Changes in Vitamin D Levels Following Climatotherapy at the Dead Sea

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Abstract

Background: The Dead Sea region in Israel is the deepest spot on earth, 422 meter beneath sea level. The atmosphere layer overhanging this region is larger than in any other place on earth, allowing a filtration effect on sunshine beams and leading to their moderate attenuation in the Ultraviolet B (UVB) spectrum. The question was raised whether exposure to this sunshine may increase serum Vitamin D levels of patients treated at the Dead Sea.

Objectives: To assess, in Norwegian patients suffering from joint disease and chronic pain syndromes, the magnitude of change in 25-Hydroxyvitamin D levels (25-OH-D) after Dead Sea Climatotherapy (DSC).

Methods: 117 Norwegian patients received regular DSC procedures during their 3 weeks visit, which includes sun exposure (60 to 90 minutes), Dead Sea bath and outdoor physical activities. The cumulative solar UVB exposure was calculated in Minimal Erythema Doses (38.3 ±12.8 MEDs). Blood sampling for measurements of 25-OH-D levels were performed upon arrival and on the last day of their stay. Data were evaluated by statistical analysis using paired t test.

Results: Following the DSC serum 25 OH Vitamin D levels were increased from 51.9 ± 2.7 nano mol per liter (nM), to 64.2 ± 3.1 nM ($p < 0.001$, 23.8% increase). The rate of increase in serum 25-OH-D was found to be age related with the highest increase in the youngest group. Variations in response were found between patients with different diseases). The highest increase in serum 25-OH-D was obtained in patients with Post Polio Syndrome (36.7%) and only 16.5% increase was measured in Fibromyalgia patients.

Conclusions: Even in the attenuated sunshine existing in the Dead Sea region, a daily sun exposure for 3 weeks induces significant increases in serum 25-OH-D levels by Caucasian patients suffering from musculoskeletal and joint diseases. Changes in 25-OH-D after sun exposure were found to be related to initial value of serum 25-OH-D, to age, and disease.

Key words: Musculoskeletal Diseases, Vitamin D, Dead Sea.

Cambios en los niveles de vitamina D después de Climatoterapia en el Mar Muerto

Resumen

Antecedentes: La región del Mar Muerto en Israel es el lugar más profundo de la tierra, 422 metros por debajo del nivel del mar. La capa de la atmósfera que domina esta región es mayor que en cualquier otro lugar del mundo, lo que permite un efecto de filtración de los rayos de sol que conduce a su atenuación moderada en el ultravioleta B (UVB) del espectro. Se planteó la cuestión de si la exposición a esta luz del sol puede aumentar los niveles de vitamina D en suero de los pacientes tratados en el Mar Muerto.

Objetivos: Evaluar, en pacientes noruegos que sufren de enfermedad en las articulaciones y síndromes de dolor crónico, la magnitud del cambio en la 25-hidroxivitamina D (25-OH-D) después de Climatoterapia en el Mar Muerto (DSC)

Métodos: 117 pacientes noruegos recibieron los procedimientos habituales de LSD durante su visita de tres semanas, que incluye la exposición al sol (60 a 90 minutos), el baño en el Mar Muerto y actividades físicas al aire libre. La exposición acumulada de UVB solar se calculó en la dosis mínima de eritema (MED 38,3 ± 12,8). Las muestras de sangre para la medición de los niveles de 25-OH-D se tomaron a la llegada y en el último día de su estancia. Los datos fueron evaluados mediante un análisis estadístico utilizando la prueba t para datos apareados.

Resultados: Después del DSC los niveles séricos de 25 OH vitamina D se incrementaron de 51,9 ± 2,7 nano moles por litro (nM), a 64,2 ± 3,1 nM ($p < 0,001$, el 23,8% de incremento). La tasa de aumento de la concentración sérica de 25-OH-D se encontró que se relaciona con la edad, con un mayor incremento en el grupo más joven. Se encontraron variaciones en la respuesta entre los pacientes con distintas enfermedades. El mayor aumento en suero de 25-OH-D se obtuvo en los pacientes con Síndrome Post Polio (36,7%) y sólo tuvo un 16,5% en los pacientes con fibromialgia.

Conclusiones: Aun en la luz del sol atenuada existente en la región del Mar Muerto, una exposición al sol todos los días durante 3 semanas induce aumentos significativos en la concentración sérica de los niveles de 25-OH-D en pacientes de raza blanca que sufren enfermedades músculo-esqueléticas y articulares. Los cambios en la 25-OH-D después de la exposición al sol que se encontró están relacionados con el valor inicial de suero de 25-OH-D, con la edad, y la enfermedad.

Palabras clave: Enfermedades del Aparato Locomotor, Vitamina D, Mar Muerto.

REFERENCE STANDARD

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INTRODUCTION

Vitamin D deficiency in both healthy and sick people is apparently a growing concern in medical practices. The Norwegian Clinic at the Dead Sea, which has a multidisciplinary rehabilitation program, including Dead Sea Climatotherapy (DSC) for people suffering from musculoskeletal, skin and pain diseases, provides an opportunity to carry out studies on groups of patients attending the clinic program and undergoing both sun exposure and bathing in the unique waters and environment of the Dead Sea.

The effect of climate therapy on vitamin D production was recently investigated at the Gran Canarias, on 20 Norwegians patients suffering from moderate to severe psoriasis. As expected, sun exposure increased vitamin D levels and resulted in a significant improvement in the psoriasis severity[1]. In contrast to the Canarias, the Dead Sea region in Israel, is the deepest spot on earth, 422 meter beneath sea level. As a result, the atmosphere layer overhanging this region is larger than in any other place on earth, allowing a filtration effect on sunshine beams and leading to their moderate attenuation in the Ultra-Violet B (UVB) spectrum. Although this moderate UVB radiation may have a negative effect on the amount of Vitamin D produced in the skin, it has a clear advantage in reducing the dangerous of developing skin cancer diseases. The present study was aimed to address the question whether exposure to this limited sunshine may increase serum Vitamin D levels of patients treated at the Dead Sea. Such an increase in Vitamin D levels may be responsible, at least partially, for the health beneficial effect of climatotherapy at the Dead Sea.

PATIENTS AND METHODS

Patients

117 Norwegian patients have participated in the present study that took place in the DMZ Medical Center at the Lot hotel in Ein Bokeq at the Dead Sea, Israel. The patient's group included 90 females and 27 males. The patients mean age was 64.9 ± 12.3 (range: 32.7 ± 85.2). The patients have suffered from various diseases which included Chronic pain syndrome (33 patients), Osteoarthritis (26 patients), Inflammatory joint diseases (22 patients), fibromyalgia (10 patients), post folio syndrome (9 patients), and psoriasis (7 patients). The patients have received DSC treatments for 21 days which included bathing at the Dead Sea water Spa, indoor and outdoor physical activities, and a daily sun exposure for 60-90 minutes. Detailed medical anamnesis and physical examination were taken for each patient on arrival, during, and on the end of the treatment period. Informed consents were obtained from all participants upon arrival to the DMZ Medical Center, after being given oral and

written information concerning the study. The study protocol was approved by the RIDS committee for Medical Ethics and the declaration of Helsinki.

UVB radiation intensity

The rate of UVB exposure of the patients was assessed. The solar global UVB radiation on a horizontal surface was measured by a Solar Light Co. Inc., Model 501A UV-Biometer. This equipement measures the UVB radiation in units of Minimum Erythema Dose per hour (MED/h). This unit is calculated by the cross-multiplication of the irradiating flux in the UVB spectral range and the Erythema Action spectra. One MED/h is defined as the radiation dose causing incipient redness of the average skin type II after 1 hour. 1 MED = 21 mJ/cm^2.

Determination of serum 25-OH-D levels

Patients vitamin D status was determined by measuring their serum 25-OH-D concentrations. Serum 25-OH-D levels were determined for each patient on arrival, and again on departure after the DSC treatment. Serum 25-OH-D measurements were carried out in the present study by using the IDS OCTEVIA 25-OH-D kit (IDS AC-57F1, Immunodiagnostic Systems, Boldon, UK). This assay is an enzyme-immuno-assay in which biotin labeled 25-OH-D is bound to a specific sheep 25-OH-D antibody. This is followed by the addition of a horseradish peroxidase labeled avidin, which binds the biotin complexes. A characteristic color is developed after the addition of a chromogenic substrate[2]. The absorbance was determined in a 96 wells micro-plate by using an ELISA reader (Molecular Devices Corp., Menlo park, CA, USA) at a wavelength of 450 nm. The intensity developed is inversely proportional to the 25-OH-D concentration. Each serum sample was tested in duplicate. An external Quality Control for 25-OH-D determination was used routinely in the Lab. The results are expressed in nM 25-OH-D (Mean±SE).

Statistical analysis

The results were analyzed by using SPSS15 software. Matched paired t-test was used for uni-variable analysis.

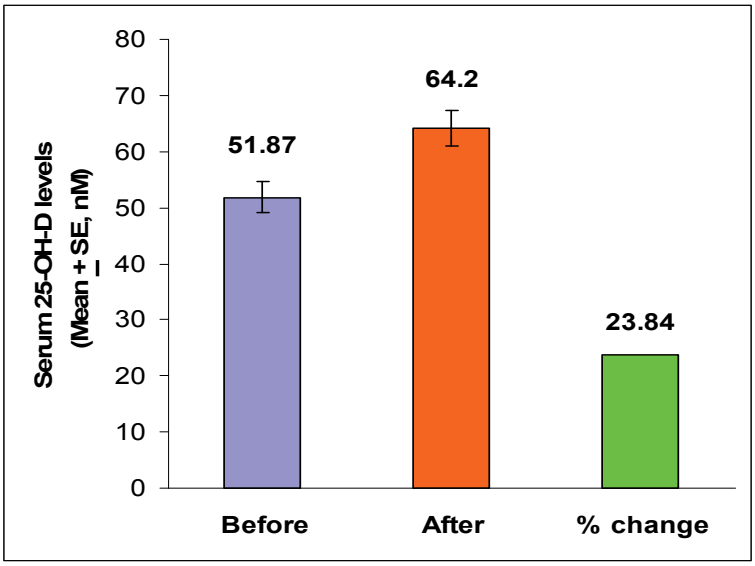
RESULTS

The mean age of the 117 participants was 64.9±12.3 (range of 32.7-85.2). No differences in age were depicted between the 27 males (64.9 ± 13.1) and the 90 females (64.9 ± 12.1) participated in the present study. Mean Body Mass Index (BMI) was found to be in the over weighted zone (30.5 ± 20), Although, males

were more over weighted (30.4 ± 5.3) than the females (28.1 ± 5.4). This difference was not found to be significant.

The mean serum 25-OH-D level before the DSC was 51.9 ± 29.3 nM. No statistical differences in initial 25-OH-D levels were determined between males (47.1 ± 25.2 nM) and females (53.3 ± 30.4 nM). During the DSC therapy patients were exposed to natural Ultra Violate radiation (38.2 ± 12.8 MED). Following this amount of U.V. exposure, mean serum 25-OH-D was increased to 64.2 ± 33.4 nM. This new level represents a 23.7 ± 38.2 % increase in serum 25-OH-D concentration (Figure 1).

Figure 1 - Serum 25-OH-D levels (nM) before and after DSC treatment and relative change (%)



The rate of increase was found to be much higher in males (34.0 ± 42.5 %) than in females (21.0 ± 37.0 %). As demonstrated on Figure 2, the increase in serum 25-OH-D was found to be age related with the highest increase of 24.2 ± 16.5 nM in the youngest group (Les than 40 years old) and with only a minimal increase of 4.4 ± 14.6 nM in the oldest group (Age above 80 years). Figure 3 summarizes the rate of increase of serum 25-OH-D levels in the studied patients following the DSC, according to their specific disease. The results revealed variations between the various patients with the highest increase in 25-OH-D levels in patients with Post Polio Syndrome (36.7%) and only 16.5% increase in Fibromyalgia patients. The ra-

Figure 2 - Serum 25-OH-D levels (nM) before and after DSC treatment and relative change (%) as a function of patients' age group

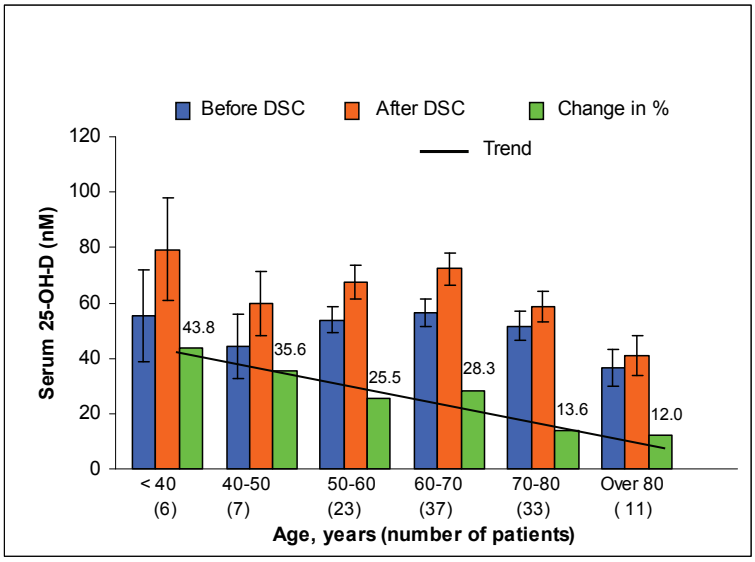
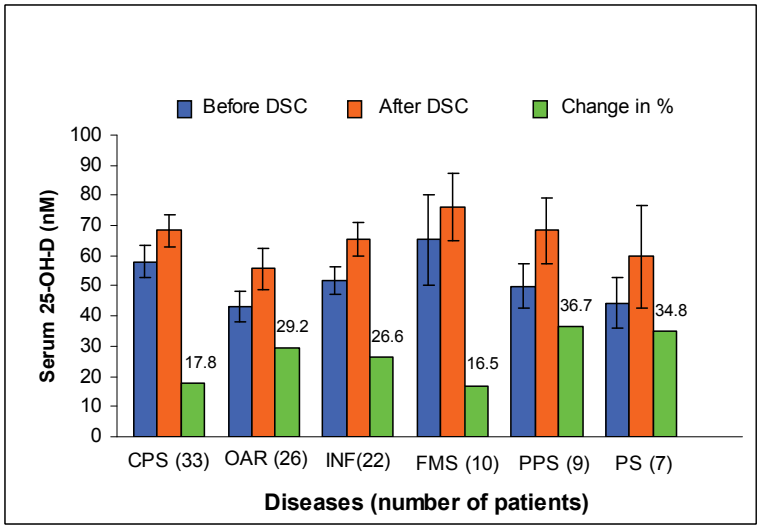


Figure 3 - Serum 25-OH-D levels (nM) before and after DSC treatment and relative change (%) as a function of patients' disease group



te of increase in serum 25-OH-D following DSC treatment was found to be in a negative correlation to the initial serum concentration of this vitamin D metabolite (Table 1). While a significant mean elevation of 43.3 % in serum 25-OH-D was obtained in the 23 patients included in the vitamin D deficient group (Initial serum 25-OH-D below 25 nM) and a significant 33.7% increase in the 73 patients included in the vitamin D insufficient group (Initial serum 25-OH-D between 25 to 75 nM), only a minimal insignificant increase of 6.1 % was obtained in the 21 patients determined as a sub-group with sufficient vitamin D levels (Initial serum 25-OH-D above 75 nM).

Table 1 - Changes in 25-OH-D following DSC according to the three baseline sub-groups.

	Deficiency at baseline (< 25 nM) N = 21			**Insufficiency at baseline (25-75 nM) N = 73**			**Sufficiency at baseline (> 75 nM) N = 23**		
%	**17.9**			**62.4**			**19.7**		
	Before nM	**Delta nM**	**Change (%)**	**Before nM**	**Delta nM**	**Change (%)**	**Before nM**	**Delta nM**	**Change (%)**
Mean	20.6 ±3.8	8.2 ±5.4	43.3 ±32.4	46.0 ±14.9	16.4 ±18.1	33.7 ±34.2	98.9 ±20.7	3.4 ±28.4	6.1 ±.29.2
Min; Max	13.0; 25.0	-3.0; 21.0	-13.0; 131.0	26.0; 74.0	-12.0; 67.0	-18.0; 145.0	77.0; 151.0	-62.0; 76.0	-41.0; 89.0

DISCUSSION

The general connection between sun exposure and the skin synthesis of vitamin D is absolutely known. It is well established that sun exposure is the main source for natural vitamin D supplementation[3-4]. Recent controlled study carried out in Manchester, England, supports this conclusion[5]. While the general connection between sun exposure and vitamin D production in the skin is well accepted, the question was raised whether such effect of sunshine exist also in the Dead Sea area.

One should recall that the Dead Sea area is the deepest spot on earth, 422 m beneath sea level. The atmosphere overhanging this region is higher than in any other spot on earth. As a result of this phenomenon, the sunshine beams are filtrated and the amounts of UVB reaching the ground are much lower than that at sea level or higher places. The results of the present study demonstrate clearly that even moderate exposure of 60-90 minutes per day during 3 weeks, to the moderate sunshine at the Dead Sea, increases significantly the vitamin D levels in patients treated by

DSC. These results are in full agreement with previous observations concerning the relationship between sun exposure at the Dead Sea and increase in vitamin D levels as expressed in patients' serum 25-OH-D concentrations[6-7].

Gender related differences were detected in the present study, since the rate of increase in males was higher than in females. However, unrelated to gender differences, the increase in serum 25-OH-D was found to be negatively correlated with the patients' initial serum 25-OH-D levels and to their age. These results are in accordance with previous studies[8-9]. Besides the positive effect of sunshine exposure for vitamin D production, excess exposure is accompanied by negative side effects such as sunburns and more seriously by skin carcinogenesis[10-11]. The exposure to the moderate sunshine in the Dead Sea may decline these negative side effects while still allowing the significant increase in skin vitamin D production, as shown in the present study.

Recent studies provide more and more evidence for the contribution of sufficient serum vitamin D levels for human health[3]. Beside its classical role in mineral homeostasis and bone health, it is evident today that vitamin D has a significant contribution in prevention and curing of many diseases such as Cancer, Cardiovascular, Diabetes, Psoriasis, Rheumatoid arthritis, Fibromyalgia and other chronic diseases[3-4]. A lot of attention was directed to the effects of sunshine and vitamin D in the treatment of Psoriatic patients. In a previous study carried out in the Dead Sea, the amounts of UVB (MED's) required for the treatment of individual psoriatic patients were determined[12-13]. On a recent study carried out at the Dead Sea by us on 60 patients suffering from chronic pain and from Rheumatoid arthritis, we could demonstrate after a DSC treatment, a direct correlation between increased serum 25-OH-D levels and pain reduction and reduction of disease severity[7]. Not in every case the mode of action and the involvement of vitamin D in preventing these diseases, is clear enough, but recent findings concerning the anti-inflammatory effect of vitamin D[14-15] may provide a clue for a possible mechanism by which vitamin D acts, at least in some cases.

Based upon the data reported herein, it is evident that even the moderate sun exposure in the Dead Sea, causes a significant increase in serum 25-OH-D levels. This increase in vitamin D status may affect the health condition of patients suffering from a variety of chronic diseases. Although increase in serum 25-OH-D levels occurs in any situation of sun exposure, the main advantage of sun exposure at the Dead Sea is in the fact that this purpose is obtained possibly without, or at least with less dangerous side effects caused usually by exposure to excess Ultra Violet radiation exists in the regular sunshine.

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