

Although there is a tendency to publish statistically significant findings and there is a lack of access to many non-significant studies, existing data support the beneficial effects of spa therapy in several diseases and conditions. Apart from any specific effect of any natural waters, a proper regimen of treatment, rehabilitation with physiotherapy and hydrotherapy in an atmosphere free from stress will undoubtedly help many patients. In interpretation of the findings, the methodological aspects for each study should be taken into consideration. Can the tap water be adequately disguised? Can immersion be organized in a double-blind fashion? Can the wider aspects of climatotherapy be controlled? In addition, some other important questions should also be answered: Could the positive findings have resulted from patient expectations? How long the positive effects persist? Were the benefits worth the costs? It is not clearly recognizable whether the improvements seen were due to direct effect of spas or from resorts stay. Since temperature and chemical compositions of each spa is a characteristic for that spa resort, extrapolating the results to other spa resorts should be considered cautiously.

Most of the studies reported in this review were conducted on a small number of subjects. With a smaller number clinically relevant effects might be missed. Performing randomized studies using a larger study population is recommended so that statistical significance comes close to clinical relevance. Randomized studies performed and reported properly give a sound answer to the question whether balneotherapy is an effective treatment in different medical conditions.

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Table 1. Effects of balneotherapy in randomized controlled trials or clinical studies conducted on patients with dermatologic disorders.

Disease	Authors	Mode of therapy	n	Treatment duration	Efficacy	*Evidence (Design and journal type)
Atopic dermatitis	Kubota et al. (8)	Acidic hot-spring bath pH: 2.0 plus Mn 1.4 mg/l, I 0.3 mg/l	70	Median of 2 months	Significant clearing of skin lesions and reduction in itch	B(C)
	Shani et al. (9)	Balneotherapy In Dead sea	1408	4 to 6 weeks	Complete clearance of lesions in 90% of patients	A(D)
	Dupuy et al. (17)	Drinking low-salt spa water (sodium 4.9 mg/l, calcium 44.3 mg/l)	12	18 days	Normalizing the intestinal permeability of patients	B(C)
Psoriasis	Halvey et al. (11)	Dead sea balneotherapy	25	3 weeks	Mild improvement in comparison with those treated with common salts bath	B(A)
	Leaute-labreze et al. (12)	Saline water balneotherapy (sodium concentration, 250 g/l; magnesium, 980 mg/l)	71	3 weeks	Minor therapeutic effects with saline spa water alone, and no beneficial effect of bathing to enhance phototherapy	C(A)

Continued:

Disease	Authors	Mode of therapy	n	Treatment duration	Efficacy	*Evidence (Design and journal type)
	Pinton et al. (18)	Drinking immersion in selenium rich spa (70 µg/l)	92	3 weeks	Improvement in psoriatic plaques	A(C)
Acne Vulgaris	Shani et al. (9)	Dead sea balneotherapy	86	4 weeks	Reduced numbers of comedones and pustules	A(D)
Cutaneous microcirculation	Hartmann et al. (15)	Balneotherapy with CO <sub>2</sub> (1200 mg/ kg water)	18	20 minutes	Cutaneous vasodilation and increased oxygen utilization	A(A)

\* Evidence. A: effective, B: probably effective, C: may not be effective.

Journal type and design: A: Randomized clinical trial (RCT) in a major journal, a: RCT in a non-major journal, B: case-control study in a major journal, b: case-control study in a non-major journal, C: clinical study in a major journal, c: clinical study in a non-major journal, D: review article.

Table 2. Effects of balneotherapy in randomized controlled trials or clinical studies conducted on patients with chronic inflammatory musculoskeletal diseases.

Disease	Authors	Mode of therapy	n	Treatment duration	Efficacy	*Evidence (Design and journal type)
Rheumatoid arthritis	Sukenik et al. (19)	Sulfur baths, mud packs and combination	40	2 weeks	Improvement in clinical indices up to 3 months	A(A)
	Elkayam et al. (20)	Mineral water baths and mud packs (rich in sodium chloride and sulfate)	41	2 weeks	Temporary improvement in clinical indices	A(A)
	Sukenik et al. (21)	Dead sea, sulfur bath or combination	36	3 months	Improvement in clinical indices in all three intervention groups	A(A)
Ankylosing spondylitis	Franke et al. (23)	Combined radon (1.3 KBq/l) carbon dioxide (1.6 g/l) spa	60	4 weeks	Lower pain intensity after 6 months comparing to taking only a carbon dioxide bath	B(a)
	Tishler et al. (24)	Combination of hot mineral baths (38°C) and mud packs (45°C)	14	2 weeks	Improvement in morning stiffness and overall well-being	B(C)
	Tubergen et al. (25)	Combination of spa-exercise therapy	120	3 weeks	Improvement in clinical indices up to 40 weeks	A(A)

Continued:

Disease	Authors	Mode of therapy	n	Treatment duration	Efficacy	*Evidence (Design and journal type)
Fibromyalgia	Buskila et al. (27)	Sulfur baths (2000 mg/l)	48	10 days	Improvement in clinical indices up to 3 months	A(A)

\* For details see table 3 caption

Table 3. Effects of balneotherapy in randomized controlled trials or clinical studies conducted on patients with chronic non-inflammatory musculoskeletal diseases.

Disease	Authors	Mode of therapy	n	Treatment duration	Efficacy	*Evidence (Design and journal type)
Osteoarthritis	Nguyen et al. (28)	Spa therapy at Vichy (France)	188	3 weeks	Improvements in pain and functional impairment up to 6 months	A(A)
	Kovacs et al. (29)	Spa therapy (Solute content 1675 mg/l) mainly sodium bicarbonate and fluoride)	58	15 days	Improvement in clinical indices compared to tap water	B(A)
	Green et al. (30)	Hydrotherapy in a deep pool, and home exercise	47	6 weeks	Improvement of symptoms in both groups	C(A)
	Wigler et al. (31)	Dead sea balneotherapy	33	2 weeks	Improvement in clinical indices specially with the combination of mineral bath and mud packs	A(A)
Low back pain	Guillemin et al. (32)	Spa therapy (total minerals <500 mg/l, mainly sulfate and sodium) with high pressure under water shower (36°C)	102	3 weeks	Positive short term effectiveness on chronic pain compared to controls	A(A)

Continued:

Disease	Authors	Mode of therapy	n	Treatment duration	Efficacy	*Evidence (Design and journal type)
	Constant et al. (33)	Spa therapy (total minerals 8073 mg/l, mixed bicarbonate, chlorine and sodium) and drug therapy compare with drug therapy alone	121	3 weeks	Improvements in signs and symptoms in the combination group	A(A)
	Konard et al. (34)	Balneotherapy (bicarbonate 445.3 mg/l, sulfate 109.9 mg/l) and calcium (117.2 mg/l), underwater massage, underwater traction bath	158	4 weeks	Reduction of prescription of analgesics and pain score in all intervention groups	B(C)
Chronic pain	Strauss-Blasche et al. (35)	Balneotherapy with mud and CO <sub>2</sub> applications	387	3 weeks	Seasonal variation in effectiveness, best response was between April and June	B(c)

\* For details see table 3 caption

Table 4. Effects of balneotherapy in randomized controlled trials or clinical studies conducted on metabolic conditions.

Condition	Authors	Mode of therapy	n	Treatment duration	Efficacy	*Evidence (Design and journal type)
Blood viscosity	Shirakura et al. (39)	Whole body bathing in hyperthermal water (42°C or higher)	7	10-15 minutes	Marked increase of blood viscosity and enhancement in the blood coagulation system	A(c)
	Kurabayashi et al. (40)	Drinking electrolyte water at midnight containing (meq/l) Na, 21; K, 7; ca, 1; Cl, 18.5	7	2 days	Decreasing in blood viscosity from midnight to 8 AM	A(C)
Platelet aggregability	Ohtsuka et al. (43)	Hydrotherapy with water temperature between 30 to 40°C	12	4 weeks	Partial improvement of platelet glutathione metabolism	B(c)
Beta-thromboglobulin	Take et al. (45)	Hydrotherapy with water temperature of 47 and 42°C	5	10 minutes	Increasing in plasma level of beta-thromboglobulin with 47°C bathing water	B(a)
Bone structure	Ay et al. (48)	Aerobic exercise in a spa resort pool with water temperature of 29-30°C	41	6 months	Anabolic effects on the heel bone	A(A)
Plasma lipids	Strauss-Blasche et al. (49)	Spa therapy (CO <sub>2</sub> ), exercise therapy, and dietary measures	395	3 weeks	Mild decrease in total cholesterol, HDL cholesterol and LDL cholesterol	B(c)

Continued:

Condition	Authors	Mode of therapy	n	Treatment duration	Efficacy	*Evidence (Design and journal type)
Stress hormones	Kuczera et al. (51)	Spa therapy at Wysowa (Poland)	175	20 days	Increase of concentration of ACTH, cortisol, growth hormone and prolactin	plasma A(c)
Plasma homocysteine	Leibetseder et al. (52)	Spa therapy with Sulfur as the main mineral (7.3 mg/l)	40	3 weeks	Reduction of homocysteine in sulfur bath group compare to controls	plasma A(A)

\* For details see table 3 caption

Table 5. Effects of balneotherapy in randomized controlled trials conducted on psychological conditions.

Condition	Authors	Mode of therapy	n	Treatment duration	Efficacy	*Evidence (Design and journal type)
Psychological tension	Kamioka et al. (58)	Once a week balneotherapy(41.5°C) with lifestyle education and physical exercise	56	3 months	Less psychological tension in the intervention group than controls	B(a)
Self-rating depression and vigorousness	Kamioka et al. (59)	Once a week balneotherapy(41.5°C) with lifestyle education and physical exercise	56	6 months	Less self-rating depression and increasing vigorousness in the intervention group than controls	B(a)

\* For details see table 3 caption