

## CLINICAL REPORT

# Empowering Heliotherapy Improves Clinical Outcome and Quality of Life of Psoriasis and Atopic Dermatitis Patients

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**Empowering heliotherapy aims at clinical healing and improved coping with psoriasis and atopic dermatitis, but evidence of long-term effects is scarce. We studied the effect of 2-week empowering heliotherapy in the Canary Islands on clinical outcome and quality of life in 22 psoriasis and 13 atopic dermatitis patients. Empowerment consisted of meeting peers, sharing experiences and performing physical and mental practices. Using the self-administered PASI (SAPASI) psoriasis was alleviated statistically significantly during heliotherapy ( $p < 0.001$ ), and the treatment effect was still detectable 3 months later ( $p < 0.001$ ). Atopic dermatitis was improved ( $p < 0.001$ ) when assessed with the patient-oriented SCORAD (PO-SCORAD), and the effect was still obvious 3 months later ( $p = 0.002$ ). During heliotherapy the dermatology life quality index (DLQI) improved in both groups ( $p < 0.001$ ), persisting in atopic patients for up to 3 months ( $p = 0.002$ ), but not in psoriasis patients. In conclusion, a 2-week empowered heliotherapy showed a long-lasting improvement in psoriasis and atopic dermatitis disease activity, and also in the quality of life of atopic patients. *Key words: vitamin D; ultraviolet B radiation; SAPASI; PO-SCORAD; DLQI.***

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Psoriasis (PS) and atopic dermatitis (AD) are chronic inflammatory skin diseases with a negative impact on quality of life (QoL) (1, 2). PS and AD can be treated with sunbathing, i.e. heliotherapy (HT), alleviating the physical and psychological fatigue of patients (3–5). The Nordic health authorities have funded HT courses since the 1970s (5, 6). Recently, emphasis has moved from HT to empowerment of patients and coping with the disease. Therefore, HT was renovated to meet these goals. The present HT model consists of meeting peers, sharing experiences, adopting a healthy life style, exercising practices, improving physical,

psychological and social wellbeing and coping with the disease guided by health care experts. The staff consists of experienced nurses, a physiotherapist and a psychologist. Because less emphasis is put on HT, the treatment results could differ from those of traditional HT.

To our knowledge, no earlier study has assessed sunbathing habits, QoL or vitamin D (VD) changes in parallel for PS and AD patients receiving HT. The aim of the study was to monitor the efficacy of a 2-week empowered HT on personal UV exposure, clinical outcome, QoL and VD balance in PS and AD patients attending the same course. We also performed a follow-up 3 months after the HT course.

## MATERIAL AND METHODS

### Patients and heliotherapy course

The Finnish Psoriasis Association and the Finnish Central Organisation for Skin Patients together arranged a 2-week HT course for PS and AD patients in Puerto Rico (27°N, 15°W), the Canary Islands, Spain from 27<sup>th</sup> October to 10<sup>th</sup> November in 2012. Inclusion criteria were psoriasis or atopic dermatitis without demanding any minimum severity scorings, subjects had to be aged 18 or older and have a referral from a doctor. Exclusion criteria were photosensitivity, Fitzpatrick's skin photo-type I, photosensitising drugs, excessive alcohol use, drug abuse, severe cardiovascular diseases, unbalanced diabetes or mental disorders (7). The course included an education day before HT and a reunion weekend 3 months afterwards. The amount to be paid by the participants was €400, the total cost per patient being €2,450. Twenty-two PS and 13 AD patients took part in the study (Table I). Fifteen patients had psoriatic arthritis and 5 of them used biologic drugs, 3 of these patients also used methotrexate. Two patients had methotrexate as a monotherapy. During HT the patients were allowed to use their routine topical medication. Nineteen patients (14 PS, 5 AD) used VD supplementation before HT, on mean 23 µg (range 5–50 µg) daily, but not during HT or 3 months after it.

The patients had their sunbathing plans adjusted for their Fitzpatrick's skin types. The first solar exposure times ranged

Table I. Demographics of patients with psoriasis and atopic dermatitis (AD), and UV radiation doses received during a two-week heliotherapy course

	Psoriasis (n=22)	AD (n=13)	p-value
Male/Female, n	8/14	0/13	0.013
Age, years, mean ± SD (range)	52 ± 10 (34–68)	44 ± 17 (21–74)	0.069
Body mass index, mean ± SD (range)	28.2 ± 6.2 (17.1–41.9)	27.1 ± 6.9 (19.1–39.8)	0.643
Fitzpatrick's skin type, II/III/IV	6/15/1	5/8/0	0.615
UV dosimeter (SED), mean ± SD (range)	30 ± 16 (22.4–38.5) <sup>a</sup>	43 ± 16 (32.1–53.9) <sup>b</sup>	0.062

<sup>a</sup>From 18 patients, <sup>b</sup>From 12 patients. SED: standard erythema dose.

from 20–90 min for PS and 15–30 min for AD patients. Both sides of the body were exposed during sunbathing. The time was increased within a week to 90–300 min for PS and to 120 min for AD patients. The scheduled sunbathing treatments were done without sunscreen in the mornings or afternoons. Sunscreen was applied liberally thereafter. The supporting program included teaching self-management and a healthy life style as well as group conversations with a psychologist, altogether for 14 h for both groups. Physical exercise included water sports, trekking and gymnastics for 24 h for the PS group and 11 h for the AD group.

The Ethics Committee of the Tampere University Hospital approved the study protocol. All patients gave their informed consent before the study.

#### UV exposure measurements

To measure the personal UVB dose received by the skin during HT the patients wore personal UV dosimeters (VioSpor blue line Type III, BioSense, Bornheim, Germany), one meter was used for week one and another for week two (8, 9). The meters detect a dose ranging from 1.5 to 90 Standard Erythema Dose (SED). The dosimeters were attached to the patients' upper arms or wrists with straps and during sunbathing they were placed on towels beside the patients (10). Eighteen PS and 12 AD patients wore dosimeters. The ambient maximum solar UV-irradiance was measured as a mean dose from 2 VioSpor Type III dosimeters at a time. The meters were put in an open place and replaced every other day to avoid overexposure. The Spanish Agency of Meteorology (Agencia Estatal de Meteorología; www.aemet.es) supplied the global solar UV irradiance data from the nearby (distance 15 km) Maspalomas C. Insular Turismo weather station. The first HT week was rainy and cloudy and the second HT week was sunny. During the HT maximum UV index varied between 5 and 8.

#### Assessment of disease activity

The PS patients filled out the Self-Administered Psoriasis Area and Severity Index (SAPASI) and AD patients the Patient Oriented Scoring of Atopic Dermatitis (PO-SCORAD) to follow the disease activity (11, 12). Disease severity and pruritus were assessed globally using the Visual Analogue Scale (VAS) (13). The Dermatology Life Quality Index (DLQI) was used to assess the change in the QoL (14). All measures were filled out 3 times: at the onset, at the end and 3 months after HT.

#### Serum 25-hydroxyvitamin D measurements

VD samples were taken immediately before, at the end and 3 months after HT. The sera were deep-frozen and stored at

–20°C. Analysis of 25-hydroxyVD was performed in duplicates using radioimmunoassay (Immunodiagnostic Systems, Boldon, UK), as described earlier (15).

#### Statistics

The data are presented as means with standard deviations (SD) or as counts with percentages. Confidence intervals (95% CI) were obtained by bias-corrected bootstrapping (5,000 replications). Statistical comparisons were made by using analysis of *t*-test, covariance (ANCOVA). In the case of violation of the assumptions (e.g. non-normality), a bootstrap type test was used. Longitudinal measures for continuous outcomes were analysed using a bootstrap type generalised estimating equations (GEE) model. GEE were developed as an extension of the general linear model to analyse longitudinal and other correlated data. GEE models take into account the correlation between repeated measurements in the same subject; models do not require complete data and can be fit even when there are not observations at all time-points for individuals. No adjustment was made for multiple testing. When comparing increases in VD concentrations, the model was standardised by age, sex and body mass index (BMI). Pearson's  $\chi^2$  test was used when comparing nominal data. The STATA 13.1, StataCorp LP (College Station, TX, USA) statistical package was used for the analyses.

## RESULTS

### UV exposures during heliotherapy

According to personal dosimeter measurements the PS patients received a mean UV dose of  $30 \pm 16$  SED and the AD patients  $43 \pm 16$  SED during HT (Table I) showing no significant difference ( $p = 0.062$ ). The respective cumulative ambient two-week UV irradiance was 244 SED measured by VioSpor III dosimeters and 303 SED using the UV records obtained from the Maspalomas C. Insular Turismo station.

### Disease activity and quality of life at the end of heliotherapy

HT was statistically equally effective in PS and AD when disease activity was scored (Table II). Mean SAPASI decreased from 6.7 by 4.9 units ( $p < 0.001$ ) and PO-SCORAD from 30.6 by 19.5 units ( $p < 0.001$ ). Four

Table II. Clinical outcome of a two-week heliotherapy course in patients with psoriasis and atopic dermatitis (AD) measured by Self-Administered Psoriasis Area and Severity Index (SAPASI) or PO SCORAD scores, and by visual analogue scores of severity and pruritus. Vitamin D concentrations were measured at the same time points as the clinical outcome scores. Mean  $\pm$  SD and change ( $\Delta$ ) of mean value compared to Day 0

	Psoriasis (n=22)			AD (n=13)		
	Day 0	$\Delta$ Week 2	$\Delta$ Week 14	Day 0	$\Delta$ Week 2	$\Delta$ Week 14
SAPASI/PO SCORAD (95% CI)	6.7 $\pm$ 5.6 (4.2–9.2)	–4.9*** (–6.8 to –3.0)	–3.1*** (–4.7 to –1.4)	30.6 $\pm$ 17.6 (20.0–41.3)	–19.5*** (–26.2 to –12.9)	–10.0** (–16.3 to –3.8)
Visual analogue score global (95% CI)	3.9 $\pm$ 2.2 (2.9–4.9)	–2.0*** (–2.8 to –1.0)	–1.4** (–2.3 to –0.4)	3.4 $\pm$ 2.2 (2.1–4.7)	–1.8*** (–2.4 to –1.2)	–0.9 (–2.0–0.2)
Visual analogue score pruritus (95% CI)	3.1 $\pm$ 2.2 (2.1–4.1)	–2.2*** (–3.1 to –1.4)	–0.9 (–1.9–0.1)	3.7 $\pm$ 2.5 (2.2–5.3)	–2.2*** (–3.1 to –1.4)	–0.9 (–2.3–0.4)
Dermatology Life Quality Index (95% CI)	6.1 $\pm$ 3.3 (4.7–7.6)	–4.3*** (–5.5 to –3.1)	–0.8 (–2.8–1.2)	7.2 $\pm$ 4.8 (4.3–10.0)	–5.3*** (–7.3 to –3.4)	–3.2** (–5.2 to –1.2)
Vitamin D, nmol l <sup>–1</sup> (95% CI)	86.6 $\pm$ 20.0 (77.8–95.5)	13.8*** (8.6–19.0)	0.4 <sup>a</sup> (–5.2–6.8)	84.1 $\pm$ 16.0 <sup>b</sup> (73.4–94.9)	20.5*** (14.0–25.6)	–3.1 <sup>c</sup> (–10.0–4.0)

\*\* $p < 0.01$ , \*\*\* $p < 0.001$  compared to heliotherapy day 0 values.

<sup>a</sup>20 patients; <sup>b</sup>11 patients; <sup>c</sup>10 patients.

PS but none of the AD patients experienced complete clearance, and 75% clearance was seen in 13 (59%) PS and 2 (15%) AD patients. Using the VAS scales there was significant improvement in disease severity and pruritus in both groups (Table II). QoL was improved showing a decrease in mean DLQI score from 6.1 by 4.3 units ( $p < 0.001$ ) in PS patients and from 7.2 by 5.3 units ( $p < 0.001$ ) in AD patients (Table II). At onset of HT no PS or AD patient was VD-insufficient, defined as  $25(\text{OH})\text{D}_3 < 50 \text{ nmol l}^{-1}$ . During HT the VD concentrations increased significantly ( $p < 0.001$ , Table II) and equally ( $p = 0.56$ ) in both patient groups.

#### *Disease activity and quality of life after heliotherapy*

At the follow-up 3 months after HT, the treatment effect significantly persisted when compared to initial scores (Table II). The decrease in SAPASI was 3.1 ( $p < 0.001$ ) and in PO-SCORAD 10.0 ( $p = 0.002$ ). Using the VAS the global disease severity also remained decreased ( $p = 0.004$ ) in PS patients but not ( $p = 0.11$ ) in AD patients. The VAS scores depicting pruritus had returned close to baseline levels both in PS ( $p = 0.058$ ) and AD ( $p = 0.17$ ) patients (Table II). In PS patients the 3-month follow-up DLQI scores had dropped to baseline ( $p = 0.43$ ), but in the AD patients it remained improved ( $p = 0.002$ ) (Table II). The VD concentrations had decreased in both the PS and AD patients close to the pre-HT values (Table II).

## DISCUSSION

The results showed PS to improve statistically highly significantly during empowering HT, the mean SAPASI reducing by 73%. Complete clearance was reached in 18% and 75% SAPASI clearance in 59% of the patients. The mean initial SAPASI score of 6.7 was markedly lower compared to the PASI or SAPASI scores of previous studies (16–19) indicating a mild disease, but 7 patients were using systemic drugs. Use of methotrexate or biologic drugs should however not dampen the effect of HT since both have synergistic effects with UVB irradiation (20, 21). HT reduced the PS scorings only slightly, which could be due to the short duration of HT, or the insensitivity of SAPASI as regards a mild disease state. In a study by Wahl et al. (17) the mean SAPASI remained decreased by 21.1% 4 months after HT, whereas in our study the reduction was 46.3% at the 3-month follow-up visit. It is not known whether the persisting improvement of the SAPASI in our patients was due to the enhanced educative contents of the course.

In AD patients the mean PO-SCORAD score improved statistically significantly from 30.6 to 11.1 but did not show complete clearance in any of the patients, and only 15% reached 75% clearance. SAPASI and PO-SCORAD are not comparable with each other, because PO-SCORAD includes subjective parameters in addition

to visible signs. At the end of HT there were patients with no visible eczema, but due to pruritus or sleep disturbances the PO-SCORAD did not show complete clearance.

We used the DLQI measure to make a parallel assessment for the QoL of both PS and AD patients. The improvement of QoL in the AD patients seemed to be more long-lasting than in the PS patients, but direct between-groups comparisons are not justified due to limited sample size in this study (22, 23). The PS and AD patient groups also differed significantly for gender ( $p = 0.013$ ), and there were only females in the AD group. This could have influenced the results, because women have been shown to comply better with topical treatments than men (24). In this study, the size of the group as well as inclusion and severity of the patients were in the hands of the patient associations depicting the real life situation, rather than a strict experimental research protocol.

The persistent long-term (up to 3-month) statistically significant improvement of DLQI among AD patients surprised us, because this contradicted the VAS scores measuring disease severity and pruritus. The VAS scores had returned to baseline. This discrepancy could be due to pruritus affecting the QoL of atopic patients more than the DLQI scores can show. It is important to use more than one measure in parallel to increase reliability. An interesting measure, which we unfortunately were not aware of earlier, is the Health Education Impact Questionnaire (25). This was used in a recently published study of Wahl et al. (25), however also in this study the educational impact of empowering HT was a challenge (25).

PS patients could be more risk-taking and prone to higher UV doses than AD patients (26, 27), but it turned out that AD patients received a higher dose in fewer hours. This could be explained by the different outdoor activities of the groups (28). Ambient irradiance is also highly dependent on the season. This became obvious in our earlier study where the personal UV dosimeter exposures of AD patients on two-week HT were 75 SED in January and 131 SED in March (9). The 30 SED and 43 SED UV doses of our PS and AD patients reflect both the lower UV index of November season and unfortunate weather conditions of the first HT week, which probably affected the clearance of the skin diseases.

No patient was VD insufficient at the onset (Table II). Despite this, HT improved the VD status statistically significantly in both patient groups, 13.8  $\text{nmol l}^{-1}$  for PS and 20.5  $\text{nmol l}^{-1}$  for AD having received on mean 30 SED and 43 SED respectively. Sunlight seems to be a very potent VD inductor even in subjects who showed no VD deficiency.

The empowering HT model is a response to public pressures stressing patients' own responsibility and self-management for their care. New courses run by the patient organisations focus more on empowerment than clearance of the disease. Wahl et al. (25) studied the effect of climate therapy on self-management in PS patients, and our study focused also on AD pa-

tients showing that both PS and AD were statistically significantly improved (25). In our past study HT was regarded cost-effective for the high indirect costs only for patients with severe psoriasis (29). Similar to the Norwegian study (25) we were unable to confirm long-term improvement of QoL in PS patients (25).

To conclude, UV doses received by PS and AD patients were comparable showing no obvious differences. The empowering HT cleared the skin symptoms statistically significantly, but in the long run did not improve the QoL of PS patients. In PS patients the decrease in disease severity expressed using the VAS seemed more long-lasting than in AD patients. A two-week HT improved VD status statistically significantly even in non-VD deficient and substituted individuals.

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## REFERENCES

- Zachariae R, Zachariae H, Blomqvist K, Davidsson S, Molin L, Mork C, et al. Quality of life in 6497 Nordic patients with psoriasis. *Br J Dermatol* 2002; 146: 1006–1016.
- Maksimovic N, Jankovic S, Marinkovic J, Sekulovic L, Zvic Z, Spiric V. Health-related quality of life in patients with atopic dermatitis. *J Dermatol* 2012; 39: 42–47.
- Vahavihu K, Ylianttila L, Salmelin R, Lamberg-Allardt C, Viljakainen H, Tuohimaa P, et al. Heliotherapy improves vitamin D balance and atopic dermatitis. *Br J Dermatol* 2008; 158: 1323–1328.
- Autio P, Komulainen P, Larni HM. Heliotherapy in atopic dermatitis: a prospective study on climatotherapy using the SCORAD index. *Acta Derm Venereol* 2002; 82: 436–440.
- Mork C, Wahl A. Improved quality of life among patients with psoriasis after supervised climate therapy at the Canary Islands. *J Am Acad Dermatol* 2002; 47: 314–316.
- Snellman E, Lauharanta J, Reunanen A, Jansen CT, Jyrkinen-Pakkasvirta T, Kallio M, et al. Effect of heliotherapy on skin and joint symptoms in psoriasis: a 6-month follow-up study. *Br J Dermatol* 1993; 128: 172–177.
- Fitzpatrick TB. The validity and practicality of sun-reactive skin types I through IV. *Arch Dermatol* 1988; 124: 869–871.
- Quintern LE, Furusawa Y, Fukutsu K, Holtschmidt H. Characterization and application of UV detector spore films: the sensitivity curve of a new detector system provides good similarity to the action spectrum for UV-induced erythema in human skin. *J Photochem Photobiol B* 1997; 37: 158–166.
- Vahavihu K, Ylianttila L, Kautiainen H, Tuohimaa P, Reunala T, Snellman E. Spore film dosimeters are feasible for UV dose monitoring during heliotherapy. *Photochem Photobiol* 2010; 86: 1174–1178.
- Thieden E, Agren MS, Wulf HC. The wrist is a reliable body site for personal dosimetry of ultraviolet radiation. *Photodermatol Photoimmunol Photomed* 2000; 16: 57–61.
- Feldman SR, Fleischer AB, Reboussin DM, Rapp SR, Exum ML, Clark AR, et al. The self-administered psoriasis area and severity index is valid and reliable. *J Invest Dermatol* 1996; 106: 183–186.
- Stalder JF, Barbarot S, Wollenberg A, Holm E, De Raeve L, Seidenari S, et al. Patient oriented SCORAD (PO-SCORAD): a new self-assessment scale in atopic dermatitis validated in Europe. *Allergy* 2011; 66: 1114–1121.
- Shikier R, Bresnahan BW, Stone SP, Thompson C, Koo J, Revicki DA. Validity and reliability of patient reported outcomes used in psoriasis: results from two randomized clinical trials. *Health Qual Life Outcomes* 2003; 1: 53.
- Finlay AY, Khan GK. Dermatology Life Quality Index (DLQI) – a simple practical measure for routine clinical use. *Clin Exp Dermatol* 1994; 19: 210–216.
- Ala-Houhala M, Vahavihu K, Hasan T, Kautiainen H, Ylianttila L, Viljakainen H, et al. Comparison of narrowband ultraviolet B exposure and oral vitamin D substitution on serum 25-hydroxyvitamin D concentration. *Br J Dermatol* 2012; 167: 160–164.
- Osmancevic A, Nilsen LT, Landin-Wilhelmsen K, Soyland E, Abusdal Torjesen P, Hagve TA, et al. Effect of climate therapy at Gran Canaria on vitamin D production, blood glucose and lipids in patients with psoriasis. *J Eur Acad Dermatol Venereol* 2009; 23: 1133–1140.
- Wahl A, Mork C, Cooper B, Padilla G. No long-term changes in psoriasis severity and quality of life following climate therapy. *J Am Acad Dermatol* 2005; 52: 699–701.
- Harari M, Novack L, Barth J, David M, Friger M, Moses S. The percentage of patients achieving PASI 75 after 1 month and remission time after climatotherapy at the Dead Sea. *Int J Dermatol* 2007; 46: 1087–1091.
- Kopel E, Levi A, Harari M, Ruzicka T, Ingber A. Effect of the Dead Sea climatotherapy for psoriasis on quality of life. *Isr Med Assoc J* 2013; 15: 99–102.
- Al-Hamamy H, Al-Mashhadani S, Mustafa I. Comparative study of the effect of narrowband ultraviolet B phototherapy plus methotrexate vs. narrowband ultraviolet B alone and methotrexate alone in the treatment of plaque-type psoriasis. *Int J Dermatol* 2014; 53: 1531–1535.
- Calzavara-Pinton P, Sala R, Arisi M, Rossi M, Venturini M, Ortel B. Synergism between narrowband ultraviolet B phototherapy and etanercept for the treatment of plaque-type psoriasis. *Br J Dermatol* 2013; 169: 130–136.
- Katugampola RP, Lewis VJ, Finlay AY. The Dermatology Life Quality Index: assessing the efficacy of biological therapies for psoriasis. *Br J Dermatol* 2007; 156: 945–950.
- Basra MKA, Fenech R, Gatt RM, Salek MS, Finlay AY. The Dermatology Life Quality Index 1994–2007: a comprehensive review of validation data and clinical results. *Br J Dermatol* 2008; 159: 997–1035.
- Uttjek M, Dufaker M, Nygren L, Stenberg B. Psoriasis Care Consumption and Expectations from a Gender Perspective in a Psoriasis Population in Northern Sweden. *Acta Dermatol Venereol* 2005; 85: 503–508.
- Wahl A, Langeland E, Larsen M, Robinson H, Osborne R, Krogstad A-L. Positive changes in self-management and disease severity following climate therapy in people with psoriasis. *Acta Derm Venereol* 2015; 95: 317–321.
- Bahmer J, Kuhl J, Bahmer F. How do personality systems interact in patients with psoriasis, atopic dermatitis and urticaria? *Acta Derm Venereol* 2007; 87: 317–324.
- Sansone R, Sansone L. Excessive tanning: some psychopathological explanations. *Psychiatry* 2010; 7: 13–17.
- Holman CD, Gibson IM, Stephenson M, Armstrong BK. Ultraviolet irradiation of human body sites in relation to occupation and outdoor activity: field studies using personal UVR dosimeters. *Clin Exp Dermatol* 1983; 8: 269–277.
- Snellman E, Maljanen T, Aromaa A, Reunanen A, Jyrkinen-Pakkasvirta T, Luoma J. Effect of heliotherapy on the cost of psoriasis. *Br J Dermatol* 1998; 138: 288–292.