The Egyptian Journal of Hospital Medicine (January 2019) Vol. 74 (2), Page 310-317

# Assessment of serum vitamin D level before and after narrowband therapy in vitiligo

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## ABSTRACT

**Background:** Vitiligo is an acquired, progressive, multifactorial, depigmenting disorder characterized by the appearance of circumscribed white macules in the skin due to chronic progressive loss of functional melanocytes in the epidermis. The etiology of vitiligo is not clear, although various hypotheses have been proposed.

**Objective:** To evaluate the serum levels and the possible role of 25 OH vit D in vitiligo and to detect whether its level is modulated by Narrowband ultraviolet (B NB-UVB) therapy.

**Patients and Methods:** The current study included 30 patients with vitiligo. In addition, 30 healthy subjects who were age and gender matched, served as a control group. All persons were recruited from the outpatient clinic of Al-Azhar University hospital (Damitta) and from Dermatology, Leprosy and Venereology Mansoura Hospital, from March 2018 to June 2018.

**Results:** Vitamin D levels were lower in patients with vitiligo as compared to the control subjects. Levels of vitamin D increased significantly after NB-UVB therapy. Also, VASI scores showed improvement after NB-UVB therapy. The mean VASI score in both groups showed **highly significant** decrease after treatment by NB-UVB. Comparison and correlation between VASI before NB- UVB therapy and 25(OH) D showed good negative correlation.

**Conclusion:** Decreased vitamin D serum level was found in vitiligo patients, indicating its possible involvement in the pathogenesis of the disease. This level was increased significantly after NB-UVB therapy. In addition, vitamin D serum level correlated negatively with the severity of the disease.

**Keywords:** Narrowband ultraviolet B, vitiligo, melanocyte stimulating hormones

## Introduction

Vitiligo is a chronic depigmenting disorder characterized by the absence of functional melanocytes in the skin. The etiology and pathogenesis are still not completely understood [(1)].

Strong evidence supports an autoimmune cause, together with an underlying genetic predisposition [(2)].

Vitiligo is frequently associated with systemic autoimmune disorders, including thyroid disease, diabetes, and pernicious anemia [(3)]. A link was reported between low vitamin D levels and some autoimmune disorders, such as type I diabetes, rheumatoid arthritis, and multiple sclerosis. Vitiligo could be another example of a relationship between vitamin D deficiency and autoimmunity. Vitiligo has been found to be associated with low levels of 25-hydroxyvitamin D [25(OH) D]. In addition, vitiligo patients who had comorbid autoimmune diseases were found to be more likely to have very low 25 (OH) D levels [(4)].

Narrowband ultraviolet B (NB-UVB) phototherapy is a widely used and effective modality in the treatment of vitiligo. The mechanism of action of NB-UVB in patients with vitiligo has not been completely elucidated. Beneficial effects of phototherapy have been demonstrated in a variety of skin disorders. Such therapy results in increased cutaneous vitamin D synthesis, which could be one of its mechanisms of action [(5)].

Previous studies showed that full-body NB-UVB is more effective compared with daily oral intake of vitamin D in the treatment of vitamin D deficiency. The mechanism of action of NB-UVB in vitiligo is through induction of immuno suppression and stimulation of the proliferation of melanocytes in the skin and the outer root sheath of hair follicles [(6)].

There is a stimulatory effect on melanogenesis and on the production of melanocyte stimulating hormones (MSH). Moreover, several data demonstrate that the UVB portion of the sunlight (29o – 32o nm) brings about the photochemical conversion of



Received: 07/10/2018
Accepted: 26/10/2018

7-dehydrocholesterol to previtamin D3 in the stratum spinosum and stratum basal, which is the key step to vitamin D3 synthesis [7].

Vitamin D exerts both stimulatory and protective effects on melanocytes through its action on nuclear VDR on target cells. In addition, vitamin D increases melanogenesis and the tyrosinase content of cultured human melanocytes by its antiapoptotic effect, and it may exerts both stimulatory and protective effects on melanocytes through its action on nuclear VDR on target cells [8].

Vitamin D receptors have been found in all immune system cells, including activated CD4+ and CD8+ T cells, B cells, neutrophils, and antigen presenting cells (macrophage and dendritic cells). The association between vitamin D and autoimmune diseases, such as type 1 diabetes mellitus, multiple sclerosis, rheumatoid arthritis, systemic lupus erythematosus, asthma, and inflammatory bowel disease, was established. Whether this association indicates a causal relation is a matter of debate [9].

**Aim of the work**

The aim of the present study was to evaluate influence of NB-UVB therapy on vitamin D serum level among vitiligo patient and its correlation to response to NB-UVB.

**Patients and methods**

The current study included 30 patients with vitiligo. In addition, 30 healthy subjects who were age and gender matched served as a control group. All persons were recruited from the outpatient clinic of Al-Azhar University Hospital (Damitta) and from Dermatology, Leprosy and Venereology Mansoura Hospital, from March 2018 to June 2018.

**The studied patients were divided into the following groups:** Group 1 Included 15 patients with localized vitiligo. Group II: Included 15 patients with generalized vitiligo. Group III: Included 30 healthy persons without any dermatological or systemic disease serving as controls.

**Inclusion criteria:** Vitiligo cases with no previous treatment in the past six weeks. Patients who agreed to join the study.

**Exclusion criteria:** Vitiligo patients who received oral vitamin D supplementation. Vitiligo patients who had dairy allergy. Vitiligo patients who had other dermatological or systemic disease as thyroid and renal diseases and diabetes mellitus. Vitiligo patients who received topical, systemic treatment or phototherapy in the past six weeks. Patients who did not complete NB-UVB sessions. Pregnant, lactating women, or who were receiving hormonal contraceptives.

**Methods:**

All patients were subjected to the following: **Full history taking:** Personal history including name, age, gender, marital status, address, occupation. History of present illness including onset, course, duration. History of drug intake especially drugs that affects calcium metabolism as anticonvulsants, barbiturates, vitamin D supplement and corticosteroids. Family history of vitiligo. History of other dermatological or systemic diseases. All selected patients were instructed to avoid any other therapy (topical or systemic) during the whole duration of study. An informed consent was obtained from all the participants before starting the study.

**NB-UVB therapy for the patients:**

Equipment used was Waldmann medical device of the family UV100 version G 8 Philips equipped with 8 UVB radiators of type TL-01.

The initial dose of 250 mJ/cm$^2$ was started in all adult patients and the treatment was administered two times/week on non-consecutive days for 12 weeks. The irradiation dose was increased by 20% for each subsequent visit till the optimal dose was achieved to obtain minimal erythema in the lesions. In case of children an initial dose of 150 mJ/cm$^2$ with 20% increments was given.

If symptomatic erythema burning pain or blistering developed the irradiation dose was decreased by 20%. During treatment the affected parts were only exposed and the genitalia and other uninvolved areas were protected. Similarly the eyes were protected by UV-blocking goggles. If significant depigmentation was present on the eyelids and if patients or parents insisted on treating these areas the patients were advised to keep their eyes closed during treatment. All the patients were asked to use sunscreens during daytime. Patients were advised to apply emollients to their skin daily after treatment.

**Blood samples collection:**

Five milliliters of venous blood were collected from each patient and control. The samples were collected twice; once before NB-UVB therapy and the other sample after 24

sessions of NB-UVB therapy. The blood samples from the control were collected once for comparison. The blood sample were left to clot then subjected to centrifugation for 15 minutes at 1000xg to separate the serum. The serum samples were removed using a sterile pipette and each sample was coded with a number and stored at -20ºC until used.

**Statistical Methods:**

The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Data were presented and suitable analysis was done according to the type of data obtained for each parameter.

Descriptive statistics: 1. Mean, Standard deviation (± SD) for parametric numerical data. 2. Frequency and percentage of non-numerical data.

**Analytical statistics:** Student t test was used to assess the statistical significance of the difference between two study group means. Chi-square test was used to examine the relationship between two qualitative variables; Fisher's exact test: was used to examine the relationship between two qualitative variables when the expected count is less than 5 in more than 20% of cells. Correlation analysis: Pearson's correlation was used to assess the strength of association between two quantitative variables. Regression analysis: Linear regression analysis was used for prediction of improvement. Percentage change from baseline was calculated using the formula: (values after treatment-values before treatment)/ values before treatment. N.B: p is significant if ≤0.05 at confidence interval 95%.

**RESULTS**

**Table 1.** Comparison of age and gender in all studied groups.

| | | Control N=30 | | Vitiligo N=30 | | *p* |
|---|---|---|---|---|---|---|
| **Age (years)** | **Mean, SD** | 30.3 | 9.7 | 30.7 | 9.3 | >0.05 |
| **Male** | **N, %** | 10 | 33.3 | 6 | 20 | >0.05 |
| **Female** | **N, %** | 20 | 66.7 | 24 | 80 | |

**N**: Number

**Table 2.** Comparison of age and gender between localized and generalized subgroups.

| | | Localized N=15 | | Generalized N=15 | | *p* |
|---|---|---|---|---|---|---|
| **Age (years)** | **Mean, SD** | 27.9 | 4.7 | 33.5 | 7.7 | 0.02 |
| **Male** | **N, %** | 3 | 20 | 3 | 20 | >0.05 |
| **Female** | **N, %** | 12 | 80 | 12 | 80 | |
| **Duration (years)** | **Mean, SD** | 3.7 | 1.2 | 5.3 | 1.7 | 0.006 |
| **Positive family history** | **N, %** | 8 | 53.3 | 3 | 20 | >0.05 |
| **Fitzpatrick skin type** | **II** | 1 | 6.7 | 0 | 0 | >0.05 |
| | **III** | 10 | 66.7 | 7 | 46.7 | |
| | **IV** | 4 | 26.7 | 5 | 33.3 | |
| | **V** | 0 | 0 | 3 | 20 | |

**N**: Number

**Table 6.** Comparison of VASI score before and after NB-UVB in localized and generalized subgroups.

| | Vitiligo N=30 | | | | |
|---|---|---|---|---|---|
| | Before NB-UVB | | After NB-UVB | | *p* |
| | mean | SD | mean | SD | |
| **Localized** | 14.6 | 3.2 | 7.6 | 2.2 | <0.001 |
| **Generalized** | 56.5 | 4.5 | 52.1 | 7.1 | 0.001 |

**N**: Number: **VASI score**: Vitiligo Area Scoring Index

**Table 7.** Comparison of 25 hydroxy vitamin D3 between vitiligo cases and control groups.

| | | Control N=30 | | Vitiligo N=30 | | *p* |
|---|---|---|---|---|---|---|
| **25 hydroxy vitamin D3 (ng/mL)** | **Mean, SD** | 44.4 | 11.2 | 29.9 | 9.5 | <0.001 |
| **Adequate vitamin D** | **N, %** | 19 | 63.3 | 8 | 26.7 | 0.004 |
| **Insufficient vitamin D** | **N, %** | 11 | 36.7 | 22 | 73.3 | |

**Table 8.** Comparison of 25 hydroxy vitamin D3 before and after NB-UVB in all studied cases.

| | Vitiligo N=30 | |
|---|---|---|

| | | Before NB-UVB | | After NB-UVB | | *p* |
|---|---|---|---|---|---|---|
| **25 hydroxy vitamin D3 (ng/mL)** | **Mean, SD** | 29.9 | 9.5 | 34.8 | 10.4 | 0.013 |
| **Adequate Vit D** | **N, %** | 8 | 26.7 | 11 | 36.7 | 0.004 |
| **Insufficient Vit D** | **N, %** | 22 | 73.3 | 19 | 63.3 | |

**Table 9.** Comparison of vitamin D before and after NB-UVB in localized and generalized subgroups.

| | Vitiligo N=30 | | | | |
|---|---|---|---|---|---|
| | Before NB-UVB | | After NB-UVB | | *p* |
| | mean | SD | mean | SD | |
| **Localized** | 25.8 | 8.1 | 32 | 10.2 | 0.02 |
| **Generalized** | 33.9 | 11.1 | 37.6 | 12.2 | 0.046 |

**Table 10.** Comparison of age and gender according to 25 hydroxy vitamin D3status in all studied cases.

| | | Vitiligo N=30 | | | | |
|---|---|---|---|---|---|---|
| | | Adequate vitamin D N=8 | | Insufficient vitamin D N=22 | | *p* |
| **Age (years)** | **Mean, SD** | 29 | 14.8 | 29.7 | 14.5 | >0.05 |
| **Male** | **N, %** | 0 | 0 | 6 | 27.3 | >0.05 |
| **Female** | **N, %** | 8 | 100 | 16 | 72.7 | |
| **Family history** | **N, %** | 3 | 37.5 | 8 | 36.4 | >0.05 |
| **II** | **N, %** | 0 | 0 | 1 | 4.5 | >0.05 |
| **III** | **N, %** | 6 | 75 | 11 | 50.0 | |
| **IV** | **N, %** | 1 | 12.5 | 8 | 36.4 | |
| **V** | **N, %** | 1 | 12.5 | 2 | 9.1 | |
| **Duration (years)** | **Mean, SD** | 4.8 | 1.4 | 5.5 | 1.7 | >0.05 |

**Table 14.** Comparison of VASI score according to 25 hydroxy vitamin D3 status in all studied cases.

| VASI score | | Vitiligo N=30 | | | | |
|---|---|---|---|---|---|---|
| | | Adequate vitamin D N=8 | | Insufficient vitamin D N=22 | | *P* |
| | | mean | SD | mean | SD | |
| **Localized** | **Before NB-UVB** | 8.1 | 1.4 | 16.2 | 4.2 | <0.001 |
| | **After NB-UVB** | 2.9 | 1.7 | 9.3 | 3.1 | <0.001 |
| **Generalized** | **Before NB-UVB** | 52.4 | 1.7 | 58.6 | 4 | <0.001 |
| | **After NB-UVB** | 45.9 | 2.8 | 57.4 | 4.8 | <0.001 |

**Table 15.** Correlation of 25 hydroxy vitamin D3 level before NB-UVB with other studied parameters in all vitiligo cases.

| | 25 hydroxy vitamin D3 level before NB-UVB | | | | | |
|---|---|---|---|---|---|---|
| | Total cases | | Localized | | Generalized | |
| | *r* | *p* | *r* | *p* | *r* | *p* |
| **Age** | -0.805 | 0.180 | -0.619 | 0.103 | 0.473 | >0.05 |
| **Gender** | 0.231 | 0.219 | 0.309 | 0.263 | 0.193 | >0.05 |
| **Family history** | -0.116 | 0.542 | 0.093 | 0.742 | -0.193 | >0.05 |
| **Skin type** | -0.112 | 0.555 | -0.192 | 0.494 | -0.154 | >0.05 |
| **Duration** | 0.172 | 0.362 | -0.013 | 0.964 | 0.251 | >0.05 |
| **VASI score before** | -0.726 | 0.002 | -0.702 | 0.004 | -0.883 | <0.001 |

**Table 16.** Correlation of 25 hydroxy vitamin D3 after treatment with other studied parameters in all vitiligo

| | 25 hydroxy vitamin D3 level after NB-UVB | | | | | |
|---|---|---|---|---|---|---|
| | Total cases | | Localized | | Generalized | |
| | *r* | *p* | *r* | *r* | *p* | *r* |
| **Age** | -0.401 | 0.197 | -0.419 | 0.114 | 0.476 | >0.05 |
| **Gender** | 0.092 | 0.630 | 0.058 | 0.838 | 0.135 | >0.05 |
| **Family history** | -0.076 | 0.690 | -0.031 | 0.913 | -0.116 | >0.05 |
| **Skin type** | -0.013 | 0.945 | -0.013 | 0.964 | -0.042 | >0.05 |
| **Duration** | 0.232 | 0.218 | 0.043 | 0.878 | 0.427 | >0.05 |
| **VASI score after** | -0.472 | 0.033 | -0.881 | <0.001 | -0.949 | <0.001 |

**Table 17.** Correlation of VASI after NB-UVB with other studied parameters in all vitiligo cases.

| | VASI score after NB-UVB | | |
|---|---|---|---|
| | Total cases | Localized | Generalized |

| | *r* | *p* | *r* | *p* | *r* | *p* |
|---|---|---|---|---|---|---|
| **Age** | 0.240 | 0.201 | 0.420 | 0.202 | -0.426 | >0.05 |
| **Gender** | -0.096 | 0.613 | -0.232 | 0.406 | -0.154 | >0.05 |
| **Family history** | -0.284 | 0.129 | -0.093 | 0.742 | 0.193 | >0.05 |
| **Skin type** | 0.264 | 0.148 | 0.150 | 0.594 | 0.116 | >0.05 |
| **Duration** | 0.186 | 0.325 | 0.058 | 0.838 | -0.487 | >0.05 |

**Table 18.** Linear Regression analysis for prediction of VASI improvement.

| | **Localized** | | **Generalized** | |
|---|---|---|---|---|
| | ***β*** | ***p*** | ***β*** | ***p*** |
| **Age** | -1.626 | 0.121 | 0.187 | >0.05 |
| **Gender** | -1.588 | 0.680 | 1.092 | >0.05 |
| **Family history** | 2.512 | 0.911 | 2.773 | >0.05 |
| **Disease duration** | -3.835 | 0.356 | 2.126 | 0.144 |
| **25 hydroxy vitamin D3 before NB-UVB** | -0.188 | 0.025 | -0.147 | 0.047 |
| **25 hydroxy vitamin D3 after NB-UVB** | -0.615 | 0.013 | -0.598 | 0.025 |

## DISCUSSION

Vitiligo is an acquired depigmentary disorder characterized by the loss of functioning epidermal melanocytes [(10)].

There are accumulating data giving rise to vitamin D association in the etiopathogenesis of vitiligo [(4)].

Various factors were implicated in the etiopathogenesis of vitiligo as vitamin D receptor-Apa-1 polymorphism, calcium imbalance and low levels of circulating 25-OH vitamin D, as vitamin D levels are insufficient or very low in most patients with vitiligo. Therefore, supplementation with vitamin D could be used to treat autoimmune diseases such as vitiligo [(4)].

Vitamin D insufficiency is common in Egypt especially in Upper Egypt in spite of good sunshine throughout the year. UVB can produce vitamin D in the skin, which also can be provided by fat fish diet [(11)].

There are different mechanisms by which vitamin D may help in the treatment of Vitiligo. Vitamin D can suppress the activation of T cells and the release of cytokines such as TNF-alpha (tissue necrosis factor alpha) because of its suppression to some cells of the immune system [(11)].

Furthermore, a proposed mechanism involving vitamin D in the protection of vitiliginous skin is based on its antioxidants properties and regulatory function toward the RoS that are produced in excess in vitiligo epidermis [(12)].

Another point is that the active form of vitamin D reduces the apoptotic activity induced by UVB in keratinocytes and melanocytes [(13)] that was reported to remove melanocytes from the skin [(14)].

Vitiligo is considered to be autoimmunity related. Vitamin D analogues are effective topical therapies for cutaneous autoimmune conditions including vitiligo and psoriasis [(15)].

The sun and UVB exposure are the strongest factors influencing 25 OH vitamin D levels. The vitamin D production has a unique auto regulated mechanism which occurs at two levels. Excessive sun exposure does not lead to overdosing of vitamin D due to conversion of previtamin D to inactive photoproducts as well as conversion of vitamin D to its isomers in the skin which are thought to have a low calcemic effect at physiological concentration [(16)].

The skin is the only tissue yet known in which the complete UVB induced pathway from 7-DHC via intermediate 25 OH vitamin D to the final product 1, 25 $(OH)_2$ vitamin D, takes place under physiological conditions [(17)].

Serum levels of 25 OH vitamin D are greatly increased by NB-UVB therapy and this can be explained by the fact that this wavelength range (290-315 nm) induces synthesis of vitamin D [(18)].

Our study was conducted on 3o patients with vitiligo and 3o healthy controls. All patients and controls were subjected to full history taking, clinical examination (general and dermatological) and blood samples collection before and after 24 sessions of NB-UVB therapy for patients only. Each patient was subjected to VASI score calculation.

In our study Patients were divided into two groups, localized vitiligo group (group I) and generalized vitiligo group (group II), Control group (III). Serum 25 OH vit D levels were measured for patients and control by ELISA.

The cut-off level for serum 25 OH vitamin D, which is used as a diagnostic marker for vitamin D deficiency, has varied over the

years. The early biochemical changes in vitamin D insufficiency include a rise in serum parathormone, which begins to increase as serum 25 OH vitamin D levels fall below 3o ng/ml, this level has become the suggested cut-off point for vitamin D deficiency[19].

our study showed that 25(OH) vitamin D levels were lower in patients with vitiligo as compared to the control subjects.

Levels of 25(OH) vitamin D increased significantly after NB-UVB therapy. Also, VASI scores showed improvement after NB-UVB therapy

Comparison and correlation between VASI before NB-UVB therapy and 25(OH) D showed negative correlation.

The study was in agreement with previouse studies which investigated the correlation of vitamin D levels with pigmentation in vitiligo patients treated with NB-UVB therapy. The study included 30 patients of generalized vitiligo. Phototherapy was given twice weekly on non-consecutive days for 12 weeks. 24 (80 %) patients had deficient (< 25 nmol/L) and 6 (20 %) has insufficient baseline vitamin D levels (25-35 nmol/L) of 25 vitamin D. None of the patients had normal (75-250 nmol/L) levels. Levels of 25 OH vitamin D in the control group were also found to be low. 9o % has insufficient levels (25 - 75 nmol/L) and 1o % had deficient (<25 nmol/L) 25 OH vitamin D increased significantly with increase in the cumulative dose of NB-UVB [2o].

Interestingly a significant increase in 25 (OH) D levels together with clinical improvement in vitiligo patients was demonstrated after 6 months of oral vitamin D treatment [21].

This further supports that vitamin D correction may help reduce disease activity in vitiligo and this can be alternatively achieved with NB-UVB therapy.

In addition studies showed that a short course of NB-UVB is more effective in improving vitamin D balance compared with orally given vitamin D in healthy individuals [6].

The effect of NB-UVB was still evident after 2 months of the treatment course. Similar long-lasting increase in serum vitamin D was also reported after NB-UVB therapy in patients with psoriasis and atopic dermatitis and was equally effective to oral vitamin D [22].

However there are no published studies comparing the effects of NB-UVB and oral vitamin D substitution on serum 25 (OH) D concentrations in vitiligo patients.

On the contrary another study done on a large number of subjects from both vitamin D highest and lowest months. They clearly demonstrated that there was no difference in vitamin D levels between vitiligo patients and controls throughout the year. Their data do not reveal a correlation between vitamin D levels and onset of vitiligo. Therefore did not support a role for vitamin D in vitiligo pathogenesiss [23].

In addition another study which investigated vitamin D levels in patients with vitiligo and vitamin D levels were found to be insufficient (<30 ng/ml) or very low (<15 ng/ml) in most of the patients with vitiligo but not statistically significantly different as a group when compared to the controls [23].

On the other hand another study showed a relationship between vitamin D and psoriasis. They compared serum levels of vitamin D of 20 psoriasis patients and 20 controls. Only 2 cases and 4 controls had sufficient levels of vitamin D although without statistical significance between the groups (p= 0.608) [24].

In the current study, there was no correlation between serum level of 25 OH vitamin D before and after NB-UVB phototherapy and the gender of patients. This was in agreement with previous studies [25] but another study found that female psoriatic patients have lower vitamin D levels than in males [24].

Deficiency of vitamin D levels is more common in female which maybe related to the effect of estrogen and less sun exposure.

It has been suggested that vitamin D and estrogen levels influence each other and collaborate to maintain Ca homeostasis. Correction of estrogen deficiency in postmenopausal women was associated with increased 1, 25 $(OH)_2$ vitamin D production. [24]. In another study, no difference between postmenopausal women and younger women was found [23].

In our study, there was no correlation between serum levels of vitamin D and the duration of vitiligo. This was in accordance with previous studies [23].

In current study, no significant correlation could be detected between serum level of vitamin D in each vitiligo gr oup before and after NB-UVB therapy and positive family

history of vitiligo. This was in agreement with previouse studies [23].

In our study, the patients who were treated with NB-UVB showed a significant negative correlation between serum level of 25 OH vitamin D in both vitiligo groups before and after NB-UVB therapy and VASI score. on the contrary, another study showed that there is no statistically significant correlation between reduction of VASI and 25 OH vitamin D levels. However, the correlation was getting stronger with duration of phototherapy [20].

The depigmentation coincided with decrease in 25 OH vitamin D and an increase in vitamin D levels correlated clinically with repigmentation in their patients[20].

It was noted that non-responders failed to synthesize adequate vitamin D inspite of being on NB-UVB, thus, vitamin D seem to be a key in NB-UVB induced melanogenesis [20].

This study included small sample size and NB-UVB sessions twice per week for 12 weeks, so further studies with larger sample size including patients and controls and more NB-UVB sessions are needed to prove the complete mechanism of NB-UVB-induced pigmentations and vitamin D in vitiligo.

There are some limitations in our study, first being a cross-sectional design, therefore we can only report associations and cannot comment on causation, and therefore we could only make assumptions about the possible etiological relationships. Second, this study is a single center study and multicenter studies are needed to support our findings.

One limitation also, was not taking into account clinical factors, such as individual physical activity and dietary habits that can affect the pathogenesis of vitiligo. Besides, we only assessed the level of 25 OH vitamin D at one time-point, we could not examine changes in levels at different time-points, or following treatment, and the small sample size did not give a chance for the standardization of our results.

## CONCLUSION

NB-UVB therapy improve vitamin D levels in patients with vitiligo, which might have a significant role in NBUVB-induced regimentation and may contribute to its therapeutic efficacy. Further studies with larger sample size including patients and controls are needed to prove the complete mechanism of NB-UVB induced pigmentations and vitamin D in vitiligo.

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