

Psoriasis Treatment at the Dead Sea: 40 Years of Clinical Studies

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ABSTRACT

Since 1980 dermatologists have been interested in the exceptional healing reported by patients who underwent treatments at the Dead Sea. Tens of thousands of patients have visited this area and more than 10,000 cases have been the subject of clinical and laboratory studies since this natural therapeutic option was discovered for psoriasis management. Through evaluation of the published articles on climatotherapy, we tried to reach a global assessment of the usefulness of this approach and to discover whether this treatment still can be recommended in the era of biologic treatments. I conducted a review of the available literature on clinical trials through PubMed, Medline, and Google Scholar using the terms *psoriasis* and *Dead Sea*. I found 26 studies published between 1982 and 2021. Assessment of patients showed major improvement through several selected parameters. Length of the stay and medical supervision positively influenced the major outcomes observed. Duration of improvement and possible long-term side effects of this natural treatment still need to be more precisely determined. Exposure to the unique climatic factors of the region, essentially the sun and the sea, induces fast and significant results with high clearance rates of psoriasis plaques. Dead Sea climatotherapy still has its place for the control of psoriasis symptoms.

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SCIENTIFIC ACTIVITIES AT THE DEAD SEA

While the Dead Sea has been a center of considerable interest in skin problems since ancient times, it is only recently that the effects of ultraviolet radiation have been shown to be paramount in the treatment of psoriasis [1]. Since the 1980s, scores of patients have flocked to the shores of the *Sea of Salt* to treat their psoriasis lesions. Most patients come from Europe, specifically Germany, Austria,

and Denmark. To meet the medical needs of these patients, hoteliers and travel agencies called on dermatologists, who were the first to demonstrate the beneficial effects of the treatment.

In the early days, medical personnel learned from their experience on the spot, and their recommendations were often modified. Gradually, scientific studies on solar ultraviolet (UV) irradiance enabled customized treatment protocols [2]. The directives introduced the doses of solar energy assigned in a specific way to each patient rather than protocols simply using times of sun exposure. Many parameters influence the UV intensities for the same amount of sun exposure, such as the exact date and time of day when the treatment takes place.

Climate therapy is closely linked to tourism. Thus, the flood of patients to the Dead Sea has had its ups and downs, depending on events and the security situation in Israel. In addition, Dead Sea clinicians might have feared that the arrival on the market of new high-performance drugs, such as biological therapies would reduce the number of patients undergoing treatment at the Dead Sea. Indeed, there has been a substantial reduction in foreign psoriasis patients on treatment at the Dead Sea since 2007–2009 [personal communication]. For its part, the COVID-19 pandemic stopped medical tourism activities concerning the treatment of psoriasis.

Review of these clinical studies, based on evaluation of more than 10,000 patients, may show whether climatotherapy still is an option in the arsenal of psoriasis treatments.

Methods

I reviewed the available literature on clinical trials through PubMed, Medline, and Google Scholar using the terms *psoriasis* and *Dead Sea*. I selected only clinical trials performed on psoriasis patients treated at the Dead

Sea, except for one study conducted in one hospital in Israel, with Dead Sea salts.

I tried to standardize the parameters of each study by exploring the populations treated, the treatment times, the protocol (when possible), the tools used to evaluate the effectiveness of the treatment, as well as the time the treatment was applied. By choosing the most significant studies, I summarized the study conclusions. The benefits induced on the quality-of-life parameters of the patients undergoing this natural option were also reported by many authors, echoing the statements of almost all the patients.

This research has helped determine and examine the limits and benefits of climatotherapy, thus shedding light on the mechanism of action and its safety.

Results

The first clinical studies were published by Israeli dermatologists. However, most patients treated at the Dead Sea arrived from abroad. Therefore, demographic studies were first conducted on German, Austrian, Scandinavian, and other European patients. Later, clinical studies on Israeli patients emerged. Few studies have been devoted to the mechanism of action of climatotherapy in psoriasis. Similarly, few publications discuss post-treatment remission times and long-term side effects.

The studies have shown convincing effects of medical climatotherapy, including clinical improvement of patients immediately after their treatment. Some studies also have shown remission of symptoms for several months. It seems that the dose of UV received correlates positively with the results. Short-term side effects were limited and quickly controlled.

CHRONOLOGICAL ANALYSIS OF CLINICAL STUDIES

Table 1 shows a chronology of clinic studies. In 1985 two dermatologists, Abels and Kattan-Byron, published an article on 110 patients with psoriasis treated successfully at the Dead Sea [2]. They reported a clearance rate of more than 85% and concluded that Dead Sea climatotherapy should be included in the therapeutic arsenal for psoriasis.

At that time, doctors and patients feared the side effects of the few available systemic treatments proposed in moderate-to-severe clinical forms of the disease. This new treatment, a priori without side effects, became the

choice for many patients. The advantages of (finally) clearing the skin completely, in a short time, outweighed the inconveniences of travelling abroad, the length of the treatment stay (4 weeks), and the expenses induced.

The real pioneer of this method of treatment was an Israeli-German dermatologist, Dr. med. Raphael Shimshoni, who started his activity at the Dead Sea in the early 1980s. He advocated the importance of daily sun exposure and repeated baths in the Dead Sea waters. His reputation spread quickly, and many patients, especially from Germany, flocked to his clinic. Among his many publications, few regarding the Dead Sea treatment are available [3]. However, his imprint on the development of climatic treatment remains indelible.

During this same period the essential work of two physicians, Prof. Avraham Kushelevsky and Dr. Avraham Kudish, specializing in solar energy began. Their published results [4] demonstrated the uniqueness of the ultraviolet radiation reaching the Dead Sea region. Dermatologists used this baseline data to shape treatment protocols according to every skin type, every time of year, and every time of the day.

Ten years after his first report, Abels [5] confirmed the preliminary results, which were previously published, in a study on 1448 patients. Using mainly the sun and some creams as an adjunct, 88% of the patients showed 80–100% improved while 58% were totally cleared of skin lesions.

Even-Paz [6], director of the department of dermatology at the Hadassah Medical Center in Jerusalem and the first scientific director of the Dead Sea Research and Development Center, which was founded in 1993, was the first to definitively determine the primordial importance of solar exposure in the climatic treatment at the Dead Sea. Alignment with the standard clinical evaluation methods helped to strengthen the quality of published articles, as has been shown in the literature since 1996.

The results obtained at the Dead Sea have been evaluated at the end of treatment, 3 or 4 weeks after the patient’s arrival and just before departure. In 1996, for the first time, an article published in a Scandinavian medical journal showed the long-term results of the climatic treatment [7]. Using physician assessments and questionnaires, the authors found that 55% of patients were still in remission 1–3 months later.

Assessment of long-term results requires either patients

DEAD SEA CLIMATOTHERAPY IS A POTENT MODALITY OF TREATMENT FOR PSORIASIS.

MEDICAL GUIDANCE AND SUPERVISION ARE NECESSARY TO ACHIEVE VALUABLE OUTCOMES.

Table 1. Chronological summary of trials and reports on patients undergoing Dead Sea climatotherapy for psoriasis

Year of publication	First author	Reference #	Journal	Study design	Length of treatment (mean)	Number of patients included	Mean age in years	Methods of Measurement	Time of assessment	Outcomes
1982	Leuteritz G	3	<i>Zeit F Hautkrankh</i>	Retrospective	-	75	-	Psychologist assessment	Before stay	75% had a critical life period, 33% had a critical life event, 52% revealed lesions proceeding from the head
1985	Abels DJ	2	<i>J Am Acad Dermatol</i>	Retrospective	-	110	-	Physician assessment	End of stay	85% complete clearing or excellent improvement
1989	Schewach-Millet M	14	<i>J Am Acad Dermatol</i>	Retrospective	3-4 weeks	19	-	Histology	End of stay	No epidermal dystrophy + no melanocytic atypia
1995	Abels DJ	5	<i>Int J Dermatol</i>	Retrospective	3-4 weeks	1448	-	Physician assessment	End of stay	58% complete clearing + 80-100% clearance in 88% of patients. Overseas patients responded considerably better than Israelis
1997	Even-Paz Z	6	<i>J Dermatol Treat</i>	Open, prospective	5 weeks	81	-	PASI improvement in 3 groups	End of stay	Dead Sea bath only: 28%. Sun only: 73%. Sea and sun exposure: 83%
1996	Knudsen EA	7	<i>Ugeskr Laeger</i>	Retrospective	4 weeks	192	-	Physician assessment + questionnaires	Back home + after 3 months	Total or almost total remission: 73% Improvement: 20%, 88% very satisfied, 55% in remission 1-3 months
1996	Kushelevsky AP	8	<i>Pharmacol Res</i>	Prospective	4 weeks	Study1: 688 Study2: 502 Study3: 1142	10-60 + ≥ 65	Involved Body Surface Area (BSA)	End of stay	Higher clearance rate (78%) for longer disease duration + type 1 psoriasis
1997	Harari M	9	<i>Int J Dermatol</i>	Retrospective	4 weeks	740	Range 10-72	Involved Body Surface Area (BSA)	End of stay	Best results for 7 hours of sun exposure (72%), severe disease, presence of arthritis
1997	Bisharat ZZ	10	<i>J Am Acad Dermatol</i>	Retrospective (Jordan)	-	519	-	Physician assessment	End of stay + remission evaluation	Complete clearance: 39%. Significant to moderate improvement: 60%. Majority maintained clearance for long time
1997	Halevy S	11	<i>J Am Acad Dermatol</i>	Prospective, double-blind (NOT at the Dead Sea)	3 weeks	Group1: Dead Sea salts Group2: Common salt N=31	-	PASI improvement	End of treatment and 1 month after	Dead Sea salts: 35% and 43%. Common salt: 27% and 24%
1998	Kushelevsky AP	4	<i>J Am Acad Dermatol</i>	Retrospective, comparative	4 weeks	80	-	UVB Phototherapy in several countries, Minimal Erythema Doses	End of stay / annual	Lowest reported MED cumulative doses for Dead Sea Climatotherapy
1998	Nissen JB	15	<i>Br J Dermatol</i>	Prospective, control	4 weeks	21 (only 10 psoriasis)	-	RIA for enkephalin	End of stay	Total clearance on sample sites
2001	Frentz G	12	<i>Br J Dermatol</i>	Retrospective, nation wide cohort	6.1 years (Range 0-22)	1738	25.3	Presence of any type of skin cancer at follow-up	Follow-up range: 0-22 years	Greater overall risk for NMSC, more BCC in young women
2003	Hodak E	16	<i>J Am Acad Dermatol</i>	Prospective, single arm cohort	4 weeks	27	Range: 24-73	PASI, quantitative histologic measures	End of stay	81.5% PASI decrease, complete / marked therapeutic response in 66%
2005	David M	13	<i>J Am Acad Dermatol</i>	Multicenter controlled cross-sectional	Multiple stays of 2-3 weeks	Psoriasis: 480 Control: 738	Psoriasis: 48 Control: 47	Any sun damage lesion including cancer	After last stay at the Dead Sea: 7.5 months (mean)	No increased risk of any skin cancer. Mores skin damage lesions
2005	Cohen AD	17	<i>J Dermatol Treat</i>	Prospective, single-arm cohort	2-3 weeks	70	Range: 19-78	PASI, BPSS	End of stay	75.9% PASI decrease and 57.5% in BPSS
2007	Harari M	22	<i>Int J Dermatol</i>	Prospective, single arm cohort	4 weeks	64	41.4	PASI, QoL, VAS	End of stay and follow-up at home	At end 75.9% reached PASI75. Median duration therapeutic effect: 33.6 weeks
2009	Ben-Amitai D	18	<i>Pediatr Dermatol</i>	Open uncontrolled prospective	2 weeks	17	Range: 10-18	PASI	End of stay and follow-up at 6 months	PASI50: 64.7%, PASI75: 35.2%. 70.5% free and 29.4% almost free at 6 months
2011	Czarnovicki T	19	<i>Psoriasis Forum</i>	Retrospective comparison	4 weeks	40	-	PASI, BMI, BSA. Patients with or without methotrexate	End of stay	No better results with methotrexate
2012	Kopel E	23	<i>IMAJ</i>	Prospective observational	4 weeks	119	46.8	Skindex-29 Questionnaire (Quality of Life score)	Arrival, departure, 3-6 months after	Marked improvement from time of arrival to time of departure + 3 months after
2012	Harari M	20	<i>J Eur Acad Dermatol Venereol</i>	Retrospective	4 weeks	605	48.1	Age at psoriasis onset, PASI, BSA	End of stay	PASI95: 74% if onset before age of 40y and 62% for onset after 40 years
2016	Harari M	21	<i>Glob Dermatol</i>	Retrospective report	3-4 weeks	719	51.2	PASI, BMI, BSA	End of stay	Previous DSC, younger age at onset, longer duration of disease and skin type II associated to better outcomes
2020	Trøstrup H	24	<i>Dermatol Ther</i>	Prospective single arm cohort	4 weeks	49	-	PASI, DLQI	End of stay, follow-up at 4-6 months after	At end: 39.5% PASI and 34.1% DLQI decrease with 22.4% PASI75 and 60% improvement in DLQI

BMI = body mass index, BPSS = Beer Sheva Psoriasis Score, DLQI = Dermatology Life Quality Index, PASI = Psoriasis Area and Severity Index, QoL = quality of life, VAS = Visual Analog Scale

Table 2. Dead Sea climatotherapy for psoriasis vulgaris: pros and cons

Pros	Cons
Natural treatment (without medicines)	Not always available (8 months per year)
Long experience	Need to be on location to get treatment
Few contraindications	Need of 2-4 weeks of treatment
Available in childhood and pregnancy	Need strict medical supervision
Possible with systemic treatments	Not always covered by health insurances
Improvement of quality-of-life parameters	
Good remission time after treatment	
Good cost-effectiveness ratio	
High compliance	
Remitting treatment (once every 1-2 years)	

to come to the Dead Sea for treatment or a close cooperation with treating institutions and dermatologists. These results have been difficult to obtain. However, patients who regularly returned each year to the Dead Sea clinics allowed those clinicians to evaluate the duration of a patient's remission by questioning about when new lesions appeared.

Two retrospective clinical studies demonstrated the effectiveness of the treatment on large cohorts of patients [8,9]. A third study conducted in Jordan confirmed the positive results of sun exposure and sea bathing [10].

In this review, I reported on studies conducted at the Dead Sea, except for the one by Halevy [11]. In a prospective double-blind controlled study, Halevy demonstrated the beneficial effects of Dead Sea salts used by psoriasis patients in a hospital setting during daily baths for two consecutive weeks. The superiority of Dead Sea salts baths over table salts was shown even 1 month after treatment [11].

Irradiance measurements in the Dead Sea area began earlier, but it was only in 1998 that a fundamental study was published, shedding light on the physical geoclimatic conditions of the region and the understanding of the treatment effectiveness and safety [4]. This article was followed one year later by a major retrospective study that showed an increased incidence of cancerous skin lesions in patients who underwent treatment at the Dead Sea [12]. However, this study has been criticized because of its methodology and was not accepted in medical literature. In contrast, a multicenter controlled cross-sectional study showed more skin damage lesions in the group of patients who underwent Dead Sea climatotherapy, but no

increased risk of any skin cancer [13].

Three studies addressed the histological changes that occurred after improvement of the lesions [14-16]. Other authors focused mainly on assessment of clinical improvement [17] of adults and children [18] and with or without association of systemic treatment [19]. Excellent outcomes were confirmed by two important retrospective studies on a total of 1324 patients [20,21].

Quality-of-life parameters were measured in several articles [22-24]. The authors demonstrated a beneficial effect that persisted for at least 3 months after the end of treatment. However, not all prospective studies that have attempted to determine the duration of remission concurred.

LONG-LASTING EFFECTS OF DEAD SEA CLIMATOTHERAPY

While a small study on 18 patients showed reappearance of skin symptoms after only 3.1 months, another reported a rate of 22.4% in Patients with Psoriasis Area and Severity Index improved by 75% (PASI75) at the end of treatment and of 20% at a follow-up 4 and 6 months later [24].

These figures do not correspond to those found in a German prospective study, in which 75.9% of patients reached PASI75 at the end of treatment. In that study, the median remission time was 8 months [22]. In another publication focusing on young patients, the authors reported that 70% of patients were free of symptoms at 6 months [18].

These last evaluations correspond more to our observations and to the responses from our patients. Many patients, in fact, return each year to the Dead Sea for further treatment, for their own positive assessment of the long remission obtained, reaching more than 6 months.

NON-CUTANEOUS ASPECTS OF PSORIASIS AT THE DEAD SEA

Psoriasis can affect several non-cutaneous aspects of the body: nails, scalp, genital area, joints, and eyes. There may also be an impact on mental health. Moreover, multiple studies have shown a higher prevalence of metabolic conditions such as obesity, type 2 diabetes, hypertension, dyslipidemia, and metabolic syndrome. Chronic inflammation, which may be a shared factor contributing to these conditions [25], was sparsely studied on psoriatic patients at the Dead Sea.

DEAD SEA CLIMATOTHERAPY SHOULD REMAIN AN ACCESSIBLE OPTION FOR MANY PATIENTS.

Sukenik [26] investigated the effectiveness of balneotherapy at the Dead Sea for rheumatic diseases. He showed, in a randomized control study published in 1994, that additional mud packs and sulfur baths induced better results in

patients presenting with psoriatic arthritis. In addition, several studies confirming improvement of rheumatic conditions were later published by his team.

NEW INSIGHTS IN DEAD SEA CLIMATOTHERAPY

Cost effectiveness

In a meta-analysis published in 2015, only a few years after the onset of biotherapies, Torres and colleagues [27] define the variables essential for the calculation of cost-effectiveness of psoriasis treatments. They evaluated cost related to the treatment, hospitalization for non-responders, efficacy, and utility values. They concluded that more studies on the subject were needed. Nevertheless, the cost-effectiveness ratio of artificial phototherapy appeared to be favorable, like climatotherapy at the Dead Sea.

Mechanism of action

While it seems obvious that climatotherapy at the Dead Sea is within the scope of phototherapy in the UVB spectrum, many questions remain. What is the role of UVA irradiance, the increased production of vitamin D [28], the changes appearing in the skin microbiota [29], and the emotional elements of the vacation atmosphere in improving symptoms?

Overseas patients presented better results, most likely because they received a 4-week treatment. Still, Israeli patients obtained good results, despite a sun protocol concentrated to only 2 weeks.

Did biologics induce a dramatic reduction of climatotherapy at the Dead Sea?

For approximately 10 years, fewer patients visited the Dead Sea to treat their psoriasis (~10% fewer, personal data). Likewise, health insurance companies approved fewer requests for climatotherapy, either because there were indeed fewer demands or because priority was given to new treatments. Our clinic noted an increase of approximately 30% in self-pay patients.

Table 2 demonstrates the value of climatotherapy treatment for many patients. The safety profile and a cost-efficacy ratio of the treatment showed a difference over other therapies.

CONCLUSIONS

Exposure to the unique climatic factors of the Dead Sea region, essentially the sun and the sea, induced fast and significant results, with high and rapid clearance rates of psoriasis plaques. Even in the era of biological therapies,

Dead Sea climatotherapy, administered under strict medical supervision and with a personalized protocol, can help control psoriasis symptoms.

In this review, I showed the favorable effects of climate therapy at the Dead Sea, as did my eminent predecessors [30]. Yet, a better approach would be to write a critical meta-analysis rather than a descriptive review.

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Capsule

Lung healing after viral injury

Viral infection can lead to acute respiratory distress syndrome, which damages the lungs and is often lethal. **Zhao** et al. have shown that the transforming growth factor β receptor 2 (TGF β R2) is important for lung endothelial cells to recover after injury caused by influenza virus or severe acute respiratory syndrome coronavirus 2 infection. The researchers used mice, human organoids, and human endothelial cells to demonstrate how TGF β R2 interacts with

VEGFA specifically in endothelial lung cells to promote tissue regeneration after viral injury. They also developed lung-targeted nanoparticles to deliver *Vegfa* mRNA to promote lung healing in mice lacking TGF β R2. This study highlights the potential for targeting TGF β R2 signaling in lung endothelial cells as a treatment for acute respiratory distress syndrome.

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Capsule

The eyes have high-level visual processing

Complex object features are processed in high-level visual areas such as the inferior temporal cortex. **Azadi** and co-authors hypothesized that neural activity in this brain region plays a causal role in controlling eye movements. Using muscimol, a potent neural silencer, to reversibly inactivate clusters of face-selective neurons in macaques, the authors investigated the resulting effects on eye movements while the monkeys were freely viewing faces and other objects. Inactivation of face-

selective neurons altered the overall structure of eye movements. The animals still found faces in the scene but neglected the eye contralateral to the inactivation hemisphere. These results indicate that high-level visual processing can determine the input to the visual system by steering the eyes toward the relevant parts of the visual field.

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