



Anxiety Symptoms Among Lebanese Health-care Students: Prevalence, Risk Factors, And Relationship With Vitamin D Status

José-Noel Ibrahim^{1,2*}, Léa Audi¹

¹Department of Medical Laboratory Sciences, Lebanese German University, Faculty of Public Health, Sahel Alma, Lebanon, ²Department of Medical Laboratory Sciences, Lebanese University, Faculty of Public Health II, Fanar, Lebanon

ABSTRACT

Introduction: Various emotions may arise in the context of extensive curriculum of paramedical education. Their association to biological aspects such as Vitamin D status is to be examined with regard to the prevalence of Vitamin D deficiency in the region. This research aims to evaluate the prevalence of anxiety symptoms and their relationship with Vitamin D status among Lebanese health-care students.

Methods: A total of 157 university students aged 18-25 years old completed a questionnaire related to medical and psychiatric history, nutritional intake, lifestyle habits, and social difficulties. Anxiety symptoms were assessed by Hamilton Anxiety Rating Scale. Vitamin D serum levels were analyzed using ELISA technique.

Results: Anxiety symptoms were present in 37.5% of students with 2.5% presenting severe anxiety. Anxiety symptoms were significantly associated to health problems ($p = 0.0038$), social difficulties ($p = 0.001$), and a family history of psychiatric disorders ($p < 0.0001$). Low Vitamin D levels were detected in 49.3% of participants; 77.5% having a Vitamin D insufficiency while the rest presenting a Vitamin D deficiency. Students with anxiety symptoms had significantly lower Vitamin D levels as compared to those having no anxiety manifestations ($17.9 \text{ ng/mL} \pm 7.9$ vs. $24.2 \text{ ng/mL} \pm 9.9$, $p = 0.0023$). However, no significant correlation was registered between anxiety symptoms scores and Vitamin D levels.

Conclusion: Anxiety symptoms were found to be relatively prevalent among health-care students and associated to low Vitamin D levels. Further studies are warranted to clarify the beneficial effect of Vitamin D supplementation in the prevention, management, and treatment of anxiety symptoms among health-care students.

Keywords: Anxiety, health-care students, Vitamin D, prevalence, risk factors

INTRODUCTION

The emotions experienced in the academic environment are known to be linked to important outcomes, such as academic adaptation and success, as well as student health and well-being. Indeed, studying at university can be a stressful stage of life and it is characterized by modifications in lifestyle, novel relationships including friendships and affective attachments, and sometimes a certain distance from home and family (1,2).

Paramedical education includes students from a variety of health professions such as nursing, medical laboratory sciences, nutrition and dietetics, physical therapy, medical imaging, speech therapy, and pharmacy. It is particularly considered to be a challenging program in regard to the

intensive curriculum, including the high amount of knowledge pertaining to be memorized, exam preparation, and internships with forced night awakenings for shifts (3). Moreover, balancing between courses and internships, and being often involved in emotionally-charged situations such as dealing with medical severe conditions, and feeling responsible for making life-death decisions expose healthcare students to high levels of stress. Such demands may affect the students' psychological well-being, and subsequently constitute one of various precipitating factors of depression and anxiety. In addition, they may impact academic performance, dropout rates, work efficacy, and aspects of the individual's daily life (1,2,4,5).

Anxiety symptoms, although somewhat more common than depression, seem to garner less attention and are often undetected and undertreated in the general population (6). Moreover, most studies in the literature focused on evaluating the prevalence and consequences of mental health problems among medical students, given the corresponding highly extensive program (7), while only few surveys were

Corresponding author: José Noel Ibrahim, Lebanese German University, Faculty of Public Health, Sahel Alma, Keserwan, Lebanon. Tel: +961 70 68 31 79, Fax: + 961 9 93 89 33. E-mail: jn.ibrahim@lgu.edu.lb.

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carried out among health-care students. Thus, excessive anxiety experienced in the field of paramedical education warrants wider awareness. In addition to intense feelings of fear or panic, subjects presenting with anxiety symptoms may have somatic manifestations including dizziness, fatigue, nausea, headaches, abdominal pain, palpitations, shortness of breath, and urinary incontinence (8). Furthermore, profound anxiety can alter goal-directed attention and concentration (9), working memory (10), and perceptual-motor function (11), which may jeopardize quality of patient care.

Vitamin D or calcidiol is a steroid hormone obtained via dietary intake or mostly synthesized cutaneously in the human organism following exposure to sunlight, particularly ultraviolet B rays. The activation of calcidiol occurs in the kidneys through the enzyme 1-alpha hydroxylase. Along with its long known essential function in the phosphocalcic metabolism and its role in proliferation, differentiation and immunomodulation, there is handful evidence that Vitamin D plays an important role in nervous system health (12,13). Age, obesity, or limited sun exposure are associated with higher risk for Vitamin D deficiency; a condition that is prevalent in Lebanon, even among young adults, despite adequate sunlight throughout the year (14,15).

As for the association between Vitamin D deficiency and mental health problems, studies have assessed its link with depressive disorders. There are many reports that low levels of Vitamin D are associated with major depression or symptoms of depression (16,17). However, research did not demonstrate an effect on reducing the severity of these symptoms with Vitamin D supplementation (18). In contrast to these reports, fewer contributions have been published on the association of anxiety disorders with levels of Vitamin D (19,20), with data being variable and sometimes contradictory.

Hence, our study aims at evaluating anxiety symptoms and Vitamin D deficiency particularly among healthcare students. Its objectives consist of assessing the prevalence of anxiety symptoms and that of Vitamin D deficiency, as well as exploring the relationship between both variables. They also include identifying risk factors for anxiety symptoms in this specific context to propose timely psychological support and intervention.

METHODS

Study design and population

The research was conducted according to the Declaration of Helsinki and in agreement with standards of the Ethical Committee of Notre Dame University Hospital. The target population was Lebanese university students, aged 18-25 years old, and enrolled in a paramedical science program.

The sample size was calculated using Cochran's equation ($n_0 = Z^2 pq / e^2$) (21), with a 95% confidence level, a precision of 5%, and an estimated anxiety proportion of 15% based on two previous studies; the first one evaluating the prevalence of generalized anxiety disorders among nurses in Tunisia (22), and the second one exploring anxiety prevalence in the Lebanese general population (23). The estimated sample size yielded 196 participants.

A total of 225 students from different Lebanese universities were randomly approached to participate in the research, but only 178 responded and accepted to participate in the survey. A data cleaning was performed to remove responses from individuals who did not fit the inclusion criteria or who did not answer the questions thoughtfully ($n = 16$). None of the respondents was found to have a prior history of psychiatric or cognitive disorder, or suffered from an inflammatory or autoimmune disease based on the medical history and medication intake. Moreover, five students were excluded from the study for taking Vitamin D supplements, hence making the final number of subjects including in the research 157.

Questionnaire

After obtaining a written informed consent from all participants, a structured questionnaire was filled to gather relevant information regarding socio-demographic characteristics of participants, personal medical history, family history of medical and psychiatric disorders, medication, duration of sun exposure, tobacco smoking, as well as social difficulties that may be encountered. Alcohol and caffeine consumption were evaluated according to the 2015-2020 Dietary Guidelines for Americans (24). The short Vitamin D questionnaire (VDQ) developed and validated by Hedlund *et al.* in 2014 was used to assess intake of four major sources of dietary Vitamin D (oily fish, milk, margarine, and yoghurt/sour milk) (25) to make sure that all participants had an adequate dietary intake with regard to Vitamin D.

Blood collection and vitamin D quantification

Blood samples were collected in Vacutainer® tubes containing clot activators for the isolation of sera from all participants during the months of March and April 2019. Sera were obtained by centrifugation and stored at -80°C until analysis. Vitamin D levels were quantified by ELISA sandwich, using the "25-OH Vitamin D ELISA" kit (Catalog #EQ 6411, EUROIMMUN, Germany). The test was found, according to the previous studies, to be highly correlated to results obtained by several reference methods such as liquid chromatography mass spectrometry LC-MS/MS and high-performance liquid chromatography. An optimal Vitamin D status was associated with levels ranging between 20 and 50 ng/mL. Levels lower than 20 ng/mL were considered as suboptimal or insufficient, whereas a Vitamin D deficiency was defined when levels were ≤ 10 ng/mL (26).

Assessment of anxiety

The Hamilton anxiety rating scale (HAM-A) was administered by a specialist to assess the severity of anxiety symptoms in students by covering many features of generalized anxiety disorder. HAM-A is a widely used and well-validated tool consisting of 14 items, each defined by a series of symptoms, and measures both psychic anxiety (mental agitation and psychological distress) and somatic anxiety (physical complaints related to anxiety). Each item is scored on a 5-point scale, ranging from 0=not present to 4=severe (27,28). The sensitivity and specificity of the test are, respectively, 85.7% and 63.5% (29).

Statistical Analysis

Study data were analyzed using the GraphPad Prism software version 6 (GraphPad Software, Inc., USA). Means and standard deviations for quantitative variables were calculated. The unpaired *t* test with Welch's correction was used to compare means between two groups. Differences among multiple groups were analyzed using non parametric one-way ANOVA test, followed by Tukey's *post hoc* test. The Pearson correlation test was used for correlations between variables. The evaluation of factors associated with anxiety was performed by Chi-square test comparing frequencies between groups. Fisher's exact test was used where appropriate. To identify factors independently associated with anxiety symptoms, a multivariate analysis using binary logistic regression was performed. Anxiety was considered as a dependent variable, while health problems, family issues, social problems, family psychiatric history, and Vitamin D status were considered as independent variables. Before the binary logistic regression analysis, a test of significance (omnibus test) and a goodness-of-fit test (Hosmer–Lemeshow test) were applied for the model used. $p < 0.05$ was considered statistically significant.

RESULTS

Socio-demographic characteristics, personal history, and lifestyle of participants

This study included 157 participants between 18 and 25 years of age (21.0 years \pm 2.0) and of whom 61.8% were females and 60.5% had a normal BMI, between 18.5 and 24.9 kg/m². No significant difference was found between males and females with regard to age (21.1 years \pm 2.3 vs. 20.9 years \pm 1.6; $p = 0.6386$).

The majority of students (81.5%) were enrolled in a bachelor's program while the rest were pursuing a master's degree. The main paramedical departments included in the study were physical therapy (28%), nursing (22.4%), medical laboratory sciences (21.6%), and pharmacy (14%). Medical imaging, speech therapy, and nutrition and dietetics departments constituted the remaining 14% of our sample.

Among participants, the majority (80.9%) did not have a history of medical disorders. Respiratory diseases (5.7%) and hyperthyroidism (1.3%) constituted most mentioned pathologies by students. Social problems were reported by 23.6% of participants mainly related to high level of competition among students (15.5%) and difficulty in making friends (3.7%) or blending in a group (4.4%).

Several parameters were investigated to evaluate the lifestyle of individuals. Results showed that all participants had adequate sun exposure of 15-30 min/day. More than half of the students present a moderate consumption of alcohol and caffeine (56.7% and 67.5%, respectively), while 34.4% of them smoke tobacco, and only one person (0.6%) reported taking stimulants such as cocaine or amphetamines.

Family background and history of psychiatric disorders

The majority of students (75.2%) did not state family related difficulties. Family conflict (5.4%), financial problems (4.9%), parents' separation (3.7%), bereavement

(3.6%), the presence of a sick family member (3%), the absence of family support (2.4%), and the lack of education (1.8%) were among the concerns mentioned by participants. Although 84.7% of participants did not have a family history of psychiatric disorders, the remaining students reported having one or several members of the family presenting anxiety symptoms (10.3%) or other mental health disorders (5%).

Prevalence of anxiety

The prevalence of anxiety symptoms among health-care students was 37.5%. According to Hamilton's Anxiety Scale, 22.3% presented mild anxiety severity (score between 13 and 17), 8.9% mild to moderate anxiety severity (score between 18 and 24), 3.8% moderate to severe anxiety severity (score between 25 and 30), and 2.5% severe anxiety severity (score >30).

Female participants had a higher percentage of anxiety as compared to men (42% vs. 32%). On the other hand, pharmacists reported the most anxiety symptoms among students (50%), followed by nurses (45.7%), physical therapists (34%), and finally medical laboratory students (23.5%).

Factors associated to anxiety among healthcare students

The prevalence of anxiety with regard to socio-demographic characteristics, lifestyle factors and personal and family history of participants are shown in Table 1. Students with health problems and those reporting family issues, social problems, or family history of psychiatric disorders showed significantly higher frequencies of anxiety as compared to their counterparts ($p = 0.0038$; $p < 0.0001$; $p = 0.001$; and $p < 0.0001$, respectively). In contrast, all other investigated factors, namely, sex, student's major, academic level, weight status, and alcohol, caffeine or tobacco consumption were not significantly associated with the presence of anxiety among health-care students (Table 1). A correlation analysis of Hamilton's anxiety score with student's age showed also no relation between the two variables ($r=0.127$; $p = 0.114$).

Vitamin D status among health-care students and relationship with anxiety

Serum levels of Vitamin D ranged between 2.5 ng/mL and 44.3 ng/mL, with a mean value of 21.1 ng/mL \pm 9.4. Levels were lower than the normal in 49.3% of participants; 77.5% had a Vitamin D insufficiency while the rest had a Vitamin D deficiency. There was no significant difference in Vitamin D levels with regard to student's gender (males: 23.9 ng/mL \pm 9.2 [95%CI: 20.17-27.63] versus females: 19.7 ng/ml \pm 9.3 [95%CI: 17.21-22.25], $p = 0.0631$) or to the academic major ($p=0.0980$) (Figure 1).

Interestingly, significantly lower levels of Vitamin D were observed in students with anxiety symptoms as compared to those having no anxiety manifestations (17.9 ng/mL \pm 7.9 [95%CI: 15.37-20.42] versus 24.2 ng/mL \pm 9.9 [95%CI: 21.04-27.29], $p = 0.0023$) (Figure 2).

However, Vitamin D levels were comparable among students with anxiety, irrespectively of its severity level ($p = 0.2478$) (Figure 3). Results were further supported by

TABLE 1. Prevalence of anxiety with regard to socio-demographic characteristics, lifestyle factors and personal and family history of participants.

Variables	Students with anxiety (n=60) n (%)	Students without anxiety (n=97)n (%)	p value	OR (95% CI)
Sex				
Male	19 (31.6)	41 (68.4)	0.2368	1.580 (0.803-3.109)
Female	41 (42.3)	56 (57.7)		
Major				
Physical therapy	15 (34.1)	29 (65.9)	0.1963	1.628 (0.683-3.943)
Nurses	16 (45.7)	19 (54.3)		
Medical laboratory sciences	8 (23.5)	26 (76.5)		
Pharmacy	11 (50.0)	11 (50.0)		
Other	10 (45.5)	12 (54.5)		
Academic level				
Bachelor	52 (40.6)	76 (59.4)	0.2118	0.557 (0.229-1.352)
Master	8 (27.5)	21 (72.5)		
Traumatic event				
Absence	54 (36.7)	93 (63.3)	0.1828	2.583 (0.698-9.563)
Presence	6 (60.0)	4 (40.0)		
Health problems				
Absence	43 (33.9)	84 (66.1)	0.0038**	3.374 (1.473-7.727)
Presence	19 (63.3)	11 (36.7)		
Weight status				
Underweight	4 (44.5)	5 (55.5)	0.9391	0.7292 (0.199-2.511)
Normal weight	35 (36.8)	60 (63.2)		
Overweight	12 (32.5)	25 (67.5)		
Obese	9 (56.0)	7 (44.0)		
Alcohol consumption				
No	23 (33.3)	46 (66.7)	0.3214	1.451 (0.753-2.795)
Moderate	37 (42.0)	51 (58.0)		
Excessive	0 (0.0)	0 (0.0)		
Caffeine consumption				
No	7 (26.9)	19 (73.1)	0.2971	1.712 (0.666-4.325)
Moderate	41 (38.7)	65 (61.3)		
Excessive	12 (48.0)	13 (52.0)		
Tobacco consumption				
Absence	39 (37.9)	64 (62.1)	1	1.044 (0.531-2.054)
Presence	21 (38.9)	33 (61.1)		
Family issues				
Absence	32 (27.1)	86 (72.9)	<0.0001****	6.841 (3.053-15.33)
Presence	28 (74.4)	11 (25.6)		
Social problems				
Absence	39 (32.0)	83 (68.0)	0.001**	3.648 (1.704-7.810)
Presence	24 (63.2)	14 (36.8)		
Family psychiatric history				
Absence	41 (30.8)	92 (69.2)	<0.0001****	8.527 (2.979-24.410)
Presence	19 (79.2)	5 (20.8)		

N: Number of individuals; OR: Odds ratio; CI: Confidence interval; p values are calculated using the Chi-square and Fisher's exact tests for differences between groups

the absence of a significant correlation between Vitamin D levels and Hamilton's anxiety scores ($r=-0.034$; $p = 0.766$) as well as between Vitamin D status and the severity of anxiety symptoms ($\chi^2 = 7.46$; $p = 0.0585$) (Table 2).

Anxiety predictive factors in health-care students

Factors found to be significantly associated with anxiety symptoms through the univariate analysis were studied in a multivariate model to calculate adjusted odds ratios measuring the specific role of each factor. Interestingly, subjects having family issues or family history of psychiatric

disorders were more likely to have anxiety in comparison to their counterparts (OR=3.169; $p = 0.043$ and OR=3.777; $p = 0.036$, respectively). In contrast, Vitamin D status was not found predictive of anxiety symptoms in healthcare students ($p = 0.702$) (Table 3).

DISCUSSION

Our research focuses on exploring the specificity of anxiety symptoms and their contributing factors particularly among Lebanese healthcare students. To the best of our knowledge, this is the first study investigating the prevalence of these

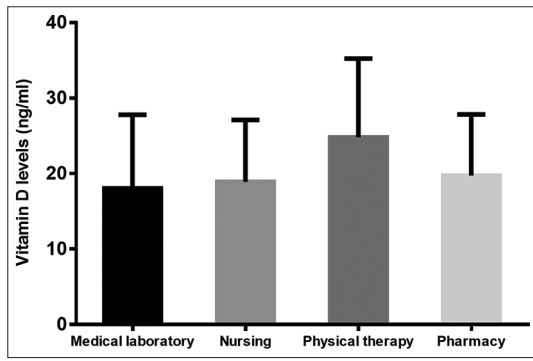


FIGURE 1. Serum Vitamin D levels with regard to students' academic major. Ns: Non-significant based on One-Way ANOVA test for differences between groups.

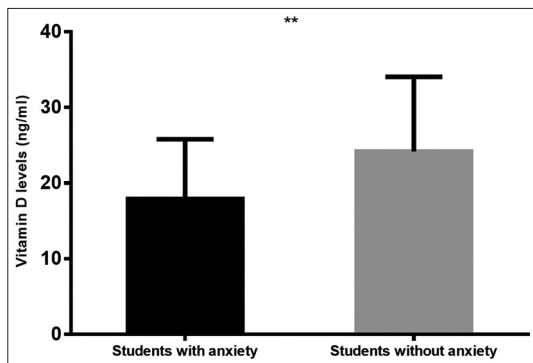


FIGURE 2. Serum Vitamin D levels in students with anxiety and those without anxiety. ** $p < 0.01$ based on the unpaired t test with Welch's correction.

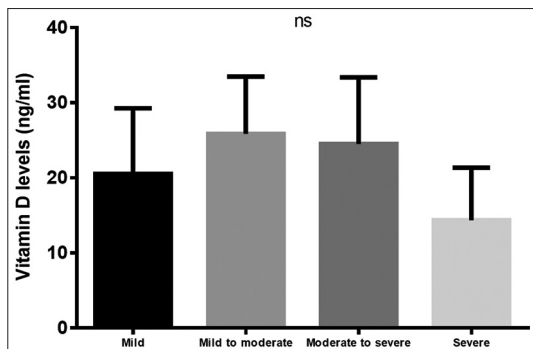


FIGURE 3. Serum Vitamin D levels with regard to the severity level of anxiety. Ns: Non-significant based on One-Way ANOVA test for differences between groups.

symptoms and assessing their relationship with Vitamin D status in this population. Three in eight health-care students were found to have anxiety symptoms as defined by the HAM-A. Indeed, the prevalence of anxiety in our study was of 37.5%, nearly comparable to the global prevalence rate of anxiety among medical students (33.8%) (30). However, it was found to be more prevalent among our sample of health-care students in comparison to other disciplines, such as economics, finance and management (23.6%), law (17.1%), and humanities and exact science (29.4%) (31,32). This finding might be attributed to several factors such as the intensive academic workload and the highly competitive environment among students, as well as the stress in relation to management and communication with patients mainly during trainings (3). Moreover, health-care students seem to experience much higher prevalence of

TABLE 2. Association of Vitamin D status with severity of anxiety among health-care students.

Severity of anxiety	Vitamin D status		p value	OR (95% CI)
	Vitamin D insufficiency n (%)	Normal Vitamin D n (%)		
Mild	19 (52.8)	17 (47.2)	0.1214	
Mild to moderate	3 (21.4)	11 (78.6)		0.244 (0.066-0.937)
Moderate to severe	2 (33.3)	4 (66.7)		0.447 (0.079-2.194)
Severe	3 (75.0)	1 (25.0)		2.684 (0.362-36.650)

N: Number of individuals. The p value is calculated based on Chi-square test for differences between groups

TABLE 3. Multivariate analysis of anxiety predictive factors in health-care students.

Variables	β	SE	p value	OR (95% CI)
Health Problems				
Absence				
Presence	0.495	0.641	0.440	1.641 (0.467-5.766)
Family issues				
Absence				
Presence	1.265	0.625	0.043	3.169 (1.051-11.432)
Social problems				
Absence				
Presence	1.022	0.638	0.109	2.778 (0.796-9.696)
Family psychiatric history				
Absence				
Presence	1.329	0.632	0.036	3.777 (1.094-13.042)
Vitamin D status				
Normal Vitamin D level				
Low Vitamin D level	-0.198	0.518	0.702	0.820 (0.297-2.263)

Omnibus test: 0.009; Hosmer-Lemeshow test: 0.619. β : Beta-coefficient; SE: Standard error; OR: Odds ratio; CI: Confidence interval

anxiety in comparison to the general population in which rates can vary between 3% and 25% (33).

Various factors including age, sex, family history, addictive substances, and social problems, have been linked to an increased risk of developing anxiety. In this regard, we studied the possibility of a relation between these factors and the presence of anxiety among health-care students. In agreement with the previous published data, students suffering from health problems and those having family issues, social problems or family history of psychiatric disorders were at higher risk of having anxiety symptoms as compared to their counterparts (34-36). Interestingly, the multivariate regression analysis revealed that family issues and family psychiatric history were independent predictors of anxiety among our sample of healthcare students. In contrast, our research registered no significant differences in anxiety frequency with regard to students' age, sex, actual weight status, academic major, educational level, or addictive substance consumption. Interestingly, our results are similar to some reports but contradictory to others and this

TABLE 4. Study findings on potential risk factors for anxiety.

Variable	Findings	References
Age	Age >20 years is a predictor for anxiety among medical students in Egypt	Abdel <i>et al.</i> , 2017 (42)
Sex	Female sex predicts higher levels of “baseline” anxiety among medical students in Saudi Arabia	Kulsoom and Afsar, 2015 (43)
	Gender is a risk factor for anxiety among Chinese students aged 13-26 years	Jin <i>et al.</i> 2014 (31)
	Female sex increases the risk of anxiety disorders in a sample of adults in the United States (US)	Blanco <i>et al.</i> 2014 (35)
Weight status	Female sex is a predictor for anxiety among medical students in Egypt	Abdel Wahed and Hassan. 2017 (42)
	Anxiety is associated to perceived weight status, but not the actual weight status, in a sample of Chinese adolescents	Tang <i>et al.</i> 2010 (44)
	Underweight and obese adults in Minnesota are more likely to have anxiety compared to normal weight individuals	DeJesus <i>et al.</i> 2016 (45)
	BMI is not associated to anxiety in a sample of residents aged 20 years and above in a city of central Norway	Bjørngaard <i>et al.</i> 2015 (46)
	BMI ≥ 25 kg/m ² is a predictor for anxiety among medical students in Egypt	Abdel Wahed and Hassan. 2017 (42)
Academic major	Students in humanities and art and design are more likely to have mental health problems than other disciplines	Lipson <i>et al.</i> 2015 (47)
Educational level	International graduate students in the US experience greater levels of anxiety than undergraduate students	Poyrazli and Kavanaugh. 2006 (48)
	Years of education increase the risk of anxiety disorders in a sample of adults in US	Blanco <i>et al.</i> 2014 (35)
	Low educational levels are associated with anxiety in a sample of adults from a city of central Norway	Bjelland <i>et al.</i> 2008 (49)
Addictive substance consumption	Regular smoking is strongly related to anxiety among medical students in Saudi Arabia	Kulsoom and Afsar. 2015 (43)
	Smoking is not a risk factor for anxiety among Chinese students aged 13-26 years	Jin <i>et al.</i> 2014 (31)
	Total weekly caffeine intake is associated to anxiety in a cohort of secondary school children from the South West of England	Richards and Smith. 2015 (50)
	Excessive alcohol consumption is not associated with the onset of anxiety among adults living in private households in the United Kingdom (UK)	Haynes <i>et al.</i> 2005 (51)

may be related to differences in the sampling size as well as to the characteristics of the study population (Table 4).

The second objective of this research was to investigate any potential relationship between Vitamin D status and the presence of anxiety among healthcare students. Low levels of Vitamin D were detected in 49.3% of participants, of which 77.5% had a Vitamin D insufficiency while the rest presented with a Vitamin D deficiency. These results are in accordance with those reported by Medlej-Hashim *et al.* in 2015 who observed a Vitamin D insufficiency prevalence of 50% in a sample of 132 Lebanese University students (37).

Interestingly, significantly lower levels of Vitamin D were noted in health-care students suffering from anxiety manifestations in comparison to those without similar symptoms. Likewise, a research conducted in Prague in 2015 reported lower Vitamin D levels in patients with anxiety disorders as compared to the group of healthy controls (19). Han *et al.* also demonstrated an association between low serum levels of Vitamin D and anxiety in children and adolescents with dialysis in China (20). Nevertheless, our research did not register any significant linear correlation between Vitamin D status and the severity of anxiety, which is consistent to the study carried out by Dean *et al.* in 2011 showing no effect of Vitamin D daily supplementation on anxiety scores in young adults (38).

The exact mechanism of action of Vitamin D in the pathophysiology of anxiety remains unknown. Vitamin D plays an important role in proliferation, differentiation, neurotrophism, neuroprotection, neurotransmission, and neuroplasticity. It exerts its function through binding to Vitamin D receptor (VDR) and Vitamin D activating enzyme 1- α -hydroxylase, which are considerably

present in neuronal and glial cells of the human brain (13). Experiments on animals have demonstrated that VDR-deficient mice showed increased anxiety symptoms (39), thus suggesting that defects in the Vitamin D-VDR system may directly result in the development of anxiety. Moreover, anxiety is associated with high serum levels of inflammatory markers tumor necrosis factor- α and C-reaction protein, while interleukin-10, as an anti-inflammatory biomarker, is decreased in patients with anxiety disorders (40). In this context, Vitamin D plays a key role in modulating the secretion of these markers and could therefore help reduce anxiety among health-care students. Finally, there is a growing body of evidence suggesting the involvement of cytokines in the anxiety process by modulating the metabolism of neurotransmitters such as dopamine and serotonin (41). Some limitations of the present study should be noted. The cross-sectional nature of the research did not allow us to explain the causal relationship between Vitamin D and anxiety among health-care students. In addition, the evaluation of several variables, specifically lifestyle factors and personal and family history of participants, was based on self-reported information. Finally, our research focused on four disciplines in the paramedical field due to the limited number of participants in other majors such as medical imaging, nutrition and dietetics, and speech therapy, which may influence the generalizability of the study results.

CONCLUSION

Our results serve to raise awareness that anxiety is a highly prevalent and unaddressed major issue among health-care students. Indeed, when untreated, students with excessive anxiety symptoms may alter their performance, with

an impact on both technical and soft skills. In view of these findings, universities can consider organizing structured validated programs including life skills training and mindfulness therapy to reduce anxiety and its outcomes in healthcare students. Moreover, qualitative research exploring the difference in predictors of anxiety with other academic programs is warranted to better understand the etiology of increased anxiety among health-care students.

On the other hand, our research demonstrates a relationship between decreased serum Vitamin D levels and anxiety among Lebanese health-care students. Exercising outdoor in the sunshine, eating foods rich in Vitamin D, and/or taking Vitamin D supplementation could represent a simple and cost-effective solution to prevent and treat symptoms in individuals at risk for anxiety and possibly other mental disorders. Furthermore, the establishment of practices and guidelines to screen for Vitamin D insufficiency among individuals presenting with anxiety in primary care may potentially improve quality of care and subsequently health outcomes. Future studies on a larger sample are necessary to elucidate the exact relationship between anxiety and Vitamin D and to clarify the beneficial effect of Vitamin D supplementation in the prevention, management, and treatment of anxiety symptoms among health-care students.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

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