study to another. As a result of this, as well as other methodological deficiencies, the evidence is considered insufficient (Karagülle and Karagülle 2015).

Inflammatory arthropathies

The different types of inflammatory arthritis, characterized by their chronic nature and/or the exacerbation of inflammation and joint pain, are a major cause of disability and loss of autonomy. Out of this set of pathologies, our study takes into account mainly rheumatoid arthritis and ankylosing spondylitis on the basis of epidemiological data. The goal in the therapeutic management of these diseases is to control the pain and the degree of activity of the disease, reduce the progression of joint damage, and improve the functional aspect, the overall health condition, and the quality of life of the patient.

Among the various international societies, the Professional Practice Committee of the Physical and Rehabilitation Medicine (PRM) division of the Union of European Medical Specialists (UEMS) has developed a systematic action plan to

Table 1 Osteoarthritis

Study type	Year	References	Treatment	Recommendation - Evidence Level
Knee osteoarthritis				
Guidelines	2014	OARSI	Balneotherapy	Appropriate: OA + comorbidity Uncertain: OA + severe comorbdity Uncertain: OA, NO comorbidity
Review	2013	Davids et al.	Balneotherapy	NF
Review	2014	Tenti et al.	Balneotherapy Peloid therapy	NF
Review	2016	Forestier et al.	Crenobalneotherapy Peloid therapy Hot showers Exercise in water	NF
Review	2017	Comer et al.	Spa therapy	Weak evidence
Review	2018	Antonelli et al.	Spa therapy Balneotherapy	NF
Meta-analysis	2016	Xiang et al.	Peloid therapy	NF
Meta-analysis	2017	Matsumoto and Hagino	Balneotherapy	NF
Hip osteoarthritis				
RCT	2016	Kovàcs et al.	Balneotherapy	NF
Hand osteoarthritis				
Guidelines	2013	Società Italiana Reumatologia (SIR) (Italian Rheumatology Society)	Balneotherapy	Ib
Review	2015	Fortunati et al.	Balneotherapy	Weak evidence
			Peloid therapy	Weak evidence

NF recommendation not formulable: inconclusive or conflicting evidence, *OA* osteoarthritis

outline a specific field of expertise for the area of rehabilitation, analyzing the principal studies on the use of balneotherapy for rheumatoid arthritis or ankylosing spondylitis. In 2013, the research group of Kucukdeveci et al. selected 27 RCTs, out of which 6 involved only rheumatoid arthritis, 2 involved ankylosing spondylitis and 19 included both (Küçükdeveci et al. 2013). Results of this systematic review showed weak-to-moderate evidence concerning the beneficial effects of balneotherapy on pain and functional limitation in the treatment of the considered rheumatic diseases (Küçükdeveci et al. 2013).

Table 2 summarizes the recommendations and the levels of evidence for balneotherapy in the treatment of inflammatory arthritis.

Among the various studies considered, the 2015 Cochrane review (Verhagen et al. 2015a) was deemed particularly relevant, being focused on management of rheumatoid arthritis, which, in the same year, was also the object of an extensive study by Verhagen et al. In the latter study, based on the assessment of the quality of the studies according to the GRADE system, 9 studies were selected out of 1093 found in the literature. The research plan on the effects of balneotherapy was divided into three main areas of comparison, i.e., between crenotherapy and placebo, between crenotherapy and other non-drug therapies, and between crenotherapy alone and in combination with other therapies. In conclusion, no significant differences were shown between the treatment groups compared in any of these three areas of study (Verhagen et al. 2015b).

Table 3 summarizes the recommendations and the levels of evidence for balneotherapy in the treatment of rheumatoid arthritis.

As regards ankylosing spondylitis, looking at smaller studies, we take into account the 2014 review conducted by Reimold et al., in which three RCTs were selected. Two of these analyzed the effects of balneotherapy on small groups of patients (Ciani et al. 2017; Nguyen et al. 2017) compared with control groups, finding an improvement in the former as regards quality of life and the level of disease activity at the end of the treatment cycles. This improvement, however, was no longer present at the time of the follow-up (maximum 40 weeks). The third RCT considered involved balneotherapy cycles associated with peloid therapy, finding significant improvements in pain and in terms of functional limitation, but with a low evidence level on account of the methodological deficiencies of the study (Reimold and Chandran 2014).

Table 4 summarizes the recommendations and the levels of evidence for balneotherapy and peloid therapy in the treatment of ankylosing spondylitis.

Crenobalneotherapy is also used, as a complementary approach, in the treatment of other musculoskeletal disorders widespread among the general population, but there have been very few studies up to now.

The Consensus Conference on the "Appropriateness and effectiveness of spa therapy in musculoskeletal disorders"

In 2017, a Consensus Conference was set up in Italy (Paoloni et al. 2017) with the aim of identifying the main aspects regarding the appropriateness and effectiveness of spa therapy in musculoskeletal disorders. A board was selected which included eight Italian thermal therapy experts, including doctors representing medical colleges and hospitals, territorial institutions, research institutions, and associations of patients, and a Consensus statement was drafted using the Delphi method. After analyzing the scientific literature on spa treatments, the experts developed two consecutive surveys (Q1–Q2) that were administered anonymously to 59 doctors. Forty-three of them responded to the surveys, including experts in thermal medicine, physiatrists, rheumatologists, other specialists and general practitioners with more than 10 years of experience in the treatment of musculoskeletal disorders. It was considered that a good level of consensus had been reached (allowing recommendations to be formulated) whenever the proportion of expressed agreement or disagreement among the survey respondents reached or exceeded 75%.

In summary, according to the results of the Consensus Conference, spa therapy is considered one of the options in the treatment of patients with osteoarthritis of the hip, knee, shoulder, ankle, and spine. Both spa therapy and hydrokinesitherapy in thermal water for the same body regions are recommended, in post-traumatic and post-surgery rehabilitation treatment as well as in the treatment of inflammatory diseases of the joints. However, thermal treatments are not recommended in the acute stages of rheumatoid arthritis and crystal arthropathies. Peloid therapy and balneotherapy are indicated as useful in the treatment of osteoarthritis and in rheumatic pathologies involving joints, as well as after surgical therapy. In addition, according to the opinion of the experts, the choice of such treatment should be predominantly dictated by the high safety profile, which affords excellent

Table 2 Inflammatory arthritis

Study type	Year	Reference	Treatment	Evidence level
Review	2013	Kucukdeveci et al.	Balneotherapy	Moderate-weak evidence

Table 3 Rheumatoid arthritis

Study type	Year	Reference	Treatment	Evidence level
Review (Cochrane)	2015	Verhagen et al.	Balneotherapy vs placebo Balneotherapy vs other non-drug therapies Balneotherapy alone vs. balneotherapy + other therapies	Weak evidence

control of symptoms in the long term and a reduction in the use of NSAIDS and analgesics by patients (Paoloni et al. 2017).

Technical table on thermal therapies—*2016–2018 Programming and Development Document of the Italian Ministry of Health*

As part of the Technical Table on Thermal Therapies organized by the Italian Ministry of Health, in connection with the development of the 2016–2018 Programming and Development Document of the Ministry of Health (2018), a "Working Group," consisting of experts from the Ministry of Health, Rome's Sapienza University, INPS, INAIL, FEDERTERME, and Foundation for Scientific Thermal Research (FoRST), developed models of integration between primary care, rehabilitative therapy, and spa treatments, especially in the context of post-surgical rehabilitation. The technical round table reached interesting conclusions, and some initial hypotheses were put forward, specifically regarding the categories of patients eligible to be rehabilitated in the spa environment. In particular, these categories were deemed to include the patients who would not require such extensive health care services as those provided in a hospital environment. In specific terms, the group hypothesized that such therapies are indicated for those who need post-surgical rehabilitation of the spine or as a result of extremity fractures. Additional categories of patients that may be added to the list include those with degenerative joint diseases, such as osteoarthritis, or rheumatologic diseases, such as ankylosing spondylitis, psoriatic arthritis, and rheumatoid arthritis, in non-acute phases. Undoubtedly, another important aspect in the recovery process is determined by the particular ecological context in which all spas are usually located. The proposals and list of necessary measures issued by the Working Group included the setup of an integrated departmental circuit for rehabilitation, with the inclusion of spa facilities—which would have to comply with authorization and/or accreditation processes for the specific purpose of rehabilitation—including appropriate supervision, and the integrated connection between institutions accredited for rehabilitation treatments (i.e., for the rehabilitation in a hospital setting of public health service beneficiaries, the functional recovery of impairments and disabilities that cannot be postponed and are reversible, requiring evaluative and therapeutic interventions that are intensive/extensive and not possible outside the hospital environment) within the National Health Service and the spa circuit. The proposals also included the integration of the spa circuit within the rehabilitation circuit, both in the elaboration of the future National Health Plan and in the regional healthcare plans and the Essential Healthcare Levels (LEA) (Programmazione e Sviluppo 2016). In this respect, it should be highlighted that the Lombardy Region is working on implementing the aforementioned provisions, through Legislative Proposal No. 367, entitled "Promotion and development of Lombardy's thermal centres," whose text has been approved during the regional government meeting on November 23, 2017. This legislative proposal reads, in Article 1: "The Lombardy Region makes use of thermal resources and hydro-thermal-mud treatments as a means of healing with recognized therapeutic efficacy for the psycho-physical benefit of the person, and favours the integration of the thermal circuit within the processes of healthcare and rehabilitation, also in connection with the regional health system and the national health care system." Furthermore, in Article 6, paragraph 2, the legislative proposal reads: "... within the limits of the available resources, the regional government is promoting experiments for integration between spa treatments, primary care and rehabilitative therapy, in particular with regard to post-surgery rehabilitation and disabling pathologies" (Commissione Consiliare 2017).

Discussion

Guidelines and studies we have reviewed, while recognizing the beneficial effects and mechanisms of action

Table 4 Ankylosing spondylitis

Study type	Year	Reference	Treatment	Evidence level
Review	2014	Reimold et al.	Balneotherapy Balneotherapy + peloid therapy	Insufficient evidence

of thermal therapy compared to placebo/other treatments in the management of OA (of the knee, hip, and shoulder), chronic back pain, fibromyalgia, rheumatoid arthritis, and ankylosing spondylitis, show common deficiencies regarding the poor methodological quality of the studies and the small sample size of the patient population studied. These limitations do not allow the formulation of recommendations based on strong evidence and, in addition, result in a relatively high risk of methodological bias. The most important limitation is the high heterogeneity of the studies regarding the subjects' clinical and demographic characteristics (age, gender, comorbidities), the trial groups under comparison, often with a small number of patients, the type of treatment and its duration, and the usage of different scales for the evaluation of outcomes. Another limitation of the extant studies, in addition to the small number of guidelines that recommend spa therapies, lies in the outcomes used to evaluate the results of the studies, which make comparison difficult and impede the possibility of weighing the effects of spa treatments against other therapies. Consideration must also be given to the nature of the diseases treated, which, for instance in the case of rheumatic diseases, have aspects connected to functional limitation or psychological discomfort from the illness or even to the personal autonomy and quality of life of these patients. In this regard, many of the extant studies that evaluated the impact of thermal therapies in rheumatology patients do not present any recommendations made by multiprofessional and multidisciplinary study groups.

As a result, the authors of the publications agree on the need to design methodologically rigorous studies to confirm the usefulness of treatments involving thermal therapies, which are today considered marginal because their effectiveness has never been evaluated in a scientifically appropriate manner. RCTs of high methodological quality and further studies on the mechanisms of action are needed to demonstrate the effects of thermal therapy in treating patients with musculoskeletal diseases.

The Italian Delphi Consensus statement published in 2017 (Paoloni et al. 2017) represents a recent evidence supporting spa therapy in order to treat musculoskeletal pathologies. From this point of view, current recommendations, in Italy, are therefore based on this document, due to the absence of guidelines derived from RCTs, meta-analyses, or systematic reviews.

In the coming years, the effort to produce scientific evidence and recommendations in this area could increase the rehabilitative options within the spa circuit, allowing a larger number of patients with osteo-musculoskeletal disorders to be properly treated over time. As a result, a positive impact could definitely be made in the field of rehabilitation in terms of the appropriateness of pathways of care within the rehabilitative network, for example in the management of chronic pathologies, with a low impact from the perspective of the burden of care, or in cases where the absence of comorbidities in the patient allows for *low-intensity care*.

The healthcare-oriented but de-hospitalized setting typical of the spa environment could be perceived in a much more positive way by the patient, fostering recovery, socialization, and reintegration.

As already evidenced by the studies reported, the particular properties of the thermal waters may amplify the effect of rehabilitation, if it is undertaken in the same context. For example, motor re-education in water (hydrokinesitherapy) could be even more effective if performed in a rehabilitative thermal bath, benefitting from both the physical and chemical interactions with the thermal water. Therefore, one may formulate the initial hypothesis of a synergistic effect between the two therapeutic modalities, i.e., rehabilitation and thermal treatments.

In the Italian context, thermal treatment is provided by the National Health Service under the LEA system; however, in practice, this is probably available only in a limited and incomplete manner. Beneficiaries of the public health system can use a maximum of one treatment cycle each year, with the exception of persons with disabilities, who are eligible for a further cycle if related to their certified disability. Rheumatic diseases are also included in the category of musculoskeletal disorders: osteoarthritis and other degenerative forms, as well as extra-articular rheumatism. However, rehabilitation in a thermal environment may be possible for many other categories of patients, with diseases and disabilities of the neuro-musculoskeletal system which are not currently included in the LEAs.

Another aspect to take into account is the socio-economic impact of the diseases that require rehabilitation treatments. In Italy in 2014, inpatient admissions for rehabilitation due to musculoskeletal diseases led to a total of 2,894,684 days of hospitalization, for a total cost of more than 700 million euros. This figure, already very high, becomes even higher if we also consider hospitalizations for nervous system disorders. Adding up the costs related to hospitalization for rehabilitation for both these groups, the annual spending is above one billion euros. The price tag becomes even higher when also taking into account day hospital treatments (Quirino 2014). Finally, to achieve an integration between the spa circuits and rehabilitation pathways, it would be necessary to specify the clinical-functional conditions that can benefit from this particular option, based on scientific evidence.

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Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

References

Antonelli M, Donelli D, Fioravanti A (2018) Effects of balneotherapy and spa therapy on quality of life of patients with knee osteoarthritis: a systematic review and meta-analysis. Rheumatol Int 38:1807–1824

Batterham SI, Heywood S, Keating JL (2011) Systematic review and meta-analysis comparing land and aquatic exercise for people with hip or knee arthritis on function, mobility and other health outcomes. BMC Muscoloskelet Disord 12(1):123

Becker BE (2009) Aquatic therapy: scientific foundations and clinical rehabilitation applications. PM R 1(9):859–872

Bender T et al (2005) Hydrotherapy, balneotherapy, and spa treatment in pain management. Rheumatol Int 25:220–224

Bender T, Bariska J, Vághy R, Gomez R, Imre Kovács (2007) Effect of balneotherapy on the antioxidant system, a controlled pilot study. Arch Med Res 38(1):86–89

Busija M, Bridgett L, Williams SR, Osborne RH, Buchbinder R, March L, Fransen M (2010) Osteoarthritis. Best Pract Res Clin Rheumatol 24(6):757–768

Ciani O, Pascarelli NA, Giannitti C, Galeazzi M, Meregaglia M, Fattore G, Fioravanti A (2017) Mud-bath therapy in addition to usual care in bilateral knee osteoarthritis: an economic evaluation alongside a randomized controlled trial. Arthritis Care Res (Hoboken) 69(7): 966–972

Combe B et al (2017) 2016 update of the EULAR recommendations for the management of early arthritis. Ann Rheum Dis 76(6):948–959

Comer C, Smith TO, Drew B, Raja R, Kingsbury SR, Conaghan PG (2018) A systematic review assessing non-pharmacological conservative treatment studies for people with non-inflammatory multijoint pain: clinical outcomes and research design considerations. Rheumatol Int 38(3):331–341

IV Commissione Consiliare "Attività Produttive E Occupazione", PDL N. 367, "Promozione e valorizzazione del termalismo lombardo", testo approvato nella seduta del 23 novembre 2017

Davis AM, MacKay C (2013) Osteoarthritis year in review: outcome of rehabilitation. Osteoarthr Cartil 21(10):1414–1424

Documento di Programmazione e Sviluppo 2016–2018, Tavolo Tecnico Termalismo, Ministero della Salute

Erol FB, Forestier RJ, Güneri FD, Karagülle MZ, Erdoğan N (2015) Spa therapy for generalized osteoarthritis: an open, observational, preliminary study. Therapie 70(3):273–281

Fioravanti A, Valenti M, Altobelli E, di Orio F, Nappi G, Crisanti A, Cantarini L, Marcolongo R (2003) Clinical efficacy and cost-effectiveness evidence of spa therapy in osteoarthritis: the results of "Naiade" Italian Project. Panminerva Med 45:211–217

Fioravanti A, Cantarini L, Guidelli GM, Galeazzi M (2011) Mechanisms of action of spa therapies in rheumatic diseases: what scientific evidence is there? Rheumatol Int 31(1):1–8

Fioravanti A, Tenti S, Giannitti C, Fortunati NA, Galeazzi M (2014) Short and long-term effects of mud-bath treatment on hand osteoarthritis: a randomized clinical trial. Int J Biometeorol 58:79–86

Fioravanti A, Giannitti C, Cheleschi S, Simpatico A, Pascarelli NA, Galeazzi M (2015) Circulating levels of adiponectin, resistin, and visfatin after mud-bath therapy in patients with bilateral knee osteoarthritis. Int J Biometeorol 59(11):1691–1700

Fioravanti A, Karagülle M, Bender T, Karagülle MZ (2017a) Balneotherapy in osteoarthritis: facts, fiction and gaps in knowledge. Eur J Integr Med 9:148–150

Fioravanti A et al (2017b) One-year follow-up of mud-bath therapy in patients with bilateral knee osteoarthritis: a randomized, single-blind controlled trial. Int J Biometeorol

Forestier R, Erol FB (2014) Is (creno) balneotherapy a drug, a surgical procedure or a non-pharmacological treatment? E-Letter on EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis. Ann Rheum Dis 73(2):e6

Forestier R, Erol FB, Francon A (2016) Spa therapy and knee osteoarthritis: a systematic review. Ann Phys Rehabil Med 59(3):216–226

Forestier R, Erol-Forestier FB, Francon A (2017) Current role for spa therapy in rheumatology. Joint Bone Spine 84(1):9–13

Fortunati NA, Fioravanti A, Seri G, Cinelli S, Tenti S (2016) May spa therapy be a valid opportunity to treat hand osteoarthritis? A review of clinical trials and mechanisms of action. Int J Biometeorol 60(1): 1–8

Gáti T, Tefner IK, Kovács L, Hodosi K, Bender T (2018) The effects of the calcium-magnesium-bicarbonate content in thermal mineral water on chronic low back pain: a randomized, controlled follow-up study. Int J Biometeorol 62(5):897–905

Giannitti C, de Palma A, Pascarelli NA, Cheleschi S, Giordano N, Galeazzi M, Fioravanti A (2017) Can balneotherapy modify microRNA expression levels in osteoarthritis? A comparative study in patients with knee osteoarthritis. Int J Biometeorol 61(12):2153–2158

Güngen G, Ardic F, Fındıkoğlu G, Rota S (2012) The effect of mud pack therapy on serum YKL-40 and hsCRP levels in patients with knee osteoarthritis. Rheumatol Int 32(5):1235–1244

Gutenbrunner C, Bender T, Cantista P, Karagülle Z (2010) A proposal for worldwide definition of health resort medicine, balneology, medical hydrology and climatology. Int J Biometeorol 54(5):495–507

Gyarmati N et al (2017) Evaluation of the effect of Hévíz mud in patients with hand osteoarthritis: a randomized, controlled, single-blind follow-up study. Isr Med Assoc J 19(3):177–182

Hilingsmann M et al (2013) Health economic in the field of osteoarthritis: an expert's consensus paper from the European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO). Semin Arthritis Rheum 43:303–313

Hochberg MC et al (2012) American College of Rheumatology 2012 recommendations for the use of non-pharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip and knee. Arthritis Care Res 64:465–474

Karagülle M, Karagülle MZ (2015) Effectiveness of balneotherapy and spa therapy for the treatment of chronic low back pain: a review on latest evidence. Clin Rheumatol 34(2):207–214

Kovács C, Bozsik Á, Pecze M, Borbély I, Fogarasi A, Kovács L, Tefner IK, Bender T (2016) Effects of sulfur bath on hip osteoarthritis: a randomized, controlled, single-blind follow-up trial: a pilot study. Int J Biometeorol 60(11):1675–1680

Küçükdeveci AA, Oral A, Ilıeva EM, Varela E, Valero R, Berteanu M, Chrıstodoulou N (2013) Inflammatory arthritis. The role of physical and rehabilitation medicine physicians. The European perspective based on the best evidence. A paper by the UEMS-PRM Section Professional Practice Committee. Eur J Phys Rehabil Med 49(4):551–564

Manara M et al (2013) Italian Society for Rheumatology recommendations for the management of hand osteoarthritis. Linee guida SIR

Masiero S et al (2008) Thermal rehabilitation and osteoarticular diseases of the elderly. Aging Clin Exp Res 20(3):189–194

Masiero S, Vittadini F, Ferroni C, Bosco A, Serra R, Frigo AC, Frizziero A (2018) The role of thermal balneotherapy in the treatment of obese patient with knee osteoarthritis. Int J Biometeorol 62(2):243–252

Matsumoto H, Hagino H (2017) The effect of balneotherapy on pain relief, stiffness, and physical function in patients with osteoarthritis of the knee: a meta-analysis. Clin Rheumatol 36(8):1839–1847

McAlindon TE, Bannuru RR, Sullivan MC, Arden NK, Berenbaum F, Bierma-Zeinstra SM, Hawker GA, Henrotin Y, Hunter DJ,

Kawaguchi H, Kwoh K, Lohmander S, Rannou F, Roos EM, Underwood M (2014) OARSI guidelines for the non-surgical management of knee osteoarthritis. Osteoarthritis Cartil 22:363–388

Morer C, Roques CF, Françon A, Forestier R, Maraver F (2017) The role of mineral elements and other chemical compounds used in balneology: data from double-blind randomized clinical trials. Int J Biometeorol 61(12):2159–2173

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

Nguyen C, Boutron I, Rein C, Baron G, Sanchez K, Palazzo C, Dupeyron A, Tessier JM, Coudeyre E, Eschalier B, Forestier R, Roques-Latrille CF, Attal Y, Lefèvre-Colau MM, Rannou F, Poiraudeau S (2017) Intensive spa and exercise therapy program for returning to work for low back pain patients: a randomized controlled trial. Sci Rep 7(1):17956

Odabasi E, Turan M, Erdem H, Tekbas F (2008) Does mud pack treatment have any chemical effect? A randomized controlled clinical study. J Altern Complement Med 14(5):559–565

Paoloni M et al (2017) Appropriateness and efficacy of spa therapy for musculoskeletal disorders. A Delphi method consensus initiative among experts in Italy. Ann Ist Super Sanita 53(1):70–76

Quirino N (2014) Executive wellness management. VIII *Edizione*, Federterme, Ott-Dic

Reimold AM, Chandran V (2014) Nonpharmacological therapies in spondyloarthritis. Best Pract Res Clin Rheumatol 28(5):779–792

Tefner KI et al (2013) The effect of Neydharting mud-pack therapy on knee osteoarthritis: a randomized, controlled, double-blind follow-up pilot study. Rheumatol Int 33(10):2569–2576

Tefner IK, Kovács C, Gaál R, Koroknai A, Horváth R, Badruddin RM, Borbély I, Nagy K, Bender T (2015) The effect of balneotherapy of chronic shoulder pain. A randomized, controlled, single-blind follow-up trial. A pilot study. Clin Rheumatol 34(6):1097–1108

Tenti S, Cheleschi S, Galeazzi M, Fioravanti A (2015) Spa therapy: can be a valid option for treating knee osteoarthritis? Int J Biometeorol 59(8):1133–1143

Valdes AM, Spector TD (2008) The contribution of genes to osteoarthritis. Rheum Dis Clin N Am 34:581–603

Verhagen AP et al (2007) Balneotherapy for osteoarthritis. Cochrane Database Syst Rev 17:CD006864

Verhagen AP, Cardoso JR, Bierma-Zeinstra SMA (2012) Aquatic exercise & balneotherapy in musculoskeletal conditions. Best Pract Res Clin Reumatol 26:335–343

Verhagen AP et al (2015a) Balneotherapy (or spa therapy) for rheumatoid arthritis. Cochrane Database Syst Rev 11(4):CD000518

Verhagen AP et al (2015b) Balneotherapy (or spa therapy) for rheumatoid arthritis. An abridged version of Cochrane Systematic Review. Eur J Phys Rehabil Med 51(6):833–847

Vincent HK, Horodyski MB, Vincent KR, Brisbane ST, Sadasivan KK (2015) Psychological distress after orthopedic trauma: prevalence in patients and implications for rehabilitation. PMR 7(9):978–989

Xiang J, Wu D, Li J' (2016) Clinical efficacy of mudpack therapy in treating knee osteoarthritis: a meta-analysis of randomized controlled studies. Am J Phys Med Rehabil 95(2):121–131

Zhang Y, Jordan JM (2010) Epidemiology of osteoarthritis. Clin Geriatric Med 26(3):355–369