Relationship between Vitamin D and Mental Health among Dental Students in Saudi Arabia: A Descriptive Cross-sectional Study

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ABSTRACT

Introduction: Vitamin D is a unique neuro-steroid hormone, which has significant effects on mood disorders such as depression and anxiety.

Aim: To determine the prevalence of vitamin D deficiency, depression, and anxiety among University Dental students.

Materials and Methods: A descriptive cross-sectional study was carried out during the academic year 2018 January to March using a simple, randomised sampling method. Hundred students at different academic levels and grades from College of Dentistry, Majmaah University in Saudi Arabia were a part of the study. Blood samples were collected to record 25-hydroxyvitamin D 25(OH)D levels. A validated Arabic Behaviour Rating Scales was used to measure depression and anxiety.

The Grade Point Average (GPA) score of each student was also recorded.

Results: Vitamin D deficiency was prevalent in 89% of the students, with a mean value of 10.24 ng/mL. Anxiety levels were observed in 62% of the students and the anxiety levels ranged between 29% (moderate) and 33% (severe). Vitamin D deficiency was found to be positively correlated with anxiety (r=0.459 with p≤0.001) and GPA scores (r=0.282 with p-0.004) although no significant correlation between Vitamin D deficiency and depression was observed (r=0.173, p-0.07).

Conclusion: Vitamin D deficiency showed significant correlation with anxiety and GPA scores, but no correlation with depression among the students of Majmaah University (dental faculty).

Keywords: Academic performance, Anxiety, Depression, Neuro-steroid hormone, Nutrition, Vitamin deficiency

INTRODUCTION

Vitamin D is a fat-soluble vitamin and has a significant physiological role in the maintenance of calcium homeostasis. Thus, it is an essential factor in the development of musculoskeletal health. Vitamin D can be obtained from dietary sources such as fish, egg yolks, and fortified milk; It can also be synthesised in the skin upon exposure to sunlight [1]. Vitamin D deficiency is linked with many systemic illnesses, including diabetes mellitus, hypertension, heart diseases, and depression [2-6].

Vitamin D deficiency is more prevalent in the Arab World, although people here are exposed to sunlight throughout the year. The rate of exposure to sunlight is significantly low due to the social, cultural, and religious factors. Sedentary lifestyle, obesity, fear about the harmful effect of excessive sunlight exposure, complete coverage of the body, and an indoor lifestyle restrict sunlight exposure required for vitamin D synthesis [7-9]. Several studies have shown that vitamin D metabolites, such as 25-hydroxyvitamin D 25(OH)D, are able to cross the blood brain barrier and interact with its receptors present on the cingulate cortex and hippocampus [10]. These brain regions are typically implicated in the pathophysiology of depression [11,12]. Furthermore, low levels of 25(OH)D are known to increase the hormone parathyroid/parathyrin, which in turn reportedly increases the risk of depression [13]. Pathological or clinical depression is usually characterised by its severity, longer duration, and hindrance to the individual's daily activities and duties [14].

A concentration of <20 ng/mL of 25(OH)D in the blood stream may be a predisposing factor for depression and other psychological disorders. Half of the older people in North America and two-thirds of the world's population have suboptimal vitamin D levels [15]. There is evidence that vitamin D replacement therapy has a beneficial effect on depression and the neuroendocrine system [16]. It is hypothesised that vitamin D deficiency is related to mood disorders, but epidemiological evidence has always been limited. However,

the relationship between Vitamin D deficiency and depression is far more pronounced than that with anxiety [17].

Vitamin D deficiency could lead to mental illness. The influence of independent factors, including: hormonal, lifestyle, and genetic factors, is largely unknown. However, biological research continues to suggest a major role of vitamin D. Therefore, it is hypothesised that vitamin D deficiency is related to levels of anxiety and depression. Epidemiological evidence is limited, and more evidence has linked depression than anxiety to vitamin D deficiency. The present study was conducted with an aim to understand the correlation between Vitamin D deficiency, incidences of depression and anxiety and its influence on academic performance amongst University dental students.

MATERIALS AND METHODS

The study had a descriptive cross-sectional design with a simple randomised sample collection procedure. The study design was approved by the Ethical Committee of Majmaah University, Saudi Arabia (Ref: MUREC-Jan.25/COM-2018/2). The study was conducted between January 2018-March 2018. The sample population was calculated using the formula $n=\{(Z)2^*\sigma(\sigma-1)\}/(CI)2$, n=sample size to be estimated, Z=1.96, σ=standard deviation, CI=Confidence Interval (0.05). Sample consisted of 100 males (as this college enroll only male students); all students across different academic levels from College of Dentistry, Majmaah University in Saudi Arabia. Written informed consent was obtained from all study participants.

Data Collection

Serum 25(OH) D Levels

Two millilitres of venous blood from the non-fasting participants were collected and allowed to clot for 30 minutes at 23°C. After centrifugation the serum was aliquoted, frozen and stored at -20°C.

The 25(OH)D assay done using DiaSorin S.p.A (Saluggia, Italy) consisted of a two-step procedure. The first step involves rapid extraction of 25(OH)D from serum with acetonitrile. Subsequently, the sample was assayed by equilibrium radioimmunoassay, using an antibody specific to 25(OH)D. The sample, antibody, and tracer were incubated for 90 minutes at 20-25°C. Phase separation was accomplished after 20-minute incubation at 20-25°C with a second antibody-precipitating complex. Then 500 μL NSB/Addition buffer was added after this incubation prior to centrifugation to aid in reducing non-specific binding. A Packard COBRA gamma counter was used to measure the concentration of 25(OH)D in serum. The reference value of 25(OH) D levels <20 ng/mL was taken from the study by Bouillon R et al., [18].

The Anxiety Scale

Anxiety scale was used to determine anxiety levels. It consists of 47 statements that represent the main axes of the anxiety symptoms (nervous stress-increased daily activity-pessimistic expectations - psychological stress). Respondents were asked to answer this using the Likert's scale by selecting one of the four responses (always, sometimes, rarely, or never). The following codes were used to mark the positive statements (always "4", sometimes "3", rarely "2", or never "1"), whereas, negative statements were marked as (always "1", sometimes "2", rarely "3", or never "4"). The respondent's total score on the anxiety scale ranged from 47-188, wherein, the high degree referred to a high level of anxiety, and the low degree referred to a low level of anxiety. The scale reliability in our study was 0.891 Cronbach's alpha statistical technique. The level of anxiety was calculated as follows: No anxiety "47-74", mild anxiety "75-102", moderate anxiety "103-130", and severe anxiety "131-188" [19].

The Depression Scale

The previously validated Arabic Beck's depression inventory by West J, (1985) was used in the present study [20]. The inventory included 21 items; each item had multiple answers and participants had to choose the right answer from those options. The items were designed to measure the existence and degree of depression. Each item of the Beck Depression questionnaire assessed a condition or a specific symptom that distinguished depression patients and that is in accordance with the description of depression in psychiatric literatures [20,21]. The test validity is high; because the test assesses a wide range of symptoms and guidelines that are related to depression. The scoring was performed according to the following criteria; no depression (1-10), mild depression (11-16), borderline clinical depression (17-20), or moderate depression (21-30), severe depression (31-40) and over 40 extreme depressions. The score of each form was calculated and assessed according to the values of the original test. In order to calculate the reliability coefficient of the test, the items of construct were divided into two halves: odd and even numbers [22].

STATISTICAL ANALYSIS

The results of the questionnaire, including the Anxiety scale reliability was calculated using Cronbach's alpha statistical technique. The collected data were further analysed using IBM SPSS, Version 23.0 (IBM Corp., Armonk, NY, USA). Pearson's correlation was employed to evaluate correlations between levels of vitamin D and anxiety and depression inventories. A p-value <0.05 was considered to be statistically significant. The scale reliability in our study was 0.891, calculated using Cronbach alpha.

RESULTS

The prevalence of vitamin D insufficiency in students {25(OH)D levels <20 ng/mL} was 89% (n=89) with a mean value of 10.24 ng/mL. The age of the participants ranged from 19-23 with a mean age of 20.89. The GPA which reflect the academic performance of the students ranged from 2.35-5 with a mean of 4.21 [Table/Fig-1].

Variables	N	Minimum	Maximum	Mean	Std. deviation
Vit-D Status	100	3.35	26.44	10.24	4.39
Age	100	19.00	23.00	20.89	0.90
GPA Score	100	2.35	5.00	4.21	0.58
Depression score	100	0.00	28.00	7.95	6.50
Anxiety Score	100	103.00	185.00	143.22	17.47

[Table/Fig-1]: Descriptive variables of study participants.

It was observed that 62% of the students (n=62) had anxiety and their anxiety levels ranged between moderate (29%, n=29) and severe (33%, n=33). Furthermore, 66% of the students (n=66) had no depression, 22% (n=22) had moderate depression and 12% (n=12) of them had mild depression [Table/Fig-2].

Scores level	Absent	Mild	Moderate	Severe
Anxiety	38 (38%)	0 (0%)	29 (29%)	33 (33%)
Depression	66 (66%)	12 (12%)	22 (22%)	0 (0%)

[Table/Fig-2]: Level of anxiety among students of the Majmaah University, N=(100).

A significant positive correlation was observed between 25(OH)D deficiency and anxiety (r=0.459, p≤0.001), showing that anxiety levels increase with decrease in the levels of Vitamin D and vice versa. Similar positive correlation existed between 25(OH)D deficiency and GPA score (r=0.282, p-0.004). No correlation was observed for 25(OH) D deficiency and depression (r=0.173, p-0.07) [Table/Fig-3].

Vit-D status	Mean	Std. deviation	Pearson correlation (r)	Sig. (2-tailed) p-value
	10.2369	4.39199		
Anxiety score	143.22	17.46603	0.459	≤0.001
Depression score	7.95	6.50	0.173	0.07
GPA score	4.21	0.57686	0.282	0.004
Age	20.89	0.89775	0.039	0.7

[Table/Fig-3]: Relationship between vitamin D deficiency; anxiety and depression among students of Majmaah University (N=100).
Significant at a *p<0.05

DISCUSSION

The correlation between vitamin D deficiency and incidences of depression and anxiety amongst University students are discussed. In the present study, 89% (n=89) students had vitamin D insufficiency. Results of this study are consistent with many other studies conducted in the Kingdom of Saudi Arabia, which reported high prevalence of vitamin D deficiency among the adults and school children across eastern, western and central region of Saudi Arabia, this could be attributed to low sunlight exposure, a highly indoor and sedentary lifestyle, and improper dietary habits [23,24]. A study conducted in the United Arab Emirates among University students also revealed one of the causes of vitamin D deficiency to be an inadequate consumption of fortified foods [25]. In the studies conducted in King Abdul-Aziz medical city hospital 79.1% of the study participants in Riyadh and 67.8% of those in the Quassim province exhibited severe deficiency of vitamin D [26,27]. These results indicate the need for increasing vitamin D supplementation in the Saudi diet.

It was observed that 62% of the students (n=62) had anxiety and their anxiety levels ranged between 29% (n=29) moderate and 33% (n=33) severe. Furthermore, a significant positive correlation was observed between Vitamin D deficiency and anxiety levels. These results are consistent with the results obtained in a similar study from Czech Republic, where calcitriol levels were decreased significantly in patients with depression and anxiety disorders [28]. The increased anxiety levels in the student population could also be attributed to the pressure from the teaching-learning process including specialisation, curricula, or social and family pressure

to achieve success and excellence [29-31]. The present authors propose that along with these factors vitamin D deficiency could also play a role in the mood disorders among student population.

It was observed that 66% of the participants had no depression while only 22% had moderate and 12% had mild depression, respectively. The results are contradictory to studies conducted among the patients in Dallas, USA which showed a vitamin D deficiency in the participants with depression as compared to those of their healthy counterparts [32]. However, the present results are in line with a previous study conducted in Washington, USA, among pregnant women, where it was observed that 40% of the participants had vitamin D deficiency ($\leq 32\,ng/mL$), but only 12.2% had moderate depression [33]. A similar study conducted among 1282 participants in Amsterdam showed 25(OH)D deficiency in 14% (n=169) with minor depression and 14% (n=26) with a major depressive disorder [34].

The present study showed potential relationship between low 25(OH) D levels and anxiety among students and minimal relationship with GPA of dental students (r=0.282, p=0.004), which could be attributed to the adverse effect of anxiety on the academic performance; thereby deserving attention. This finding was supported by a similar study among dental students of Jazan University, Saudi Arabia which showed that the students with higher GPA had lesser levels of stress [35].

Limitation(s)

The finding from this study should not be generalised owing to the small sample size and because the study participants were only males. A multicenter study with a higher sample size, including female participants would give a better insight into the effect of vitamin D deficiency on mood disorders.

CONCLUSION(S)

This article emphasises the possible relation of 25(OH) D deficiency and anxiety as well as its high prevalence among University dental students. Students with anxiety may have a more passive attitude towards academics including lack of interest in learning, examinations, and assignments; which could affect their academic performance and future health. The outcome of this study may be useful in planning preventive measures against anxiety among University dental students.

Author Contributions

Dr. Abdulrahman A. Al-Atram Conceptualization of the research idea, planning methodology, data collection and manuscript drafting. Dr. Gunapriya Ragunath planning the research and designing the questionnaire, analysis of data and drafting of manuscript. Dr. S. Karthiga Kannan data collection, questionnaire survey, drafting and proof reading of manuscript.

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