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Research Article

HEALTH STATUS AND KNOWLEDGE OF VITAMIN D DEFICIENCY AMONG FEMALE PHARMACY AND DENTISTRY STUDENTS IN AJMAN, UAE

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ABSTRACT

Objectives: This study was carried out to evaluate the level of knowledge of vitamin D deficiency (VDD) and to assess the factors affecting the knowledge score among female pharmacy and dentistry students in Ajman, UAE. Materials and Methods: A cross-sectional questionnaire-based survey was conducted at Ajman University (AU) with a total of 390 pharmacy and dentistry students surveyed from October 2015 to February 2016. Data analysis was conducted using SPSS version 24. Correlation tests were used to determine the association between the knowledge scores and the socio-demographic data. In addition, the Chi-square test was included in the data analysis. *p*-value < 0.05 was considered as significant. Results: The majority of the participants were first year students in Ajman University and have a high level of knowledge about vitamin D deficiency. About forty-three percent (42.5%) were already diagnosed with vitamin D deficiency. 97.9% think that sunshine is an important source of vitamin D, while 92.6% are aware that healthy sun exposure depends on factors like time of the day, exposure duration, direct exposure and the necessity of exposing specific body parts to produce optimally vitamin D in the body. Still, the majority of the students (89.5%) spent most of their time indoors. Conclusion: Although AU pharmacy and dental students have sufficient knowledge about VDD, many are diagnosed with vitamin D deficiency or complain about its symptoms. Students have to implement strategies for the prevention or treatment of VDD. Students need to be encouraged to transfer classroom knowledge more efficiently to practice.

Keywords: Vitamin D synthesis, Female students, Health status, Knowledge, Vitamin D deficiency, UAE.

INTRODUCTION

Vitamin D deficiency (VDD) is a worldwide problem affecting over 1 billion people and may contribute to morbidity, mortality and increase expenses through the implicated chronic illnesses[1,2]. Socio-economic and environmental factors lead to a higher prevalence of VDD in women compared to men[2,3]. Additionally, under- or malnutrition caused by poor diet and a sedentary lifestyle lead to rising obesity rates causing chronic and degenerative diseases[3,4]. The lack of vitamin D in the diet together with inadequate sensible sun exposure, as well as inability to absorb vitamin D from the intestines or to process it because of kidney or liver diseases are also main causes of VDD[5].

25-Hydroxyvitamin D [25(OH)D] is the biomarker of the serum vitamin D status. It is derived from cutaneous synthesis through sun exposure of the skin (vitamin D_3) and dietary intake (mostly vitamin D_2)[1,3]. 7-dehydrocholesterol in the skin absorbs UVB radiation, is converted to previtamin D_3 during sun exposure and then isomerizes into vitamin D_3[3]. Vitamin D_3 (cholecalciferol) and vitamin D_2 (ergocalciferol) are precursors of the hormonally active vitamin D (calcitriol)[5]. The vitamin D_3 precursor is first transported to the liver, enters the blood circulation and the vitamin D binding protein (VDBP) and is converted into 25-hydroxyvitamin D [25(OH)D][5]. The other conversion happens in the kidneys, where the biologically active hormone calcitriol 1,25-dihydroxy vitamin D_3 ([1,25(OH)D]) is formed[5].

There is an insufficient knowledge among young populations with a high prevalence of VDD despite living in sunny areas like UAE, Saudi Arabia, and India[6-10].

Outdoor physical activity is positively related to endogenous vitamin D synthesis and leads to optimal serum vitamin D levels, while inactive, sedentary lifestyle indoors is strongly correlated to VDD[2,3,5]. At the same time, climatic conditions like temperature and season are directly linked to outdoor activities. High temperatures with harsh weather conditions, urbanization and negative attitudes towards sun exposure result mostly in indoor dwelling and sun avoidance behaviors including different patterns of clothing in countries with low latitudes[3,11]. Sun-avoidance behavior due to concerns of skin aging and darkening or development of skin cancer increased the use of sunscreens and limitation of time spent outdoors in the sun[3,11]. Sunscreens filter 95% of the UV-B radiation, which is needed for the endogenous vitamin D synthesis[5]. Moreover, women living in urban areas have a higher prevalence of VDD compared to those living in rural settings[12]. A study conducted in Malaysia investigated the effect of sun exposure rates on serum 25(OH) vitamin D concentration in rural and urban women in Malaysia[12]. The study concluded, that rural women spent more time working outside and have higher sun exposure rates with higher serum 25(OH) vitamin D concentration than urban women, who mostly remain working indoors[12]. Additionally, rural women expose due to religious and cultural practices less body surface area, while urban women have more body surface area exposed and still show

prevalence in hypovitaminosis D[3]. As a conclusion, clothing style remains a minor factor in the development of VDD compared to the major issues of socio-economic status and the sedentary lifestyle of women[3].

The modern lifestyle with increased time spent indoors on work and entertainment for almost all age groups has shown a significant negative impact on cutaneous vitamin D synthesis and overall health[3]. The Tromsø study has shown an inverse relationship between physical activity and body mineral density with screen-based inactive lifestyle, as well as a positively related correlation between screen time and BMI (body mass index)[13]. While university students are required to spend time on studying, they increasingly spend most of their time on screen-based entertainment activities leading to the indoor dwelling and sedentary lifestyle[13]. Additionally, insufficient knowledge about dietary sources of vitamin D and unhealthy eating habits result in under- and malnutrition increasing the prevalence of VDD[14-16]. Here, unhealthy eating habits of students are a result of their socio-economic circumstances. Lack of time, living in a hostel, skipping important meals like breakfast and lunch, irregular meal timings and unhealthy food choices like snacks and fast food, known to lead to major mal- or undernutrition problems[14-16].

Additionally, there is a correlation between important biological factors like ethnicity, skin pigmentation, BMI and medical conditions on the [25(OH)D] status, which are still not completely resolved and depend on each individual case[3].

As a result, in general, insufficient knowledge about vitamin D, environmental, biological and socio-economic factors resulting in sun-avoidance behavior, sedentary indoor lifestyle, increased screen-based activities resulting in less outdoor physical activity are the main reasons of VDD in general[3].

This study has been conducted to investigate the knowledge about vitamin D deficiency, the socio-demographic background and the health status of young female university students in AU. Moreover, this study tried to determine the factors affecting their knowledge scores.

MATERIALS AND METHODS

A descriptive quantitative survey was carried out in Ajman University (AU), UAE for exploring and collecting data from female medical university students. Convenience sampling was used as a sampling method. A structured questionnaire was designed by the researchers based on parameters to be evaluated as part of the study and by referring to previous literature.

A total number of 390 female students from Pharmacy and Dentistry College were enrolled in the current study. Data collection was done from October 2015 to February 2016. The inclusion criteria were: female pharmacy or dentistry students of Ajman University (AU) between the first to the fifth year of study and willing to participate in the study. Students who were not willing to participate and non-medical students were excluded from the study.

The questionnaire is composed of three different sections. Section one contains questions related to the population's demographic characteristics. Section two assesses the health status of the participants. Section three explores the respondent's knowledge about vitamin D deficiency. The study was approved by the AU research ethical committee (No. UG 2018.1.4.) to allow the researcher to distribute and collect the questionnaires among AU students.

The survey tool was reviewed by university lecturers and academics with a wide range of professional experience to establish content validity of the questionnaire. Participants were informed that participation is completely voluntary. Feedback given by the pilot study population was considered and corrections were made accordingly. Questions adjustments were made to the questionnaire to improve its validity. Participants who were willing to be enrolled in this study were asked to sign informed consent forms. The developed questionnaire was designed to be interview-administrated. The interviewer intervened only to clarify a question if required. No attempt was made to prompt the respondents by suggesting answers directly.

Data analysis was conducted using SPSS version 24. Instituting identification numbers were given for all questionnaires. All questions were coded and then they were imported to SPSS for analysis. The cited objectives were also analyzed by descriptive analysis. The descriptive statistics included mean, median, standard deviation and frequency. For the knowledge items, the coding was established by giving 1 mark for the correct answers and zero for both the wrong answers and don't know choice. High knowledge level considered for score values above the mean/median score and low knowledge level was considered for score values below the mean/median score.

Results were presented as tables including numbers with percentages. Graphs were used for presenting categorical variables. A correlation analysis was performed to test association and to determine which factors might affect the knowledge score. Chi-square test was done to compare the mean of the different participants health status group with VDD. A p value of less than 0.05 was considered significant.

RESULTS

Socio-demographic Data of the Respondents

The socio-demographic background of the study participants is listed in table 1. A total number of 390 female medical students studying Pharmacy (194) and Dentistry (169) were enrolled in the study. The majority of the participants were in their 1st - 2nd-year study (63.3%). The majority of the female AU students have white skin color (70.3%), while 79.2% are covering themselves according to Islamic religious belief. Most of the students are residing in a flat (78.2%), while the rest is living in villas with a private garden (21.8%).

Health Status of the Participants

42.3% of the respondents were already diagnosed with vitamin D deficiency (Table 2). 37.2% did the test of vitamin D while being a university student. Only 23.6% of the participants were physically active outdoors in the sun, while the majority (76.2%) are not active. Half of the participants do not know if they are suffering from VDD, although 60% of the students feel often tired and 40.8% complain from having pain or weakness in muscles and bones. Most of the students in AU are healthy, not complaining otherwise from chronic illnesses (80.5%), having no gastrointestinal problems (87.4%), nor any serious other chronic illnesses except asthma (7.2%). Only 0.8% reported suffering from chronic liver disease and osteoporosis.

Table 3 shows the distribution of reporting pain and/or having VDD diagnosis with spending time in- or outdoors. The majority of students, which are spending most of their time indoors are complaining about feeling tired (61.8%), having pain (42.2%) and are diagnosed with vitamin D deficiency (36.8%). There was a statistically significant difference between the participants daily

activity (indoor /outdoor) and feeling tired (p=0.026) and diagnosis with VDD (p=0.002). While no statistically significant difference between indoor/outdoor activity and having pain in muscles.

Table 4 shows the participants distribution related to skin pigmentation and reporting pain, tiredness and being diagnosed with VDD. Thirty-five percent (35.3%) of students have white skin color and are diagnosed with vitamin D deficiency while 38 students (32.8%) with non-white skin are diagnosed with vitamin D deficiency. There was no statistically significant difference between skin color and feeling tired, having pain in bone and muscles and Diagnosis with VDD (p=0.002).

Students, who were diagnosed with VDD felt weakness in their bones and muscles (60.7%) more than students who were not diagnosed with vitamin D deficiency (Table 5). There was a statistically significant difference between participants diagnosed with VDD and the following: Doing vitamin D test (p=0.00), feeling pain (p=0.004) and felling weakness in bones and muscles (p=0.003).

Participants Knowledge About Vitamin D Deficiency

Knowledge scores ranged from the lowest score of zero (1.3%) to the highest score of seven (26.40%) (Fig.1). Mean (SD) of the knowledge score was 5.61(1.313). 95.1% (371) had a good knowledge score while 4.9% (19) had insufficient knowledge score about vitamin D (Fig. 2). The details of the responses of the participants related to knowledge questions are listed in table 6.
The majority of students have excellent knowledge about vitamin D and health problems related to VDD (table 6). More than 89% know that vitamin D is essential for normal physiological functions and that VDD will cause tiredness, low mood, as well as muscle and bone pain (musculoskeletal problems). 67.7% think, that VDD is related to other diseases like cardiovascular, diabetes, depression, hypocholesterolemia, cancer, osteoporosis and multiple sclerosis. Again, the majority of students (80.5%) are aware of supplementation and the dietary sources of vitamin D (oily fish, cod-liver oil, eggs and milk). A vast majority of students acknowledge that sunshine is an important source of vitamin D (97.9%). From these, 92.6 % are aware, that healthy sun exposure depends on factors like time of the day, exposure duration, direct exposure and the necessity of exposing specific body parts to produce optimally vitamin D in the body.

Factors Affecting Knowledge Score

The relationship between knowledge about VDD, being diagnosed with vitamin D deficiency, having done vitamin D test and engaging in outdoor activities were investigated using Pearson product-moment correlation coefficient (r). Preliminary analysis was performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity. There was a significant correlation between the knowledge and the three variables: Vitamin D test (p=0.001) (r= 0.164), Vitamin D deficiency (p=0.048) (r= - 1.00), outdoor activities (p=0.015) (r= 0.123).

DISCUSSION

University students are in serious need of adopting a healthy lifestyle to maintain positive health in their future. University students are likely to be involved in problematic eating behaviors[14]. The current study was conducted among medical students to assess their knowledge about vitamin D. Various studies confirmed the health benefits of vitamin D[17]. Being in the future a member of health care providers puts them in a critical need to develop healthy dietary habits themselves.

In the current study, most of the participants had excellent knowledge about vitamin D (95.10%). The results are consistent with other study results[17,18]. In those studies the enrolled samples were medical students, this could explain their good level of knowledge about vitamin D[17,18].

The current study results revealed that 28.7 % of the participants suffered from vitamin D deficiency. In addition, 37.2 % did the test for vitamin D as university students. The current study was not designed to measure vitamin D serum levels and relies like in many other studies on the questionnaire tool to predict vitamin D deficiency[14,19,20]. A previous study conducted in UAE reported 90.5% of vitamin D deficiency in their participants[21]. All these findings emphasize the need for urgent national intervention to lower the incidence of vitamin D deficiency.

The majority of the students were aware of the fact that sunlight is one of the main sources of vitamin D (97.9%). These findings are comparable with other studies[14,18]. Despite the awareness of the study participants about the role of sunlight in endogenous vitamin D synthesis, only 10.5% of the participants reported outdoor activities in their daily life. Although they are living in the sunny region on the shore of the Arabian Sea, which guarantees optimal circumstances to healthy sun exposure, as well as access to fresh fish that is necessary for exogenous vitamin D synthesis, still there is a high prevalence of VDD. The reason behind the low exposure is sun-avoidance behavior due to concerns about the development of skin cancer, skin aging, darkening of the fair skin. This was also reported by another study performed in the UAE[8]. Sunscreens block the UV-B rays of the sun responsible for endogenous vitamin D synthesis in the skin[3,5,11]. A growing body of evidence supports the major role of sunlight (80-90%) in the endogenous synthesis of vitamin D and only a small amount can be obtained from dietary sources including fortified food (10-20%)[8,22].

92.6 % of the participants are aware, that healthy sun exposure depends on factors like time of the day, exposure duration, direct exposure and the necessity of exposing specific body parts to produce optimally vitamin D in the body (table 6). This proves, that the young, female AU students have the necessary information about vitamin D and its sources. They also know about the necessity of sensible, healthy sun exposure to ensure endogenous vitamin D synthesis, but they lack the practice.

Other than sunshine, some foods are an important source of vitamin D[14,22]. Eighty percent of the participants were aware of the type of foods rich in vitamin D. In comparison to a previous study in Saudi Arabia only minor percent of the participants identifies accurately food as a source for vitamin D[22].

A high percentage of the participants (89.5%) correctly identifies the symptoms associated with vitamin D deficiency. Musculoskeletal pain and weakness were the most common symptoms reported by patients in a study conducted in UAE to assess the prevalence of hypovitaminosis D[21].

Many studies reported about the association between VDD and other diseases like chronic disease and physical impairments[22]. In our study 67.7% of the participants knew about the association between vitamin D deficiency and other diseases (table 6), while in previous studies the awareness was less [22].

Table 1: Socio-demographic data of the participants

Variables	Sub-variables	N (%)
Specialization	Pharmacy Dentistry	194(49.7%) 169(50.3%)
Study Year	1st- 2nd year 3rd -4th year 5th year	246(63.3%) 119(30.5%) 24(6.2%)
Skin Color	White Non-white	274(70.3%) 116(29.7%)
Covering by religious belief (Hijab)	Yes No	309(79.2%) 81(20.8%)
Live in	Flat/ hostel Villa with garden	305(78.2%) 85(21.8%)

Table 2: Health status of the participants

Q.S	Sub-variables	N (%)
Do you have pain or weakness in muscles and bones?	Yes No	159(40.8%) 231(59.2%)
Are you often feeling tired?	Yes No	234(60%) 156(40%)
Do you have chronic gastrointestinal problems?	Yes No	49(12.6%) 341(87.4%)
Do you have any other chronic illnesses?	Yes No	76(19.5%) 314(80.5%)
What are your chronic illnesses?	Osteoporosis Asthma *Chronic kidney disease* Other	3(0.8%) 28(7.2%) 3(0.8%) 38(9.7%)
Did you do any vitamin D test any time as a university student?	Yes No	145(37.2%) 245(62.8%)
Are you diagnosed with vitamin D deficiency?	Yes No	165(42.3%) 225(57.7%)
Are you overweight?	Yes No	130(33.3%) 260(66.7%)
Where do you spend most of your time during the day?	Indoors Outdoors	349(89.5%) 41(10.5%)
Are you physically active/ doing sports outdoors in the sun	Yes No	92(23.6%) 298(76.4%)
Are you complaining of vitamin D deficiency symptoms?	Yes No Don't know	112(28.7%) 83(21.3%) 195(50%)

Table 3: Distribution of participants' daily activity with symptoms of reporting pain and feeling tired

Symptoms	Indoor (348)	Outdoor (41)	*P* (Chi-Square test)
Having pain	147 (42.2%)	12 (29.3%)	0.113
Feeling tired	215 (61.8%)	18 (43.9%)	0.026*
Diagnosed with vitamin D deficiency	128 (36.8%)	7 (17.1%)	0.002*

*Significant *p* value

Table 4: Distribution of participants' skin color with reporting pain, tiredness and VDD diagnosis

Skin color	White (272)	Non-white (116)	*P* (Chi-Square test)
Having pain	112 (41.2%)	47 (40.5%)	0.948
Feeling tired	167 (61.4%)	66 (56.9%)	0.417
Diagnosed with vitamin D deficiency	96 (35.3%)	38 (32.8%)	0.113

Table 5: Participants distribution of complaining symptoms with the diagnosis of VDD

Complain symptoms	Vitamin D deficiency	No vitamin D deficiency	*P (Chi-Square test)*
Did the test before	9(32%)	19(67.9%)	0.000*
Feeling pain	14(50%)	14(50%)	0.004*
Feeling weakness in bones and muscles	17(60.7%)	11(39.3%)	0.003*

*Significant *p*-value

Table 6: Knowledge related questions

Q.S	Yes	No
Do you know that vitamin D is essential for normal physiological functions?	348(89.2%)	42(10.8%)
Do you think that vitamin D deficiency causes tiredness, low mood, as well as muscle and bone pain (musculoskeletal problems)?	349(89.5%)	41(10.5%)
Do you think that vitamin D deficiency may be related to other diseases like cardiovascular, diabetes, depression, hypocholesterolemia, cancer, osteoporosis and multiple sclerosis?	246(67.7%)	126(32.3%)
Do you think that we can get vitamin D as supplements and nutrients like oily fish, cod-liver oil, eggs, and milk?	314(80.5%)	76(19.5%)
Are you aware that supplemental vitamin D3 is better absorbed in the body than vitamin D2?	170(43.6%)	220(56.4%)
Do you think that sunshine is an important source of vitamin D?	382(97.9%)	8(2.1%)
Are you aware that healthy sun exposure depends on factors like time of the day, exposure duration, direct exposure and the necessity of exposing specific body parts to produce optimally vitamin D in your body?	361(92.6%)	29(7.4%)

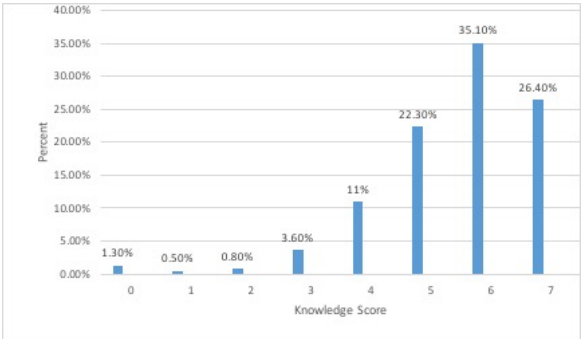

Figure 1: Distribution of knowledge scores among participants

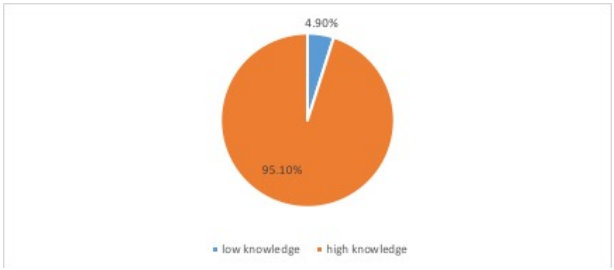

Figure 2: Knowledge prevalence among participants

The study results revealed that VDD is not due to an inability to absorb vitamin D from the intestines or to process it because of kidney or liver diseases through chronic liver disease (table 2). Most of the students in AU are healthy, not complaining otherwise from chronic illnesses (80.5%), having no gastrointestinal problems (87.4%), nor any serious other chronic illnesses except Asthma (7.2%). Only 0.8% reported suffering from chronic liver disease and osteoporosis. The VDD in female, healthy AU students is due to an inactive, indoor lifestyle with mostly screen based studies and entertainment (table 2).

The current study found a positive association between the knowledge score and doing vitamin D test (p=0.001) and having outdoor activities (p=0.015). That means participants who did the vitamin D test and have more outdoor activities were with high knowledge level than those who didn't do the test and stay indoors. Moreover, a negative association was revealed in this study between the knowledge score and having vitamin D deficiency (p=0.048). Students with VDD had also low knowledge score about vitamin D.

CONCLUSION

The findings of the present study suggest that the majority of the students had a good knowledge about vitamin D. This was also proven in a recent study in Ajman University investigating the knowledge of students regarding dietary supplementation and micronutrients[23]. In our study, the pharmacy students were having higher knowledge scores compared to dentistry students. Thus, a concentrated collaboration is needed to maintain such a high level of knowledge and to promote the practice of a healthy lifestyle. Educating students about VDD is very important to avoid risks and increase benefits.

Most of our students have a sedentary lifestyle, which is marked by physical inactivity and mostly indoor dwelling, also due to screen-based study or entertainment. The results highlighted the need to engage more in outdoor activities. Still, prolonged and unprotected sun exposure increases skin cancer risk[24]. Additionally, prolonged exposure initiates the photo-degradation of previtamin D_3 by UV-A back to 7-dehydrocholesterol and other photoproducts[5]. In general, indoor dwelling in correlation to limited or no physical activity in- or outdoors, especially in urban women in the child-bearing age leads to hypovitaminosis D, obesity and increased BMI inversely associated to optimum levels of serum 25(OH)D status[3,13,25].

This general problem needs to be addressed through media campaigns and the guidance of health professionals. The goals should be the prevention and treatment of VDD through a tailored approach, which includes socio-economic background, biological and environmental factors of the region. In addition, implementing workshops and training at the university level may help in achieving the right approach toward sunlight exposure, dietary sources, and supplementation. Moreover, universities should include vitamin D test report of new students because many suffer from vitamin D deficiency without knowing.

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