

Article

Risk Factors of Vitamin D Insufficiency/Deficiency among a sample of Egyptian Females in Child Bearing Period

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Abstract: Background: Vitamin D plays an important role in the development of bone health and possibly non-communicable diseases. Arab countries had made their own national studies to assess serum vitamin D level among women, yet in Egypt there is no national survey done. The aim of the current study was to identify risk factors affecting vitamin D level among Egyptian females during the child-bearing period. **Subjects and methods:** A total of 100 healthy adult females in their childbearing period who were attending a Family Medicine Center were included in our study. The age of the included women ranged from 19 to 49 years old with a mean age of 34 (SD 8.47) years. The majority of participants had deficiency (43%) and insufficiency (13%) of vitamin D level. **Results:** Unemployed women were more likely to have vitamin D deficiency than employed women ($P < 0.05$). Participants who were exposed to sun > 30 minutes/day were more likely to have sufficient vitamin D level ($P < 0.05$). All participants who consume fish ≥ 3 times/week had sufficient vitamin D level. Therefore, there was a statistically significance association between a number of consuming fish/week and vitamin D3 level groups. Also, there was statistically significant association between number of consumed milk cups/day and vitamin D3 level groups. All participants who drink 2 cups of milk have sufficient vitamin D level. No statistically significance association was found between using multivitamins and vitamin D3 level groups. **Conclusion:** Unemployment, low fish consumption and infrequent sun exposure were significant risk factors for vitamin D deficiency. Future research on the role of multivitamins supplements in improving vitamin D nutrition is warranted.

Keywords: Vitamin D, Sun Exposure, Nutrition, Employment, Women, Egypt

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1. Introduction

Vitamin D is a steroid hormone modulating several molecular and cellular functions, especially in the musculoskeletal system, besides its extra-skeletal role on the immune system, metabolism, cardiovascular system diseases and cancer. In addition, its association with decreased mortality was evident [1].

Vitamin D deficiency is a common public-health problem. Deficiency is more common in women than men, and the childbearing period is known to represent a particularly high-risk situation [2]. High rates of poor vitamin D status are found among women during the childbearing period throughout the world [3].

Middle East and North Africa (MENA) region registers some of the highest rates of hypovitaminosis D worldwide with taking into consideration female gender, multi-parity,

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clothing style, season, socio-economic status and urban living are recognized predictors of hypovitaminosis D in adults [1].

Bodnar *et al.* [4] had stated that women during the childbearing period, with a body mass index (BMI) greater than 30 are at increased risk of vitamin D deficiency. More over severe vitamin D deficiency can occur in young women, due to some calcium loss during pregnancy through fetal demands and increased urinary calcium excretion, which increases with advancing pregnancy [5].

Several factors have been identified in women with vitamin D deficiency like the lack of exposure to sunlight, the culture, (e.g. wearing long garments), the skin pigmentation, along with a low vitamin D dietary intake, long lactation periods, the use of skin sun blockers, tobacco smoking and obesity. However, women at reproductive age are a group that can be susceptible at earlier age for vitamin D deficiency and its complications as increase the risk of osteopenia, osteoporosis, muscle weakness, osteomalacia and pathological fractures and can worsen other chronic conditions, such as the polycystic ovary syndrome; it is also a risk factor for cardiovascular diseases, metabolic syndrome, some types of cancers and some autoimmune diseases [6].

More over factors affecting serum vitamin D level includes age, sex, pubertal status, latitude, season, race, and ethnicity [7], dark skin or concealing clothing, which may lead to limited exposure even though living in tropical areas where sun-exposure is adequate, can cause vitamin D deficiency [8].

Vitamin D deficiency is defined as a 25(OH)D below 20 ng/ml (50 nmol/liter), and vitamin D insufficiency as a 25(OH)D of 21–29 ng/ml (525–725 nmol/liter) [9].

Most of studies worldwide used 25(OH)D to assess serum vitamin D level because 1,25-dihydroxyvitamin D {1,25(OH)₂D} can be normal, high, or low in vitamin D deficiency. So, the most commonly used and most sensitive index for assessing vitamin D status is 25-hydroxy vitamin D {25(OH)D}. El Rifai *et al.* [10] had stated that maternal vitamin D deficiency is a real problem in Egypt; this is generally related to high BMI, low fish consumption, low educational level, and limited skin exposure. So, this problem needs more investigations because also El-Sagheer *et al.* [7] stated that in Egypt, data on clinical and subclinical vitamin D deficiency status are scarce.

Despite the abundant sunlight in Saudi Arabia, 100% of participants of 465 young adult Saudi females aged 19 to 40 years old in a study carried out in one of the primary care units had hypovitaminosis D with serum 25(OH) D ≤ 50 nmol/L which should be considered a public health problem [11].

A large exploring study of vitamin D status in Arabian Gulf on 7942 participants shown 85.4% deficiency in vitamin D level among all age groups and in both sexes with mean level of 25(OH) D was ≤ 20 ng/mL [12].

Several studies have identified a surprisingly high prevalence of vitamin D deficiency in all age groups such as in Europe after 14 population study [13], United States, Canada and Australia [14]. In India, 48% of 98 mothers and 52% of 98 infants have 25(OH)D less than 25 nmol/L [15]. In China, 89% of 323 adolescent girls in Beijing have serum 25(OH)D <50 nmol/L [16]. In Hong Kong, hypovitaminosis D, defined by a 25(OH)D concentration <50 nmol/L, has also been shown in 90% of 441 women [17] and 60% of 504 Indonesian women [18].

Despite reported prevalence of vitamin D deficiency and insufficiency depend on the cut-off values used that vary between studies, an estimated 1 billion people worldwide have vitamin D deficiency or insufficiency or hypovitaminosis D [19].

The aim of the current study was to identify risk factors affecting vitamin D level among a sample of females during the child-bearing period attending a Family Medicine Center.

2. Subjects and Methods

Study Design and Setting: A cross-sectional study was carried out at a Family Medicine Center in Cairo, Egypt.

Study Population: 100 of Egyptian females in child-bearing period.

Females in childbearing period that fulfilled the following criteria were included in the study:

- Adult females with age ranging between 18 and 49 years old (childbearing period).
- Accept to participate in the study and sign the informed consent.

We excluded patients:

- With history of chronic illness including: renal impairment, diabetes mellitus, and primary hyperparathyroidism.
- Intake of any drug that interferes with bone mineral metabolism, such as glucocorticoids, anticonvulsants.
- Patients taking vitamin D supplement or stop it for a period less than 6 months.
- Presence of a diagnosed malignancy.
- Pregnant females.
- Lactating females.

Sample Size and Sampling method: The sample size was calculated using EPIDAT software version 4.1. Previous study of Nichols *et al.* [20] that was conducted in Jordan and showed that 95.7% of females had vitamin D insufficiency. We choose Jordan because it has similar socio-demographic and economic level as Egypt. Setting total of the population 1000, with confidence level (1α) 95%, precision 4%, and proportion 96%, the calculated sample was 90 females with taking into consideration 10% expected proportion of non-participants. Thus, the total needed sample size was determined to be 100 females. We then utilized a systematic random sample including every 5th woman to collect the required sample size. Thus, every working day we collected 6 women. The study was carried out at the Family Medicine Center 3 days a week every Saturday, Wednesday and Thursday to recruit women under inclusion and exclusion criteria of the study.

2.1. Study's Procedure and Data Collection

Interview Questionnaire: An interview questionnaire with 17 questions about Vitamin D Status in young adults developed. This questionnaire was previously published as a part of Wisconsin School of Medicine and Public Health (Madison, USA) Study (21). The questionnaire included data pertaining: Socio-demographic information: age, occupation, marital status, Hijab wearing. Parity history: Number of pregnancies and number of children. Sun exposure and use of sunscreen information: Dietary habits and using of vitamins. Presence of GIT chronic diseases.

Our questionnaire was formulated according to our objectives and was tested on 5 women. Pilot study was of help in formulating and structuring the questions in slang Arabic language.

Anthropometric measures: This part included weight, height, and body mass index (BMI).

Laboratory investigation: Serum vitamin D level: The serum 25 (OH) Vitamin D level was assessed by enzyme linked immunoassay using enzyme immunoassay test kits of ORGENTEC Diagnostika GmbH, Germany. A 5 ml of venous blood was collected from patients in one plane tube, the blood samples were left for clotting. All serum samples were centrifuged at 3500 rpm for 10 min after clotting. Then, the serum has been separated and divided into 2 tubes. Then, 100 ul of 25 OH Vit D calibrators, and 100 ul of standard as well, were added followed by the control samples, the 100 ul of the samples was added in the next wells. Then the plate was covered and incubated at room temp. for 30 min then the washing step (first washing) was done by using the diluted washing reagent (washing

concentrate has been included in kit) for 5 times by repeated aspiration and addition of the washing reagent. Then we added 100 ul of Enzyme conjugate reagent to each one then we incubated the plate for 15 min. at room temperature. Then the washing step (second washing) was done by using the diluted washing reagent (washing concentrate was included in kit) for 5 times by repeated aspiration and addition of the washing reagent. Then 100 ul of the TMB-substrate was added to all wells. Incubation was done in the dark for 15 min. Then 100 ul of the stopping solution was added to all wells. Then we read the absorbance value of each well including Calibrator wells using ELISA reader at 450 nm (reference 620 nm).

Interpretation of the results: Deficiency: <12 ng/ml (<30 nmol/l). Insufficiency: 12-20 ng/ml (30-50 nmol/l). Sufficiency: >20–150 ng/ml (>50-375 nmol/l).

Ethical Consideration: The present study runs in concordance with international ethical standards and applicable local regulatory guidelines. The study did not have any physical, psychological, social, legal, economic, or any other anticipated risks to study's participants. The study conserves participants' privacy. Investigators are responsible for keeping the security of the data. We also confirm that the participants' data were not used for any other purpose outside this study. Personal data (e.g. Name, Contact info) were not entered in our data entry software to conserve the participant's privacy; however, each subject got a unique identifier code.

Informed Consent Process and Institutional Review Board: Participants in the targeted Family Medicine center were informed about the study objectives, methodology, risk, and benefit. A written informed consent was obtained from every eligible woman prior to study's enrollment. The study's protocol was reviewed and approved by ethics committee department of Ain Shams University.

Statistical Analysis: An Excel spreadsheet was established for the entry of data. We used validation checks on numerical variables and option-based data entry method for categorical variables to reduce potential errors. The analyses were carried with SPSS software (Statistical Package for the Social Sciences, version 24, SSPS Inc, Chicago, IL, USA). The quantitative data were expressed as mean \pm standard deviation (SD) or median with inter quartile range (IQR) according to the normality of sample distribution. Qualitative data were expressed as frequencies or percentages. Test for quantitative data was ANOVA test according to the normality of sample distribution. We used Chi-square test to compare the differences in Qualitative data. A p-value ≤ 0.05 is considered statistically significant.

3. Results

Table 1 shows that the majority of participants are married, housewives and wearing Hijab. The mean BMI of participants indicates that obesity is prevailing. Majority of participants have 2 children or less and have also parity 2 or less.

Table 2 shows that women exposure to sun rays is variable ranging from less than 5 minutes to more than 30 minutes. Almost all participated women didn't use sun screen. Studied women were distributed according to vitamin D level so that. Almost all women didn't suffer from diarrhoea in the previous 2 weeks and those who revealed chronic GI condition suffered from IBD.

Table 3 shows that none of participants consumed >2 cups of milk/day. None of participants used Vitamin D, Calcium, Cod Liver Oil or Omega III.

Table 4 shows that the level of vitamin D didn't relate significantly to different women age, weight, height or BMI ($P > 0.05$).

Table 5 demonstrates that the majority of employed participants have sufficient vitamin D level with statistically significant association ($P < 0.05$). Marital status, Hijab wearing and parity of participated women didn't relate significantly with level of vitamin D ($P > 0.05$).

Table 1. Socio-Demographic Characteristics and anthropometric measures of Participated Females.

Anthropometric measures	Mean± SD	(Minimum – Maximum)
Height in cm	159.85±7.08	(140 – 177)
Weight in kg	83.32±18.97	(45 – 140.3)
BMI	32.48±6.57	(19.2 – 52.9)
Sociodemographic characteristic	Number	Percent
Marital status		
Unmarried	20	20%
Married	76	76%
Divorced	4	4%
Occupation		
House wife	61	61%
Employed	39	39%
Wearing Head Scarf		
No Scarf	9	9%
Hijab	82	82%
Niqab	9	9%
Parity		
2 or less	56	56%
3 and more	44	44%
N of children		
2 or less	60	60%
3 and more	40	40%

Table 2. Health life style and profile of Participated Females.

Health characteristic	Number	Percent
Daily sun exposure		
<5 minutes	24	24%
5-15 minutes	17	17%
16-30 minutes	22	22%
>30 minutes	37	37%
Sun screen usage		
No	94	94%
Yes	6	6%
Vitamin D Level		
Deficiency (<12 ng/ml)	43	43%
Insufficiency (12-20 ng/ml)	13	13%
sufficiency (>20 – 150 ng/ml)	44	44%
Diarrhea during last 2 weeks		
No	96	96%
Yes	4	4%
Chronic GIT diseases		
No	90	90%
Yes	10	10%
Total	100	100%

Table 3. Dietary History and Vitamins use among participated women.

Consuming milk/day:	Number	Percent
No milk	42	42%
<1 cup	23	23%
1 cup	32	32%
2 cups	3	3%
Fish consumption /week:		
No or rare	53	53%
1-2 times	40	40%
≥3 times	7	7%
Using Multivitamins:		
Not using multivitamins	98	98%
1 tablet/day	2	2%

Table 4. Association between Vitamin D3 Level and Age and anthropometric measures in participating women.

Variable	Mean ± SD	(Minimum - Maximum)	ANOVA	P value
Age in years				
Deficiency	34.16±8.644	(19-49)	1.531	>0.05
Insufficiency	30.77±8.033	(20-43)		
Sufficiency	34.8±8.377	(19-49)		
Height in cm:				
Deficiency	158.44±7.598	(140-171)	1.735	>0.05
Insufficiency	159.77±5.036	(147-168)		
Sufficiency	161.25±6.932	(145-177)		
Weight in kg:				
Deficiency	82.412±20.153	(45-140.3)	0.575	>0.05
Insufficiency	88.592±19.2238	(65-133.8)		
Sufficiency	82.639±17.8685	(45-132.1)		
BMI:				
Deficiency	32.693±7.0731	(19.8-48)	1.066	>0.05
Insufficiency	34.608±6.961	(24.8-52.9)		
Sufficiency	31.641±5.8941	(19.2-46.8)		

Table 5. Association between level of vitamin D and socio-demographic characteristics of participated females.

Sociodemographic characteristic	Vitamin D Level			Total N (%)	P value
	Deficiency <12 ng/ml	Insufficiency 12-20 ng/ml	Sufficiency >20-150 ng/ml		
Marital status					
Unmarried	10 (50%)	3 (15%)	7 (35%)	20 (20%)	>0.05
Married	31 (40.8%)	10 (13.2%)	35 (46.1%)	76 (76%)	
Divorced	2 (50%)	0 (0%)	2 (50%)	4 (4%)	
Wearing Hijab					
No Hijab	1 (11.1%)	2 (22.2%)	6 (66.7%)	9 (9%)	>0.05
Hijab	36 (43.9%)	10 (12.2%)	36 (43.9%)	82 (82%)	
Niqab	6 (66.7%)	1 (11.1%)	2 (22.2%)	9 (9%)	
N of children					
2 or less	24 (40%)	9 (15%)	27 (45%)	60 (60%)	>0.05

3 and more	19 (47.5%)	4 (10%)	17 (42.5%)	40 (40%)	
Occupation					
Unemployed	38 (62.3%)	8 (13.1%)	15 (24.6%)	61 (61%)	<0.05
Employed	5 (12.8%)	5 (12.8%)	29 (74.4%)	39 (39%)	

Table 6 demonstrates that those participants who have been exposed to sun >30 minutes/day have sufficient vitamin D level. A statistically significant association was observed between duration of sun exposure and vitamin D3 level groups ($P < 0.05$). The minority of participants are using sun screen with no statistically significant association observed in relation to vitamin D3 level groups ($P > 0.05$). All participants who drink 2 cups of milk have sufficient vitamin D level with statistically significant association between number of consumed milk cups/day and vitamin D3 level groups ($P < 0.05$). Regarding consumption of fish, all participants who consume fish ≥ 3 times /week have sufficient vitamin D level. Therefore, there is a statistically significant association between number of consuming fish/week and vitamin D3 level groups. ($P < 0.05$). The minority of participants are using multi vitamins. No statistically significant association was observed between using multi vitamins and vitamin D3 level groups ($P > 0.05$).

Table 6. Association between life style and dietary profile in participating women and level of vitamin D in blood.

Life style and dietary profile	Vitamin D Level			Total N (%)	P value
	Deficiency <12 ng/ml	Insufficiency 12-20 ng/ml	Sufficiency >20-150 ng/ml		
Duration of Sun Exposure					
<5 minutes	19 (79.2%)	3 (12.5%)	2 (8.3%)	24 (24%)	<0.05
5-15 minutes	8 (47.1%)	3 (17.6%)	6 (35.3%)	17 (17%)	
16-30 minutes	5 (22.7%)	2 (9.1%)	15 (68.2%)	22 (22%)	
>30 minutes	11 (29.7%)	5 (13.5%)	21 (56.8%)	37(37%)	
Sun screen use					
No	42 (44.7%)	12 (12.8%)	40 (42.6%)	94 (94%)	>0.05
Yes	1 (16.7%)	1 (16.7%)	4 (66.7%)	6 (6%)	
Daily milk consumption					
None	18 (42.9%)	9 (21.4%)	15 (35.7%)	42 (42%)	<0.05
1 cup	18 (56.3%)	2 (6.3%)	12 (37.5%)	32 (32%)	
2 cups	0 (0%)	0 (0%)	3 (100%)	3 (3%)	
Fish consumption/W					
None	31 (58.5%)	9 (17%)	13 (24.5%)	53 (53%)	<0.05
1 – 2 Times	12 (30%)	4 (10%)	24 (60%)	40 (40%)	
≥ 3 Times	0 (0%)	0 (0%)	7 (100%)	7 (7%)	
Vitamin intake					
None	43 (43.9%)	12 (12.2%)	43 (43.9%)	98 (98%)	>0.05
Intake	0 (0%)	1 (50%)	1 (50%)	2 (2%)	

Table 7 shows no statistically significant association between Chronic GIT Disease and vitamin D3 level groups ($P > 0.05$). It also shows a minority of participants that have diarrhoea during the previous two weeks prior to the study with no statistically significant association between diarrhoea and vitamin D3 level groups ($P > 0.05$).

Table 7. Association between health condition and vitamin D level among participated women.

Health condition	Vitamin D Level			Total N (%)	P value
	Deficiency <12 ng/ml	Insufficiency 12-20 ng/ml	Sufficiency >20-150 ng/ml		
Chronic GIT disease					
None	38 (42.2%)	11 (12.2%)	41 (45.6%)	90 (90%)	>0.05
IBD	5 (50%)	2 (20%)	3 (30%)	10 (10%)	
Diarrhea in last 2 weeks					
Absent	42 (43.8%)	12 (12.5%)	42 (43.8%)	96 (96%)	>0.05
Present	1 (25%)	1 (25%)	2 (50%)	4 (4%)	

4. Discussion

Nutritional status is an indication of the overall well-being of a population. Adequate nutritional status of women is important for good health and increased work capacity of women themselves, as well as for the health of their offspring. Women in child-bearing age are at one of the most nutritionally-vulnerable stages of their life cycle. The current body of evidence shows that many women do not get enough micronutrients in their diets during their reproductive age as well as during pregnancy. They are also unaware of how much their nutritional status impacts their pregnancy and infant outcomes [22].

In the past few years, a growing interest in vitamin D status among females in the childbearing period has been observed. For women of childbearing age, maternal vitamin D malnutrition imposes multiple health impacts including adverse obstetric and neonatal outcomes [23]. Nevertheless, there are limited data regarding the vitamin D status among non-pregnant females in their childbearing period, especially in the Middle East and North Africa (MENA) region which has some of the highest rates of hypovitaminosis D worldwide [1].

The main aim of the present study was to identify the risk factors affecting vitamin D level among a sample of Egyptian females during the child-bearing period.

In the present study, we included 100 healthy adult females in their child bearing period who were attending a Family Medicine Center. The recent epidemiological studies have demonstrated that an insufficiency of vitamin D (<72.5 nmol/L; <30 ng/ml), affects almost 50% of the population worldwide, while 1 billion people show vitamin D deficiency (<25 nmol/L; <10 ng/ml), as per the cutoffs established by the Endocrine Society Clinical Practice Guidelines [24]. Moreover, reports of hypovitaminosis D in MENA region showed proportions varying for the most part between 30–90% [1].

In line with these global and regional figures, our study showed that the majority of participants have deficiency and insufficiency of vitamin D level; 43% of the included women had vitamin D deficiency and 13% of the women had vitamin D insufficiency.

In concordance with our results, Meddeb and colleagues [25] conducted a cross-sectional study to estimate the status of serum vitamin D in Tunisia. A total of 389 non-pregnant women aged 20-60 years were included in the study. The accumulated prevalence of hypovitaminosis D was reported to be 47.6%.

Similarly, Nichols and colleagues [20] investigated serum vitamin D3 status and factors associated with a deficiency in a nationally representative survey of 2013 Jordanian non-pregnant women of reproductive age in spring 2010. The results showed that 60.3% of the women had vitamin D deficiency (<12 ng/ml). Moreover, in healthy Jordanians women aged 18-45, serum 25-vitamin D levels <30 nmol/l were reported in 62% in summer and 50% in winter [26]. Another study in Lebanese adults also reported levels of <25 nmol/l in 60% of 465 women aged 20-59 years in summer [27].

While similar results regarding the pregnant group were reported in a recently published study conducted on 135 pregnant Egyptians; the prevalence of deficiency and insufficiency among this sample was 40% and 28.9% respectively [10].

In our study, the prevalence of vitamin D deficiency was notably lower than that was reported from previous studies conducted in Egypt or other MENA countries.

Botros and colleagues [28] performed a cross-sectional study on 404 Egyptian females to study vitamin D status in Egyptian females of different age groups. Among the childbearing age group, the prevalence of vitamin D deficiency was found to be 72%.

Similarly, Al-Mogbel [11] carried a cross-sectional study on a total of 465 young, non-pregnant, Saudi females aged 19 to 40 years attending primary healthcare centers. Overall, hypovitaminosis D was identified in all participants and 79.1% exhibited severe vitamin D deficiency; while 20.9% exhibited vitamin D insufficiency.

The exact causes of such a higher prevalence of vitamin D deficiency in the above mentioned studies compared to our results are unclear. However, they can be attributed to the use of different cut-off values to determine vitamin D status, different population characteristics, or different sample size.

In the present study, we sought to identify the factors affecting vitamin D level among studied females. The analysis showed that there was a statistically significant association between the employment status of the included women and vitamin D3 level groups; unemployed women were more likely to have vitamin D deficiency than employed women.

The current body of evidence shows that employment status is a major determinant vitamin D levels [29]. In concordance with our findings, Al-Mogbel [11] found that housewives were more likely to have vitamin insufficiency compared to working participants.

Additionally, Junaid and Colleagues [23] conducted a cross-sectional study among 205 healthy women, in their childbearing period, living in Lahore, Pakistan. The results showed a statistically significant lower prevalence of vitamin D deficiency in employed women compared to unemployed women.

Our findings can be explained with different reasons. Firstly, employed women are more likely to expose to an adequate level of sunlight more than unemployed women. Zhao and colleagues (2012) [30] performed a cross-sectional study on 1,814 female participants to examine the prevalence and correlates of vitamin D deficiency and inadequacy among US women of childbearing age. The author reported that potential sunlight exposure during May-October was associated with decreased risks for both vitamin D deficiency and inadequacy. Secondly, employed women are more likely to have a higher educational level than unemployed women. In 2015, Junaid and colleagues [23] reported that the risk of vitamin D deficiency was independently associated with illiteracy. Thirdly, unemployment is a form of downward social mobility [31]. Fourthly, unemployed people have to bear unusually high levels of allostatic load/stress, especially after the initial shock of being fired [32]. Finally, unemployed people also suffer from a massive reduction in their social capital, which indirectly affects their overall health [33].

Vitamin D is unique because it can be made in the skin from exposure to sunlight. The major source of vitamin D for children and adults is exposure to natural sunlight. Thus, the major cause of vitamin D deficiency is inadequate exposure to sunlight [34]. In the present study, a statistically significant association was observed between the duration of sun exposure and vitamin D3 level groups. Participants who were exposed to sun >30 minutes/day were more likely to have sufficient vitamin D level.

In terms of dietary habits, it is well known that fish is the major natural source of vitamin D in the diet. Fish consumption was shown to have a beneficial effect on vitamin D levels and consequently on cardiovascular morbidity and mortality [35].

The results of the present study demonstrated that all participants who consume fish ≥ 3 times/week have sufficient vitamin D level. Therefore, there was a statistically

significant association between a number of consuming fish/week and vitamin D3 level groups.

In agreement with our findings, Lehmann and colleagues (2015) [36] performed a meta-analysis to investigate the influence of fish consumption on serum vitamin D concentrations. Seven articles and 2 unpublished study data sets with 640 subjects met the inclusion criteria and were included in that meta-analysis. The results showed that the consumption of fish significantly increased vitamin D concentrations on average by 4.4 nmol/L. The type of the fish also played a key role: the consumption of fatty fish resulted in a mean difference of 6.8 nmol/L, whereas for lean fish the mean difference was 1.9 nmol/L.

Similarly, El Rifai and colleagues [10] found that maternal vitamin D levels showed a significant positive correlation with fish consumption ($r = 0.185$).

In contrary, Zhao and colleagues [30] found no significant association between high fish intake and adequate vitamin D levels in women of childbearing age. Again, the exact causes of such discrepancies between our findings and Zhao and colleagues [30] study are unclear. However, they can be attributed to the use of different cut-off values to determine vitamin D status, different population characteristics, or different sample size.

Consumption of milk and milk products is recommended by numerous international organizations, given its positive effects on bone health. Previously, it was suggested that milk contributes to important body stores of vitamin D needed for maintaining bone health [37]. The results of the present study showed that there was statistically significant association between number of consumed milk cups/day and vitamin D3 level groups. All participants who drink 2 cups of milk have sufficient vitamin D level.

In agreement with our findings, Al-Daghri and colleagues [38] investigated the vitamin D status and its association with consumption frequencies of milk in Saudi population. A total of 820 children and 565 adults were included. Modest associations were found between mean serum 25(OH)D concentration and fresh milk consumption in children and women.

Vitamin D and other vitamin supplements are commonly taken either individually or in combination by to maintain or improve skeletal and non-skeletal health [39]. However, their efficacy is questionable based on the findings of the present study; we found no statistically significant association between using multivitamins and vitamin D3 level groups. Half of the participants in our study who were using multivitamins had vitamin D insufficiency.

In line with our findings, Gharaibeh and Stoecker [40] assessed vitamin D status in women and their children aged 4-5 years in Northern Jordan during summer; A cross-sectional study in which 93 mother-child dyads volunteered through local community centers between June and July 2007. Only seven women reported taking supplements and their 25(OH)D concentration of 30.4 nmol/l was not significantly different from the 25.2 nmol/l for those women who were not taking multivitamin supplements. These results strongly recommend a future research on the role of multivitamins supplements in improving vitamin D nutrition. However and of no doubt, getting vitamin D levels from the sun is quite different from the supplementation route [41, 42].

5. Conclusion

Vitamin D deficiency and insufficiency is prevalent among Egyptian women in childbearing period participated in the study, 43% of the included women had vitamin D deficiency and 13% of the women had vitamin D insufficiency. The unemployment, low fish consumption, low milk consumption and infrequent sun exposure are significant risk factors for vitamin D deficiency ($P < 0.05$). Therefore, for improving the health and productivity of women in childbearing period, a routine monitoring system for vitamin D and the other factors should be put in place. Nevertheless, future research on the role

of multivitamins supplements and fish consumption in improving vitamin D nutrition is warranted.

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