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Full Length Research Paper

The Relationship between Serum Vitamin D and Depressive Side Effects in Female Workers in Food Manufacturing

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Abstract
Vitamin D play an important role in keeping the bodies adjusted of both phosphorus and calcium and also bone wellbeing. Lately, more attention was paid for the importance of vitamin D (Vit. D) on different systems and organs in the body. Recently, some studies revealed to the presence of a relation between the level of Vitamin D in the serum and occurrence of depressive cases. Be that as it may, there is right now a scarcity of research exploring the relationship concerning Vitamin D and depression among Korean peoples. This investigation was aimed to determine the status of Vitamin D and its relationship with depressive side effects in Egyptian female workers. This work was carried out from January to the end of April 2016; estimation was performed on 1054 female's subjects from some food processing factories, via using of questionnaire, anthropometric estimation. The blood samples were collected from selected persons for estimation of Vitamin D status. The mean level of Vitamin Din the serum was averaged 9.07±3.25 ng/mL, whereas, in many subjects the level of Vitamin D was found to be deficient (less than 10ng/ml) in about 721 of persons (68.4%). In Vitamin D deficient group by applying the odds ratio in females complaining from depression symptoms, it was found that CES-D score of 16 or above was reached 1.55 (95 % CI=1.15–2.07). In conclusion, about 68.4 % of females working in the field of food manufacturing were found to be complaining from depressive symptoms were deficient in Vitamin D (>10ng/ml) . Moreover, the results pointed to a relationship between the Vitamin D deficiency and appearance of depression among girls working in food industries. It is recommended to check routinely Vitamin D level in workers to control and manage the cases before the appearance or exaggeration of depression among workers.

Keywords: *Serum, Vitamin D, Side effects, Workers, Food Manufacturing.*

Introduction

Generally, exposure to the sun rays can activate vitamin D in the skin, which is responsible for adjustment of levels of calcium and phosphorus and in skeletal wellbeing [1]. New approaches found that Vitamin Dis important factor for proliferation of cells and in cell multiplication [2], regulate the function of immune system [3], and play a role as anti-carcinogenic agent [4]. Furthermore, it was found an association between Vitamin D deficiency and appearance hypertensive disorders [5], diabetes mellitus [6], fatness [7], mortality from cardiovascular diseases [8], In addition, the significance of vit. D is increased expanding consideration. As per the investigation on the predominance of serum vitamin D lack in Italy individuals, it was found that 28.3% of subjects at ten years old or above , their Vitamin D level was within the normal range either in boys (20 ng/mL or above), or in girls (34.2 and 22.4 %). [9]. Whereas, another investigation was carried out in United Kingdom, it revealed that 29.9% of ladies (50-60 years old) were within the normal value of Vitamin D(20ng/ml or more), while 8.4 of ladies aging 20-29 years old were within the normal range[10].

A great importance was paid for the estimation of vitamin D status among different ages and genders; in any case, the issue of serum vitamin D lack is obviously extreme, particularly in the more youthful female ages. Furthermore, in an investigation about the relationship between shift labor and the condense of minerals in the bone , the concentration of Vitamin Din the serum among shift workers recorded a lowering than observed during day laborers [11], which indicate to the deficiency of Vitamin Din the female subjects working in the factories .

The decrease in the level of Vitamin Din the serum may lead to appearance of depression symptoms which defined as mood confusion and appeared as loneliness, loss of motivation and feelings of unhappiness, [12]. The depression affecting peoples represent the 3rd most predominant issue between the ten driving supporters of the global burden diseases as estimated by WHO. [13]. The

commonness of depressive side effects, that is, sentiments of trouble or sadness that influenced every day exercises for at least two back to back a long time in the last year was averaged 10.3 % [14]. As indicated by the Epidemiological investigation the mental diseases particularly the depression , it was recorded that the incidence of real depression elevated from 4.0 % during 2001 and to reach to 5.6 % within 2006, and the prospects to continue in elevation in the future to reach up to 6.7 % at year 2011 [15]. Furthermore, sadness is considered the main reason for suicide around the world [16, 17]. According to the survey in the USA, carried by Organization for Economic Cooperation and Development (OECD) , recorded the suicidal rate was 28.5 /100,000 individual which considered the first top between the nations [18] in comparison with the survey done by OECD , which recorded the normal suicidal rate averaged 12.1/100,1000 person .[19].

An expanding existence predominance of actual depression issue might be a dormant issue as a contributing specialist for self-destructive practices, despondency is accounted for to have noteworthy relationships through increment of non-attendance in laborers, abatement of work fitness, reduction of efficiency, and increment of wellbeing consumptions [20], recommending that the condition of depression isn't just a psychological weight to human being, yet in addition an issue as far as the wellbeing administration of laborers and a financial weight. Since ladies particularly are known to have a 2-3-overlap more noteworthy likelihood of encountering gloom amid their life span than males [21], discouragement is a basic issue in the wellbeing administration of working girls.

A study was carried out in United Kingdom to investigate the relationship between Vitamin D status and rate of depression, the results revealed that there is a correlation between serum Vitamin D level and depression in cross sectional study [22], In the United States an investigation on the association between the depression and status of Vitamin Din individuals , indicated to the presence of negative correlation between depressive conditions and deficiency in Vitamin D concentration [23], other researchers discovered concentration of Vitamin D was related with episode discouragement, where Vitamin D play special role in the function of focal sensory system. In addition, Vitamin D has a strong relation with the appearance of mental diseases such as sadness [24]. Many reports points to the increase in the predominance drop in the level of Vitamin D among Egyptian girls [9], the fundamentally deficiency in Vitamin D levels in shift laborers contrasted with calibrating with the day of laborers [11], the expanding existence commonness of depression among peoples in Egypt [15], and the privileged helplessness to gloom in girls than guys are on the whole idle issues in the wellbeing administration of Egyptian female laborers. Moreover, few distributed examinations have explored the relationship between depression conditions and deficiency in Vitamin D supplementation among Egyptian individuals .

This investigation assessed the status of Vitamin D in the serum of subjects and to investigate the relationship between depression conditions and Vitamin D levels in Egyptian female's laborers.

Materials and methods

This study is a purposive cross-sectional investigation utilizing data from wellbeing examinations. Among female workers in food industries, the subjects of this investigation were 1646 female living in 10 of Ramadan city who experienced a wellbeing examination in the beginning of Jan.to the end of April 2016. Seven females with psychic history including depression, and 13 females who were separated or divorced after marriage were barred. After eliminating subjects lacking examination results and data, the total number of subjects was 1054 females. All participants in this study signed an informed consent form.

To determine the level of serum vitamin D, blood 25-hydroxyvitamin D (25(OH)D) samples were cryopreserved and measured by electrochemiluminescence immunoassay using the Modular E device. Blood 25-hydroxyvitamin D (25(OH)D) can represent a value by both supply routes activated in the skin through sun exposure and obtained by food [1]. The subjects were classified into the low group or high group relative to the standards of deficiency defined as 10 ng/mL in previous studies [25].

To assess the level of depression, the Arabic version of the Center for Epidemiologic Studies Depression Scale (CES-D), a self-report depression scale developed by the US National Institute of Mental Health was used. Since the CES-D is a commonly used tool to identify depressive symptoms in the general population, it is known to be a reliable tool in differentiating between people with and without depressive symptoms [26]. The tool has a total of 20 items and a maximum score of 60, and each item is scored on a scale from 0 to 3 according to the frequency of a given depressive symptom experienced during the past week, with a higher score, indicating a higher level of depression. The cut-off value is usually 16 and 25, with 16 being probable depression and 25 being definite depression [27]. In this study, the cut-off value of 16 was used to divide the subjects into a group with a score under 16 and a group with a score of 16 or above.

To assess socio demographic characteristics, the age, level of education, and body mass index (BMI) were investigated, and to assess lifestyle, smoking, and regular exercise were investigated. To assess occupational factors, whether the subject had shift work or not was determined. The subjects were divided by age into a group less than 30 years of age and a group 30 years of age and above, and they were also classified by marital status into a single group and a married group. Level of education was distinguished by those with a high school diploma or less and those with a college diploma or above. The subjects were classified by BMI into an underweight group with a BMI less than 18.5, a normal weight group with a BMI 18.5–24.9, and an obese group with a BMI above 24.9, using the criteria of the WHO for the Asia-Pacific region. The subjects were divided by smoking status into a current smoker group and a

nonsmoker and ex-smoker group. The subjects were divided into a group that exercised at least three times a week and a group that exercised less than three times a week regardless of the intensity. Finally, the subjects were divided into a shift work group if they had a night shift from 10 p.m. to the next morning at 6.a.m. at least four times per month on average or worked an average of at least 60 hours per month during the night shift.

To assess the serum vitamin D level in subjects, the independent samples t-test was used to determine the average serum vitamin D level according to the variables, while to determine the difference in distribution of serum vitamin D according to the variables, the chi square test was used. To investigate the influence of the variables associated with a significant difference in the distribution of the depressive symptom group, univariate logistic regression analysis was conducted, and after controlling for the variables with significant correlation, multivariate logistic regression analysis was conducted. We used IBM SPSS Statistics for Windows version 17 for statistical analysis, and the confidence interval was set at 95 %, and the statistical significance at P<0.05.

Results

As shown in table (1), the mean concentration of Vitamin Din all individuals in the group reached to 9.07±3.25 ng/mL. Whereas, in individuals deficient in Vitamin D (less than 10 ng/ml) the rate was 68.4% (n=721), which represent a greater percentage in comparison with subjects having normal levels of Vitamin D (31.6%, n=333)

Concerning the age of subjects , it is observed that in subjects under 30 years old, the level of Vitamin D was averaged 8.86±3.12 ng/ml , the percent of subjects their serum levels of Vitamin D was complain from deficiency (less than 10ng/ml) which represent about 71.2% (n=545). Whereas, it elevated in individuals aged 30 years or more the concentration of Vitamin D reached 9.61±3.54 ng/ml in 176 people which represent about 60.9% of this group. This revealed that the deficiency in Vitamin D was significantly higher (p=0.001) among subjects under 30 years of age.

Table 1. Vitamin D serum concentration according to variables

Variables	Vitamin D (ng/mL)	Vitamin D			p-value
		≥10 ng/mL		**<10 ng/mL**	
	Mean±S.D	**N %**		**N %**	
Total	9.07± 3.25	333 (31.6)		721 (68.4)	
Age (years)					
<30	8.86± 3.12	220 (28.8)		545 (71.2)	0.001
≥30	9.61± 3.54	113 (39.1)		176 (60.9)	
Shift wok					
Yes	8.89± 3.23	253 (29.0)		619 (71.0)	<0.001
No	9.94± 3.25	80 (44.0)		102 (56.0)	
Regular exercise (times per week)					
≥3	9.09± 4.12	47 (31.8)		101 (68.2)	
<3	9.06± 3.09	286 (31.6)		620 (68.4)	0.963
Smoking habit					
Current					
Never/former	8.81± 3.21	47 (25.7)	136 (74.3)	136 (74.3)	0.058
	9.12± 3.26	286 (32.8)	585 (67.2)	585 (67.2)	
Body Mass Index (kg/m2)					
<18.5	8.32± 2.94	34 (24.5)	105 (75.5)	105 (75.5)	0.125
18.5 – 24.9	9.15± 3.34	238 (32.6)	493 (67.4)	493 (67.4)	
>25	9.31± 3.07	61 (33.2)	123 (66.8)	123 (66.8)	

With respect to shift work, the mean level of Vitamin Din the serum was averaged 9.94±3.25 ng/mL in the day of worker group, whereas, it averaged 8.89±3.23 ng/mL during the shift of working group. The number of individuals suffering from deficiency in Vitamin D reached 102 subjects which represent about 56.0% in the group of day worker, while it counted 619 subjects which represent about 71.0% in the group of shift worker. The values indicated that the deficiency of Vitamin D was significantly higher (p<0.001) in persons during shift worker. As illustrated in table (1) a non-significant influence of smoking, body mass index and regular training on deficiency of Vitamin D among subjects.

The rate of depression in all individuals included in the investigation was averaged 13.8 by applying the CES-D depression scale score, whereas, the percentage of depressed individuals was averaged 33.9 when the depression scale score was 16 or more. The ages of subjects sharing in the research were ranged from 19-37 with an average 26.5 years old. In the present study it is observed that the depression affecting the younger ages (72.6%) was significantly (p=0.004) greater than that of 30 or above 30 years old. The study

pointed that the percentage of shift workers was 82.7% whose complain from depression symptoms and were significantly greater ($p<0.001$) that the day worker .It is surprising that the incidence rate (81.4%) of depression among single subjects was significantly greater ($p=0.004$) than that in marriage peoples. In addition, the depressive symptoms among high school education or less (67.6%) and it was highly significant ($p<0.001$) than that gaining college diploma of higher certificate.

Table 2. Distribution of depressive symptoms

Variables	N %	CES-D		p-value
		<16	≥16	
		N %	N %	
Total		697 (66.1)	357 (33.9)	
Age (years)				
<30	765 (72.6)	486 (63.5)	279 (36.5)	0.004
≥30	289 (27.4)	211 (73.0)	78 (27.0)	
Shift wok				
Yes	872 (82.7)	550 (63.1)	322 (36.9)	<0.001
No	182 (17.3)	147 (80.8)	35 (19.2)	
Marital status				
Married	196 (18.6)	147 (75.0)	49 (25.0)	0.004
Unmarried	858 (81.4)	550 (64.1)	308 (35.9)	
Education level				
≥college				
≤high school	341 (32.4)	253 (74.2)	88 (25.8)	<0.001
	713 (67.6)	444 (62.3)	269 (37.7)	
Regular exercise (times/week)				
≥3	148 (14.0)	96 (64.9)	52 (35.1)	
<3	906 (86.0)	601 (66.3)	305 (33.7)	0.726
Smoking habit				
Current	183 (17.4)	111 (60.7)	72 (39.3)	0.085
Never/Former	871 (82.6)	586 (67.3)	285 (32.7)	
Body Mass Index (kg/m2)				
<18.5	139 (13.1)	89 (64.0)	50 (36.0)	0.124
18.5~24.9	731 (69.4)	497 (68.0)	234 (32.0)	
>25	184 (17.5)	111 (60.3)	73 (39.7)	
Vitamin D (ng/mL)				
≥10	333 (31.6)	246 (73.9)	87 (26.1)	<0.001
<10	721 (68.4)	451 (62.6	270 (37.4)	

Moreover, the results indicated that the percentage of persons which doing regular exercises for at least 3 times per week was 14.0%; while the smoking persons were representing about 17.4%. The table also demonstrates that 13.1 % of individuals were underweight with respect to MBI score, while about 69.4% were within the normal BMI score and 17.5% were obese. It is concluded from the results that the depression symptoms not affected by the exercises or smoking or BMI score, where the percentage of depressions among subjects were averaged 26.1 and 37.4% in high and low vitamin D levels, respectively.

By using logistic regression analysis , depression symptoms was significantly correlated with the following: deficiency in Vitamin D(OR= 1.69, 95 % CI=1.27–2.26) , and with the night shift workers (OR=2.46, 95 % CI=1.66–3.64), lower level of education (OR=1.74, 95 % CI=1.31–2.32),younger ages (OR=1.55, 95 % CI=1.15–2.09) and with singles rather than marriages (OR= 1.68, 95 % CI=1.18–2.39).

Also, the results revealed that a significant correlation was found between depressive cases and vitamin D deficiency groups. Status (OR= 1.55, 95 % CI=1.15–2.07). Moreover, the multivariate logistic regression analysis showed a significant correlation between depression conditions and both the night shift workers (OR=1.83, 95 % CI=1.18–2.82) and educational levels (OR=1.39. 95 % CI=1.02–1.90) although no significant associations was found between depression conditions and both of age or marital status.

Table 3. Univariate and multivariate logistic regression analysis of factors affecting depressive symptoms

Variables	Unadjusted		Adjusted	
	Odds Ratio	**Confidence Interval 95 %**	**Odds Ratio**	**Confidence Interval 95 %**
Vitamin D (ng/ml)				
≥10	1.00		1.00	
<10	1.69	1.27–2.26	1.55	1.15–2.07
Shift work				
Yes	2.46		1.83	
No	1.00	1.66–3.64	1.00	1.18–2.82
Education level				
≥college	1.00		1.00	
≤high school	1.74	1.31–2.32	1.39	1.02–1.90
Age (years)				
≥30	1.00		1.00	
<30	1.55	1.15–2.09	1.15	0.82–1.62
Marital status				
Married	1.00		1.00	
Unmarried	1.68	1.18–2.39	1.19	0.80–1.77

Discussion

In the present investigation, Vitamin D levels were estimated in girls working in the food manufacture, where the mean level of Vitamin D was recorded 9.07± 3.25 ng/mL. These levels are coordinated with other studies in the same scope [25]. The known scores for Vitamin D as the following: less than 10ng/ml; 10-20ng/ml and 20 ng/ml or above are corresponds to deficient, insufficient and optimum Vitamin D, respectively. From the obtained results it's found that 68.4 % of individuals were located in the deficient category; and 97.2% were fallen in the suboptimal category. Due to high percentage of persons fell under the maximum level (20 ng/ml) , it was preferable to classify the individuals into a deficient group (less than 10ng/m) and a high group (10ng/ml and above), from this work, it is easily to distinguish the deficient persons from non-deficient groups and the results pointed to prevalence of vit D deficiency among Egyptian girls working in food industry .

From the obtained results , it possible to compare the obtained data from that carried out in Saudi Arab Kingdom, where serum Vitamin D among Saudi girls in the postmenopausal was 16.0 ng/ml and about 76.0% were located under Vitamin D insufficiency and deficiency category groups. [28]. Another survey was carried out on girls (19-39 years old) , the concentration of Vitamin D was 13.4 ng/ml , and nearly 91.6% of girls fell into deficient and insufficient groups (less than 20ng/ml)[29]. High percentages of subjects were complaining from Vitamin D deficiency or insufficiently (less 20ng/ml), the differences in the percentages of females deficient in Vitamin D between the studies may be attributed to the reproductive status of females (postmenopausal) also it revealed to slight differences from our finding with respect to young girls individuals . Three possible explanation for the differences between the present study and other studies 1.the increase in the no. of participants in the present study (72.6 %) of the whole persons , their ages 20 years old , in co-ordinance with previous study , in which the deficiency of Vitamin D was predominance in younger ages than older one [10]. Similarly, in this work the level of Vitamin D was significantly lower in females less than 30 years old than girls at 30 years of age or more. Furthermore, another postulation, is that the young girls may have the opportunity for exposure to sun rise via outdoor had fewer opportunities for sun exposure through outdoor behavior and exposed to high rate of sunscreen practice [30, 31]. 2. About 82 % of individuals in the present work were night shift workers in comparison with another study interested in bone mineral density and shift of work [11], It is noticed that the night shift worker group possess a decline in Vitamin D concentration than in girls working during the day in agreement with previous work performed to find correlation between occupational workers and Vitamin D[10], the night shift worker group were suffering from high rate of vitamin D deficiency . 3. With respect to the season, the present study was carried out during February-March (winter season)2016 , whereas, in a work performed during different seasons , they found that Vitamin D concentration in the serum was lower in winter than during summer season [29, 32], and accordingly the exposure to sunrise during summer is greater than that during winter (Day light).

Most of studies are depending on the CES-D score for measuring the degree of depression, in the current work, the mean score on the CES-D was averaged 13.8, in about 34 % of the persons suffering from depression symptoms. Many studies were applied CES-D at 16 in females individuals as indicator for assessment of depression. A study was carried out on number of female police officers, included 105 females , it was found that 18% of the cases complain from depression [33], whereas, in Egypt another investigation which comprised 2366 girls , their ages ranged between 18-92 years old and the percentage of individuals suffering from depressive symptoms was arrived 41 % [34]. The results obtained from this work indicated that the rate of depression among female teachers was elevated , however , it considered less than the data recoded by the general female population referring to national center of research.

On the other hand, taking into account the individuality of depressive symptoms, socioeconomic issues, work pattern, occupation, age, and other factors are necessity to put in our consideration.

The current investigation found a significant association between Vitamin D deficiency and the occurrence of depressive symptoms. The present data are parallel to the finding of some recent international researches which showed a negative association between vit-D levels and depressive symptoms in male ageing study [35].

Along six years of observation on the level of Vitamin D between male individuals in Europe , the analysis revealed to elevation in Vitamin D concentration in males which are parallel with decrease in CES-D score [36]. In the USA a study was carried out along 9 years on some patients affected with cardiovascular diseases, it is observed that the individuals their levels of Vitamin Dwas lower than 15ng/ml were subjected to depression 2.8-folds than that having higher level of Vitamin Din the serum [23].

The mode of action of Vitamin D which played in the central nervous system and its correlation with risk of depression among peoples is unknown yet, in spite of many investigations were performed in the world and postulated different mechanism, such as the presence of receptors in the brain and CNS for Vitamin D receptors which document their role in stimulation of neurons and neuroendocrine system function [37–39]. Furthermore, another reports on the presence of receptor genes specific to different types of Vitamin D and its derivatives which synthesized in the tissues and has strong correlation with nervous system disorders particularly cognition mutilation and depressive symptoms [40], another role of Vitamin Don the nervous system, regulation of the expression of genes of nerve growth factor, and its importance in the neurotransmission in the CNS [41] also, Vitamin D due to its potent antioxidant activity and protect the neurons from oxidative processes and denaturation resulting from free radicals [42, 43]. Some investigators found that Vitamin D may be responsible for increasing the permeability cell membrane and increase the conduction velocity in the axons , for this, by indirect way it regulate the transmission in the nervous system [24].

The data in the current work ,revealed to the presence of significant variations between different variables and symptoms of depression in female subjects working in food manufactures , one of these variables is the shift work and its significant correlation with depression symptoms (OR=1.83, 95 % CI=1.18–2.82) and this data are in agreement with another study concerned with the shift of work and depression, anxiety and immune status [44], moreover ,in police officers it was found a relation between the rotating shift time or daytime and the depression [33. The educational level had also its impact on the rate of depression, where in the current work it had a significant effect (OR=1.39, 95 % CI=1.02– 1.90) with depression conditions in a high school diploma or less group, and this correlation was similar to other studies concerning with level of education and rate of depression [45].

The possible limitation for this work , the design of work depends on cross-sectional study , between Vitamin D level and some variables, which not easy to find the exact illustration for the relation between different parameters . Moreover, although a structured questionnaire was applied, the prospect of influence of subject bias still remains on the net result due to self-administered. Other interference factor is that girls which working in electronics-food indoor were chosen as individuals of this survey, but neither their individual level of outdoor physical activity nor their dietary behavior like Vitamin D supplementation or Vitamin D level in blood were estimated . On the other hand, the stability of examiners and surrounding environment beside the stability of the method in the current work was considered one of the advantages of this study. In addition, some peoples included in this work were living in 10^{th} of Ramadan city which are characterized by suitable weather and its minimal effect on the level of Vitamin D. Also, the influence of season is limited because the duration of the study was very short about one By selecting the indoor workers the same workplace as subjects, the effect of outdoor activities was also reduced.

Conclusions

It is concluded form this work that the most of Egyptian working girls in the field of food processing or manufacturing are suffering from deficiency in Vitamin D concentration, accompanied with increase in the percentages of depressive symptoms among those workers. This study through a light on the wide spread of Vitamin D deficiency and increase the cases of depressions among the youth. Between the different factors that are linked with depressive symptoms, serum vitamin D deficiency alone cannot explain depressive symptoms. However, out of the various factors that affect depressive symptoms, through this study we were able to confirm that serum vitamin D deficiency, too, is associated with depressive symptoms. In the future, if serum vitamin D deficiency checkups and care for management of depressive symptoms are provided in the workplace, we can expect to see improved outcomes in the prevention of depressive symptoms. Additionally, there seems to be a need for a study on the relationship of active management of serum vitamin D to the improvement of depressive symptoms in the subjects of the serum vitamin D deficiency group classified into the depressive symptom group.

Competing interest

The author declare that they have no competing interests

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