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Review

Benefits and clinical relevance of balneotherapy for fibromyalgia syndrome: a literature overview

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ABSTRACT

Objectives. *This literature overview synthesises evidence on the therapeutic effects of balneotherapy (BT) in fibromyalgia syndrome (FM), focusing on pain relief, psychological health, and quality of life.*

Methods. *A literature search was conducted in PubMed and Google Scholar up until December 2024. Review studies evaluating BT's clinical outcomes in FM were included and critically discussed.*

Results. *Ten key studies consistently demonstrated BT's efficacy in reducing pain and disability, with benefits persisting up to six months post-intervention. Improvements in depression, anxiety, and sleep quality were also noted, with programs combining water immersion and other treatments (mud therapy, physical exercises, and patient education) yielding superior outcomes. Mechanistic insights suggest BT's ability to modulate muscle tension, pain perception, inflammatory markers, oxidative stress, and stress-related hormones such as cortisol, contributing to its multifaceted effects.*

Conclusion. *In conclusion, BT is confirmed as an effective non-pharmacological intervention for FM, providing symptom relief with a good level of tolerability. Integration of BT into multidisciplinary care and other therapeutic interventions, such as exercise and/or education, can synergistically amplify and optimise its efficacy by further alleviating the physical and psychological burdens.*

Introduction

Fibromyalgia syndrome (FM) is a chronic condition characterised by persistent, widespread pain and a variety of associated symptoms, including fatigue, sleep disturbances, headache, irritable bowel, and psychological distress (1, 2). The condition is diagnosed based on a history of widespread pain affecting both sides of the body, the upper and lower halves, and the spine. FM affects an estimated 1% to 5% of the general population, with women being six times more likely to be diagnosed than men (2, 3). The condition has a profound negative impact on quality of life (QOL), often impairing working capacity, family dynamics, and social functioning (4). For many, FM leads to premature retirement, further compounding its detrimental effects on QOL. The high prevalence of the disease, combined with its significant disruption to daily life, drives frequent medical consultations and widespread reliance on both standard and complementary treatments. These factors collectively impose a substantial socio-economic burden, underscoring the need for effective and sustainable management strategies (3, 5, 6).

Despite extensive research, the pathogenesis of FM remains unclear, with no single cause identified, making treatment challenging: for this reason, recent international guidelines advocate for a multidisciplinary and multimodal approach to managing FM, emphasising the integration of both pharmacological and non-pharmacological interventions (7). Advancements in treatments for FM have been made, yet managing this health condition remains a significant challenge (8). Among the non-pharmacological options, balneotherapy (BT) has gained popularity, particularly in Europe and Asia, offering symptomatic relief without the common side effects associated with many medications. BT, through the use of hot, mineral-rich water, is believed

Table I. Summary of reviews on the effects of balneotherapy for fibromyalgia syndrome.

Authors (year)	Study type	Clinical studies (n)	Characteristics of the intervention	Number of BT sessions (min-max per week) and treatment duration	Outcome measures	Citation
Bravo *et al*. (2024)	SR+MA	22	BT + physical exercises	2/w-5/w; 5-23 weeks	PSQI, FIQ, VAS, SF-36, BDI	(30)
García-López *et al*. (2024)		16	BT + mud baths, hydrojet, physical exercises or other spa therapies	3/w-12/w; 2-4 weeks	VAS, FIQ, BDI	(10)
Cao *et al*. (2021)		11	BT alone or BT + mud pack	N/w not specified; 2-4 weeks	FIQ, BDI, TPC	(9)
Naumann and Sadaghiani (2014)		21	BT alone or BT + physical therapy modalities, physical exercises, algae packs, or other spa therapies	2/w-6/w; 1.5-12 weeks	VAS, TPC, FIQ, BDI	(13)
Langhorst *et al*. (2009)		10	BT + mud baths, physical exercises or relaxation techniques	2/w-6/w; 2-5 weeks	VAS, FIQ	(31)
Fraioli *et al*. (2016)	SR	7	BT alone or BT + mud packs or physiotherapy (massages, physical exercise, electrotherapy)	3/w-6/w; 2-12 weeks	VAS, TPC, BDI, FIQ	(27)
Perraton *et al*. (2009)		11	BT alone or BT + physical exercises	1/w-4/w; 4-23 weeks	?	(28)
McVeigh *et al*. (2008)		10	BT alone or BT + hydrojet, physical exercises, algae packs or other spa therapies	2/w-6/w; 2-24 weeks	VAS, FIQ, TPC, FDI, BDI, SF-36, MPQ/ MPQ-DLV, HAQ	(29)
Tomczak *et al*. (2016)	NR	?	BT alone or BT + mud packs, relaxation techniques, hydrojet or massages	2-3 weeks with a series of 15-20 of mineral baths	VAS, NRS, TPC, FIQ, BDI, PAS, AIMS, IGA, SF-36	(12)
Ablin *et al*. (2013)		?	BT alone or BT + mud packs, physical exercises or patient education	?	FIQ, VAS, AIMS, HAQ	(11)

AIMS: Arthritis Impact Measurement Scale; BT: balneotherapy; BDI: Beck Depression Inventory; FDI: Functional Disability Index; FIQ: Fibromyalgia Impact Questionnaire; FM: fibromyalgia syndrome; HAQ: Health Assessment Questionnaire; MPQ: McGill Pain Questionnaire; IGA: Investigator's Global Assessments; MA: meta-analysis; MPQ-DLV: McGill Pain Questionnaire-Dutch Language Version; NR: narrative review; NRS: Numerical Pain Scale; PAS: Pressure Algometric Score; PGE2: prostaglandin E2; PSQI: Pittsburgh Sleep Quality Index; QOL: quality of life; SF-36: the Short Form (36 items) Health Survey; SR: systematic review; TPC: Tender Points Count; VAS: Visual Analogue Scale; ?: unclear or unavailable information.

to reduce pain and improve quality of life, providing an integrative option for individuals seeking relief from the burdens of FM (9-13).

The beneficial effects of BT are believed to stem from a combination of mechanical, thermal, chemical, and microbiological effects (14-16). Thermal stimulation can produce analgesic effects by increasing the pain threshold, activating the pain inhibition system via gamma fibers in muscle spindles, and reducing muscle spasms. According to the gate control theory, pain relief may result from the combined influence of water temperature and pressure applied to the skin. In addition, heat stimuli promote increased blood flow, facilitate the removal of oxygen free radicals, and enhance tissue repair in inflamed areas (9, 16).

BT has demonstrated the ability to modulate inflammatory markers in patients with FM: specifically, BT has been shown to reduce serum levels of inflammatory factors such as prostaglandin E2 (PGE2), leukotriene B4 (LTB4), interleukin (IL)-1β, and IL-6 (17, 18). Conversely, BT increases serum levels of the anti-inflammatory cytokine IL-10, which in turn suppresses the secretion of pro-inflammatory cytokines associated with pain (19, 20). This modulation of cytokines is particularly noteworthy given their potential role in the pathogenesis of FM (21).

Emerging evidence suggests that BT's anti-inflammatory effects may also be mediated through positive modulation of the skin microbiota (22, 23). The skin, as a critical interface with mineral-rich thermal water, harbors a diverse microbiome that can influence systemic immune responses. Exposure to mineral waters during BT may promote a healthier microbial balance, enhancing the production of anti-inflammatory metabolites while reducing the activity of pro-inflammatory pathways. This interaction between the skin microbiota and immune system could provide a novel mechanism for BT's therapeutic benefits, complementing its direct effects on cytokines and other molecular mediators.

Additionally, BT has been found to influence other molecular markers relevant to FM. Bazzichi *et al*. observed significant reductions in the neurotrophic factor brain-derived neurotrophic factor (BDNF) and in the protein expression of phosphoglycerate mutase 1 (PGAM1) and zinc-alpha2-glycoprotein 1 (AZGP1) following BT or mud-bath therapy in FM patients (24). These factors are typically upregulated in FM and are thought to

contribute to the disease's pathophysiology and clinical symptoms. The observed changes suggest that BT may exert therapeutic effects through both anti-inflammatory pathways and the modulation of key molecular mediators associated with FM. Various studies suggest that, in several musculoskeletal and rheumatic disorders, BT provides greater and more sustained improvements in pain and function compared to baths with tap water at the same temperature (25, 26). However, specific standards or guidelines for these treatments in the context of FM have not yet been established.

This literature overview aims to synthesise findings from existing research to evaluate the efficacy of BT for fibromyalgia patients.

Methods

This work utilised a narrative review approach to synthesise available evidence on the effects of BT for FM. Relevant review articles were identified through a specific search conducted in PubMed in December 2024, supplemented by an additional search on Google Scholar. Search terms included a combination of "fibromyalgia", "balneotherapy", "hydrotherapy", "crenotherapy", "pelotherapy", "mud therapy", "creno-balneotherapy", "thalassotherapy", and "spa therapy". The inclusion criteria encompassed peer-reviewed studies published in English, focusing on the clinical outcomes of BT, including pain relief, psychological health, and QOL. Articles focusing solely on hydrotherapy (defined as the use of tap water for baths or aquatic exercises) were excluded. Studies were selected to provide a comprehensive overview of findings, emphasizing systematic reviews where available. Additionally, the Discussion section provides a brief description of individual clinical studies, offering important insights into their findings and implications.

Results

Following a screening of the scientific literature, 93 research items were retrieved, and ten review studies were identified and included in this overview (9-13, 27-31). Their findings are briefly summarised to provide a cohesive understanding of BT's impact on key clinical outcomes (Table I and Table II). As reported in Table I, the review studies included a broad range of interventions, such as BT alone or BT associated with mud applications, hydrojet massages, relaxation techniques, and physical exercises, showcasing the versatility of BT protocols. The number of weekly sessions varied between one and six, with treatment durations spanning two to 32 weeks and sessions lasting at least 15 to 20 minutes or longer (32, 33). Outcome measures assessed included the Visual Analog Scale (VAS) for pain (34), the Fibromyalgia Impact Questionnaire (FIQ) for disability and QOL (35), and different mood or anxiety scales for psychological health (36).

Table II builds upon these findings by summarising the key outcomes and duration of effects reported in the reviews. Pain relief and disability improvements were the most consistently observed benefits, with effects lasting up to six months in some cases. Mood and anxiety enhancements were noted, particularly in studies combining BT with relaxation or physical therapies. Sleep quality and fatigue showed improvements, while QOL and markers of inflammation also benefited from BT interventions. Sulfur and non-sulfur mineral waters were commonly studied, with most reviews reporting none or only mild side effects, such as transient stiffness or headache, which did not outweigh the therapeutic benefits. The level of evidence, assessed using GRADE (37), was generally moderate to high for pain and QOL outcomes.

Discussion

Overall, the findings of this literature overview suggest that BT can be considered as a versatile and effective non-pharmacological treatment for FM (Fig. 1). BT consistently demonstrated benefits across multiple domains, including pain relief, disability, psychological well-being, and QOL. In particular, these effects were sustained in many cases for up to six months, offering a valuable medium-term therapeutic option for FM management. Beyond its clinical efficacy, BT raises important considerations in terms of cost-effectiveness: by potentially reducing the reliance on pharmacological treatments, including painkillers and sleeping aids, BT not only minimises drug-related side effects but may also lower overall healthcare costs. Enhanced sleep quality and physical functionality can further enable patients to engage in regular physical activity, a critical factor for long-term health and symptom management. The safety profile of BT, characterised by minimal and transient side effects, reinforces its viability as a sustainable treatment option.

Pain and physical symptoms

Clinical studies consistently emphasise the efficacy of BT in alleviating pain, with interesting insights into its potential mechanisms. Ardiç *et al*. reported substantial pain relief immediately following BT, accompanied by a reduction in inflammatory mediators, with these benefits persisting throughout the intervention period (17). This finding, further supported by other researchers, who found that BT can normalise IL-10 levels in FM patients (19), suggests that BT may mitigate pain not only through its direct effects on musculoskeletal relaxation but also by addressing systemic inflammation, offering a multifaceted therapeutic approach to managing FM symptoms, as observed in other rheumatic conditions (16). Similarly, another study demonstrated that combining BT with physical therapy for three weeks yielded significant pain reduction, with these improvements persisting for up to six months: the benefits extended beyond pain relief, as patients receiving BT alongside standard care also exhibited marked enhancements in respiratory function (38). Research involving treatment protocols of 10 to 14 days has also reported significant immediate pain relief following BT: however, these benefits were observed to persist for a relatively shorter duration, typically lasting between one and three months post-treatment (39, 40). Similar benefits were observed with thalassotherapy, a specific form of BT that involves the use of sea water: in particular, this

Table II. Key findings of review articles on the effects of balneotherapy for fibromyalgia syndrome.

Authors (year)	Pain	Disability	Fatigue	Mood	Anxiety	Sleep quality	QOL	Inflammation	Level of evidence*	Maximum duration of the effect	Tolerability	Water composition	Citation
Bravo *et al*. (2024)	X			X	X	X	X		B/C	2-4 months	Moderate (mild side effects)	?	(30)
García-López *et al*. (2024)	X	X		X					B/C	6 months (pain, mood, disability)	Moderate (mild side effects)	Sulfur and non-sulfur mineral waters	(10)
Cao *et al*. (2021)	X	X		X			X		B/D	3 months (pain); 6 months (disability)	?	Sulfur and non-sulfur mineral waters	(9)
Naumann and Sadaghiani (2014)	X		X	X		X	X	X	B (pain) D (depression)	3.5 months (median)	Moderate (mild side effects)	Sulfur and non-sulfur mineral waters or sea water	(13)
Langhorst *et al*. (2009)	X		X	X		X	X		B (pain and QOL)	14 weeks (median)	Good	?	(31)
Fraioli *et al*. (2016)	X		X			X	X		B/C	2-6 months	Good	Sulfur and non-sulfur mineral waters	(27)
Perraton *et al*. (2009)	X	X		X	X		X		B/C	?	?	Any types of water	(28)
McVeigh *et al*. (2008)	X	X	X	X	X	X	X		A/B (pain and QOL)	2-3 months (pain, anxiety, mood, fatigue); 6 months (QOL)	Moderate (mild side effects)	Sulfur water	(29)
Tomczak *et al*. (2016)	X	X		X			X		?	4-6 months	Good	Sulfur and non-sulfur mineral waters	(12)
Ablin *et al*. (2013)	X	X	X		X		X	X	B	3-6 months	Good	Sulfur mineral water or sea water	(11)

BT: balneotherapy; FM: fibromyalgia syndrome; QOL: quality of life; ?: unclear or unavailable information.
*Level of scientific evidence associated with the efficacy of BT (GRADE): A: high; B: moderate; C: low; D: very low.

treatment also demonstrated improvements in various symptoms of FM, with the positive effects lasting for approximately three months (41, 42). Finally, a recent study has highlighted that BT can improve oxidative stress biomarkers in patients with FM: this suggests that BT may help mitigate the oxidative damage often associated with chronic conditions like FM, potentially contributing to the overall reduction of symptoms and enhancing the body's ability to manage stress at a cellular level (43). These findings highlight the efficacy of BT in providing both short- and medium-term pain relief, as well as improvements in inflammatory biomarkers, oxidative stress, respiratory function, and overall quality of life.

In terms of overall disability, different studies have demonstrated the benefits of BT, showing significant improvements in FIQ scores that persisted for at least three months post-treatment (44, 45). Fioravanti *et al*. extended these findings, demonstrating sustained disability reductions for up to six months, especially when BT was combined with mud therapy (46). Additional analyses demonstrate that balneotherapy offers supplementary benefits beyond standard pharmacological treatments and patient education, particularly in improving vitality and reducing fatigue in patients with fibromyalgia (47-49). Combining BT with other therapeutic interventions, such as exercise or education, can synergistically amplify its efficacy, highlighting the potential for integrated treatment approaches in managing FM.

Safety profiles for BT are generally favorable, with most studies reporting no adverse effects. Mild and transient side effects, such as headache and stiffness, were noted in a few cases, but these were rare and did not diminish the overall therapeutic value (32, 50). This suggests that BT is a safe and effective treatment option for FS, offering both physical and psychological relief with minimal risk of harm.

Psychological well-being and sleep quality

On psychological health, different clinical studies have observed significant

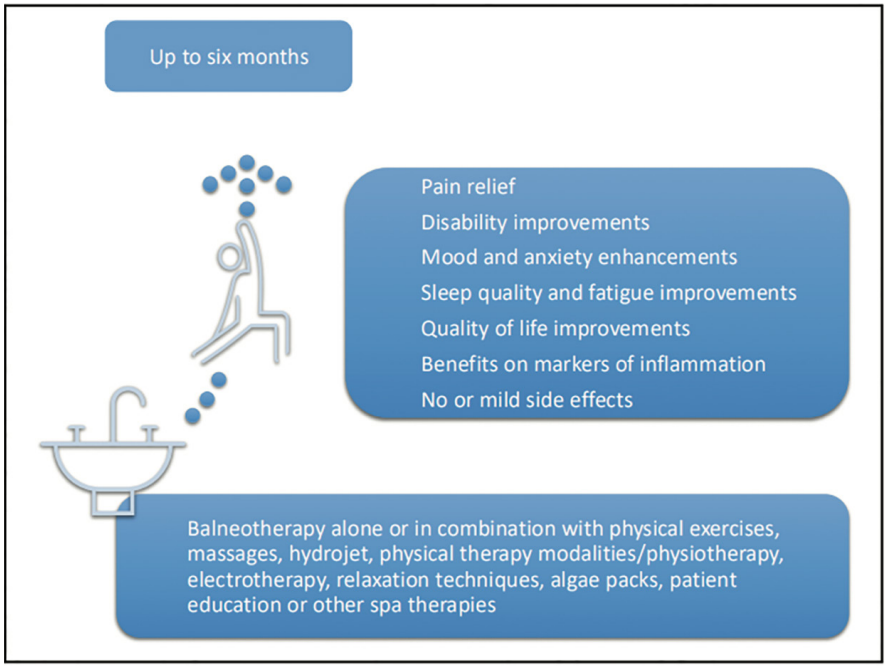

Fig. 1. Summary of the effects of balneotherapy for fibromyalgia syndrome.

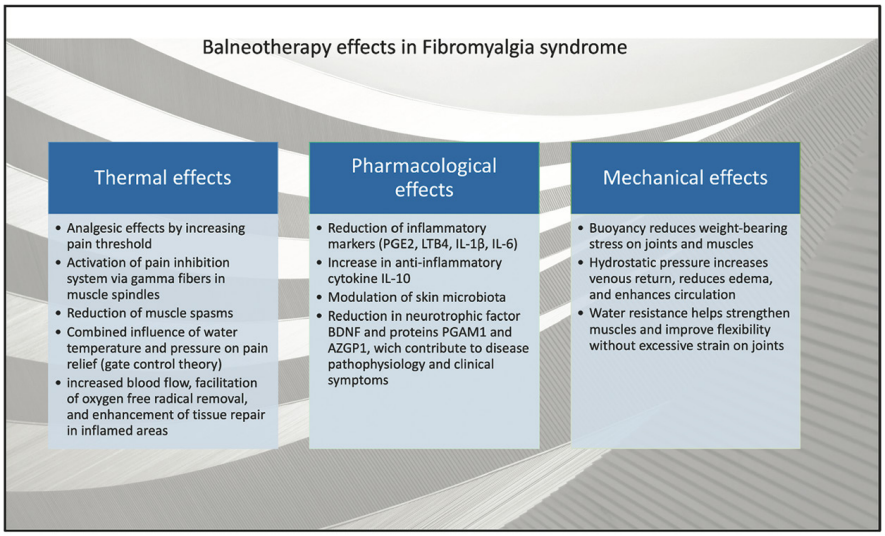

Fig. 2. Mechanisms of action of balneotherapy for fibromyalgia syndrome.

ameliorations in mood and depression scores that lasted months after intervention (38, 51, 52). Benefits were also observed for sleep quality (45) and anxiety (44), with improvements reported for both BT programs involving only water immersion and those that included mud applications as well. These studies suggest the dual role of BT in addressing both physical and psychological challenges associated with FM. One potential hypothesis for why balneotherapy may help mitigate psychological symptoms is its ability to promote relaxation and reduce stress through the therapeutic effects of warm mineral baths. The properties of hot, mineral-rich water can influence the release of cortisol and endorphins, hormones that play a key role in regulating mood and enhancing stress resilience (53-55). Additionally, the quiet, calming environment associated with BT may provide a form of psychological respite, allowing patients to experience a reduction in daily stressors and a temporary escape from the psychological burden of chronic pain.

The improvements in sleep quality observed in patients undergoing BT may stem from these same mechanisms as, reduced stress, enhanced relaxation, and the alleviation of pain, and thus, collectively foster better sleep patterns; restorative sleep, in turn, can amplify the benefits of BT by reducing fatigue and improving overall psychological resilience and pain perception (24, 56-58). Improved sleep quality through BT not only reduces the reliance on sleeping pills but also fosters higher levels of physical activity (aquatic exercises), which have been shown to further enhance sleep quality in patients with FM (24, 59, 60). Furthermore, the anti-inflammatory effects of balneotherapy might influence brain chemistry, as inflammation has been linked to mood disorders such as depression (61). In particular, IL-6 emerges as a potential key mediator in determining sleep quality, as elevated levels of IL-6 have been associated with sleep disturbances (62, 63), suggesting that BT's capacity to regulate IL-6 levels might be a crucial mechanism underpinning its beneficial effects on sleep.

Thus, the combination of physical, environmental, and biochemical factors of BT could contribute to both the alleviation of physical symptoms and improvements in psychological well-being in individuals with FM (Fig. 2).

Study limitations

This literature overview highlights the therapeutic potential of BT for FM, but some limitations must be acknowledged. Firstly, the heterogeneity of the studies included in the reviewed articles poses challenges to direct comparisons. Variations in BT protocols, such as water composition, session duration, frequency, and accompanying therapies, make it difficult to establish standardised treatment recommendations. Secondly, another limitation arises from potential publication bias, as positive outcomes may be over-represented in the literature. Furthermore, the reliance on subjective outcome measures, such as self-reported pain and QOL scores, introduces variability and potential bias in the interpretation of results. Future research should aim to standardise BT

protocols, include more diverse populations, and assess the long-term impact of BT in managing FM.

Conclusion

In conclusion, BT appears to be an effective, non-invasive treatment for FM, offering significant improvements in pain, disability, QOL, and psychological well-being. While the benefits are most pronounced immediately after treatment, sustained effects up to 6 months are possible. Review studies included a broad range of interventions, such as BT alone or BT associated with mud applications, hydrojet massages, relaxation techniques, and physical exercises, showcasing the versatility of BT protocols and combined approaches. Future studies should focus on standardised protocols and long-term outcomes to confirm these findings.

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