



Vitamin D Deficiency among Females with Acne Vulgaris in Relation to Sun Exposure: A Cross-sectional Study

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Abstract

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BACKGROUND: Acne vulgaris is a common chronic inflammatory disease of the skin. Vitamin D deficiency has been implicated in various skin diseases, including atopic dermatitis and psoriasis.

AIM: The aim of this study was to evaluate the serum 25-hydroxy Vitamin D levels among patients with acne vulgaris.

METHODS: This was a cross-sectional comparative study performed in Khartoum state at Military hospital, department of dermatology and venerology, 111 blood samples were collected from females to measure serum level of 25-hydroxy Vitamin D by immunoassay analyzer cobas-e-411-2ed generation platform of Electrochemiluminescence binding assay.

RESULTS: In this study, 111 females their age 18–36 years. 57 suffering from acne vulgaris, 61.4% of them had moderate grade of acne. A significant decrease in the serum 25-hydroxy Vitamin D concentrations in acne vulgaris patients when compared to 54 non-acne group (13.3 ± 5.0 ng/mL vs. 24.2 ± 10.3 ng/mL $p = 0.00$). Significant positive correlation between serum 25-OH Vitamin D and exposure to sunlight per day ($r = 0.562$, $p = 0.00$), while there was a significant negative correlation between 25-OH Vitamin D and grade of acne, and duration of disease per month (for grade of acne $r = -0.641$, $p = 0.00$), (for duration of disease $r = -0.696$, $p = 0.00$) among patients with acne vulgaris.

CONCLUSION: The evidence from this study suggests that female with low serum 25- OH Vitamin D had increase risk to develop acne vulgaris. Further studies are needed to confirm this potential relation.

Introduction

Acne is the most common skin disease of adolescents and young adults [1]. It is a complex skin disorder that distresses many patients because of its chronicity. Although multiple factors contribute to acne development, chronic inflammation is an important mechanism. Several inflammatory mediators such as cytokines and neuropeptides have been identified in acne lesions [2].

There are many factors which regulate sebaceous glands function including androgen stimulation, Vitamin D, and insulin-like growth factor one. Sebaceous follicles that have micro-comedones provide an anaerobic and lipid-rich environment which is ideal for *Propionibacterium acnes* activity [3]. *P. acnes* trigger cytokine activation by toll-like receptors, indicating the role of innate immunity in acne development [4]. This immune-mediated inflammation may involve CD4+ lymphocytes and macrophages which stimulates the

pilosebaceous vasculature and precede follicular hyperkeratinization [5].

Vitamin D has a number of functions. It is associated with systemic inflammatory diseases such as rheumatoid arthritis, systemic lupus erythematosus, and inflammatory bowel disease [6], [7]. In dermatological diseases, Vitamin D plays an important role as an immune modulator in atopic dermatitis, psoriasis, and alopecia [8], [9]. Vitamin D regulates the immune system and the proliferation and differentiation of keratinocytes and sebocytes. Moreover, it has anticomedogenic and antioxidant effect. Hence, a Vitamin D deficiency may facilitate the pathogenesis of acne [10]. *In vitro* studies identified Vitamin D receptors in human sebocytes [11]. Vitamin D has been found to modulate lipid and cytokine production which suggest its possible role in acne pathophysiology [12].

This study aimed to assess serum levels of 25-hydroxy Vitamin D in patients with acne vulgaris and its relation to sunlight exposure and duration of disease.

Methods

Study design

This is a cross-sectional and descriptive study.

Study setting and period

The research was carried out in the Department of Dermatology and Venerology at Military Hospital in Khartoum State (hospital for referring to it from all States of Sudan) during period October 2019–March 2020.

Selection criteria

Sudanese female clinically diagnosed with different grade of acne according to the global acne grading system [13]. The selection was done by dermatology consultant. Female on treatment with Vitamin D supplement, presence of known systemic diseases, dermatological diseases other variants than acne, pregnant, lactating women, hematological and endocrine disorders and also, patients receiving drugs such as diuretics, multivitamins, anticonvulsants, glucocorticoids, erythromycin, and estrogen compound pills were excluded from the study.

Ethical clearance

The study was approved by the internal review research board at Sudan University of Science and Technology. The objectives of the study were explained to all individuals participating in this study. Verbal consent was obtained from all participants in the study.

Sampling

After getting their consent, venous blood samples were taken from participants in the morning after a minimum of 8 h of overnight fasting. Then, specimens were centrifuged at 3000 rpm for 5 min; serum was separated and stored at -20°C .

Body mass index (BMI)

Height and weight were taken using standard protocols. BMI was calculated as weight (in kilograms) divided by height (in meters squared). All measurements were performed twice by the well experience nurse in clinic.

Measurement of Vitamin D

Serum 25-OH Vitamin D level was measured using the competitive inhibition enzyme-linked immunosorbent assay (cobas-e-411-2ed generation platform of Electrochemiluminescence binding assay). According to manufacturer's protocol, 200 μl sample was

added into biotin-coated monoclonal anti-Vit-D antibodies, followed by competitive binding of 100 μl Vit-D-labeled [14].

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) version 16.0 (SPSS Inc., Chicago, USA) was used for the data analysis. Data were presented as frequencies, percentage, and means \pm standard deviation. The Student's t-test was used to compare mean levels of study parameters between groups. Categorical variables were compared using Chi-square and multiple regression tests. Pearson's correlation coefficient test was employed to evaluate the relationship between continuous variables. $p \leq 0.05$ was used as the statistical significance.

Results

A Total of 111 females were recruited; their age between 18-36 years. 57 female (51.3%) had acne vulgaris, 54 females (48.7%) had no acne. According to grade of acne, 35 (61.4%) of them had moderate grade of acne as in Table 1.

Table 1: Demographic and characteristics of study group

Characteristic	Frequency
Age	
18–25 years	86 (78.0%)
26–36 years	24 (22.0%)
BMI	
Normal weight	103 (92.8%)
Overweight	08 (7.2%)
Acne vulgaris	
Yes	57 (51.3%)
No	54 (48.7%)
Grade of acne	
Mild	11 (19.3%)
Moderate	35 (61.4%)
Sever	11 (19.3%)
Use of sun blocker	
Yes	23 (21.0%)
No	88 (79.0%)
Family history of acne vulgaris	
Yes	9 (8.0%)
No	102 (92.0%)
Exposure to sunlight per day	
1–2 h	35 (31.5%)
3–5 h	67 (68.5%)

The mean values of Vitamin D were significantly lower among female with acne when compared with non-acne female ($p < 0.01$). However, the mean values of BMI were significantly higher in females with acne

Table 2: Comparison between means of age (years), BMI (kg/m^2), and Vitamin D levels in study group

Variable	Mean \pm SD	p value
Age/years		
Acne patient	22.5 \pm 3.8	0.153
Non-Acne	23.7 \pm 3.9	
BMI Kg/m^2		
Acne patient	22.6 \pm 2.7	0.036*
Non-Acne	21.7 \pm 1.8	
Vitamin D ng/mL		
Acne patient	13.3 \pm 5.0	0.00*
Non-Acne	24.2 \pm 10.3	

*p value ≤ 0.05 considered significant

when compared with non-acne female ($p = 0.036$) as in Table 2. The frequency Vitamin D ng/ mL among study group according to reference range, subjects were divided into 3 categories: Severe Vitamin D deficiency [25(OH)D <10 ng/ml], the frequency of non-acne disease was (1.8%) compare to Acne Patients (13.5%) which is more, Vitamin D deficiency [25(OH) D 10–<20 ng/ ml], the frequency of non-acne disease was (16.2%) compare to acne patients (30.6%) which is more, and insufficiency [25(OH)D 20–<30 ng/ml]], the frequency of non-acne disease was (20.7%) compare to acne patients (7.2%) which is less as in Table 3.

Table 3: Frequency of 25-OH Vitamin D among study group according to reference range.

Vitamin D: ng/mL	Frequency (%)	
	Non-Acne disease	Acne patients
<10	02	15
Severe Vitamin D deficiency	(1.8%)	(13.5%)
10–19	18	34
Vitamin D deficiency	(16.2%)	(30.6%)
20–29	23	8
Vitamin D insufficient	(20.7%)	(7.2%)
30–49	10	0
Vitamin D optimal	(9.0%)	(0%)
50–69	1	0
Upper normal	(0.9%)	(0%)
70–150	0	0
Overdose Vitamin D not toxic	(0%)	(0%)
>150	0	0
Vitamin D intoxication	(0%)	(0%)

The results of the study revealed that acne vulgaris disease was significantly associated with Vitamin D deficient, number of hours exposure to sunlight per days ($p < 0.01$). Furthermore, they increased the risk of acne disease with Vitamin D deficient – odd ratio (OR): 1.256 with confidence interval (CI): (1.097–1.437) and sun exposure – OR: 3.438 with CI: (1.450–8.150), $p < 0.01$ as in Table 4.

Table 4: Study variables and parameters classified according to the presence of Acne vulgaris

Variables and parameters	Frequency (%)		OR (CI)	P-value
	Non-Acne disease	Acne patients		
Vit D: ng/mL				
<30	43 (38.7%)	57 (51.4%)	1.256	0.00
≥30	11 (9.9%)	0 (0.0%)	(1.097–1.437)	
Exposure to sunlight				
1–2 h/day	10 (09.0%)	25 (22.5%)	3.438	0.005
3–5 h/day	44 (39.6%)	32 (28.8%)	(1.450–8.150)	

The relationship between Vitamin D and other studied variables and parameters was determined. A significant positive correlation was found between Vitamin D and exposure to sunlight ($r = 0.562$; $p < 0.01$). In addition, Vitamin D was negatively correlated with the grade of acne ($r = -0.641$; $p < 0.01$), duration of disease ($R = -0.696$; $p < 0.01$). The results were presented in Table 5.

Table 5: Correlation between serum 25-OH Vitamin D and exposure to sunlight per day, grate of acne, and duration of disease among patients with Acne vulgaris

Variables	25-OH Vitamin D	p
	R	
Exposure to sunlight per day	0.562	0.000
Grate of Acne vulgaris	-0.641	0.000
Duration of disease/month	-0.696	0.000

Discussion

Acne vulgaris is a multifactorial chronic inflammatory disorder of the pilosebaceous follicles of human skin [3]. Recent studies in Sudan revealed a higher percentage of Vitamin D deficiency among women in Sudan [15]; this may be attributed to nutritional, skin color, sun exposure times, and uses of sun blockers.

In this study, there were significant low serum levels of 25-hydroxy Vitamin D in acne vulgaris female when compared to non-acne female. Serum level of 25-hydroxy Vitamin D was found to be inversely related to acne severity, suggesting that there is a connection between low Vitamin D and acne. This is in agreement with a previous study which found a decrease in the levels of 25-hydroxy Vitamin D in patients with nodulocystic acne than that in the control group [16]. Furthermore, Lim *et al.* found a significant lower Vitamin D level in patients with acne than normal subjects [17]. Vitamin D levels were inversely correlated with acne severity, especially in patients with more inflammatory lesions. Vitamin D regulates the immune system and the proliferation and differentiation of keratinocytes and sebocytes. Moreover, it has antioxidant and anticomedogenic properties. Hence, a Vitamin D deficiency may contribute in the pathogenesis of acne vulgaris [3], [10], [18]. This study found that the increase exposure to sunlight per day was significantly positive correlated with Vitamin D level, by increasing skin exposure to sunlight [18], increasing lipolysis, and enhancing mobilization of deposited Vitamin D from the fat compartments [19].

Conclusion

The data of the present study revealed that Sudanese female Vitamin D <30 ng/ml had high risk to develop acne. Moreover, Vitamin D level was inversely associated with the grade and duration of disease, while it is proportionally associated with exposure to sunlight. Therefore, monitoring and supplementation regimens of Vitamin D are recommended.

What is already known on this topic

Vitamin D has been found to modulate lipid and cytokine production which suggests its possible role in acne pathophysiology.

What this study adds

The evidence from this study suggests that female with low serum 25- OH Vitamin D had increase risk to develop acne vulgaris

Authors' contributions

GAE and NAM conceived and designed the study; GAE, AAA, and AE implemented the study; GAE and AE supervised the study; GAE, MI, and NAM conducted data analysis; GAE, AE, AAA, MI, and NAM interpreted study results; GAE wrote the first draft of the manuscript; AEE and AE reviewed and corrected the draft manuscript. All the authors have read and agreed to the final manuscript.

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