Vitamin D level study within the population in Sulaymaniyah City - IRAQ

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Abstract–Vitamin **D3 regulates the uptake of calcium from the intestinal tract and enhances bone growth. Vitamin D3 deficiency causes many health problems such as autoimmune diseases, Crohn's disease, diabetes, inflammation, asthma, hypertension, and cancer. Vitamin D3 (cholecalciferol) deficiency has been documented as a persistent problem among adults, children, and elderly persons in most of the countries, especially during winter. One-third of the worldwide population suffers from Vitamin D3 hypovitaminosis due to inadequate exposure to sunlight. Our primary objective of this study was to determine the hypothesis of the prevalence of Vitamin D3 deficiency among Sulaimani region population; the secondary objective was to determine whether a gender variation affects in serum levels of Vitamin D3. Last, we sought to identify the prevalence of Vitamin D3 deficiency within different ages. For this aim, 3520 cases from Central Laboratory of disease analysis in Sulaimani enrolled from November 26, 2014, to May 24, 2017. Serum level of Vitamin D3 (1,25-dihydroxy Vitamin D) was determined by Cobas e411 (Hitachi- Germany) technique. To assess a basis for interpretation of potential relationships in our results, statistical analyses were conducted with a commercially available software program GraphPad Prism 6.0 (WI, USA).**

Index Terms**–Cholecalciferol, Cobas, Hypovitaminosis D, Serum 1,25-dihydroxy Vitamin D, Vitamin D deficiency.**

I. Introduction

Vitamin D deficiency is common worldwide and more prevalent in the United States [1]. Moreover, Vitamin D deficiency is epidemic among both children and adults, especially in elderly person [2]. Vitamin D3 1,25-dihydroxy Vitamin D or 1,25-dihydroxy Vitamin D (1,25-(OH)2D) is an active Vitamin D hormone [3]. The major source of Vitamin D3 is produced by the skin due to exposure to ultraviolet (UV) radiation of sunlight or after exposure to artificial UV light. Solar ultraviolet B is absorbed by 7-dehydrocholesterol in the skin, leading to the synthesis of pre-Vitamin D3, convert to 25-hydroxyvitamin D3 in the liver, then additional hydroxylation occurs by enzyme 1α-hydroxylase to its biologically active form 1,25-(OH)2D by the kidney [4,5]. However, serum 25-OH D is a much higher concentration which indicates total production of Vitamin D produce from both sources endogenous (exposure to UV light) and exogenous (consumption of dietary product) [1] the skin, also Vitamin D3 is less synthesis in dark-skinned persons because the skin pigment absorbs UV light [6].

Unfortunately, very few foods contain Vitamin D. Vitamin D produced in the skin may last in the blood twice longer than ingesting Vitamin D [4,7]. Thus, hypovitaminosis D occurs by inadequate exposure to sunlight and covering of there are many studies have reported associations between cardiovascular disease, coronary heart disease, and hypertension with lower Vitamin D levels [1]. Moreover, even a slight hypovitaminosis of Vitamin D causes an increase in bone atrophy [8]. Hypovitaminosis D not only causes metabolic bone disease such as rickets disease among children and osteoporosis. Vitamin D deficiency is a risk factor for many common diseases such as cancer; also, hypovitaminosis D has been associated with increased risk of autoimmune diseases such as rheumatoid arthritis and type 1 diabetes [2], inflammatory bowel diseases [9,10], and multiple sclerosis [11,12].

Study by Holick *et al.* [6] recommended daily intake of vitamin D at least 600 IU depending on the clinical case and age such as adults aged 50–70, pregnant and lactating women require at least 600 IU/d of Vitamin D for healthy muscle and bone function, However, to increase the serum level of Vitamin D consistently above 30 ng/ml need at least 1500–2000 IU/d of Vitamin D, also suggested three times more Vitamin D for obese children and adults to restore serum concentration to the normal range.

Excessive exposure sunlight can have serious consequences significantly increases the risk of non-melanoma skin cancer, thus typical exposure to sunlight is usually 2 or 3 times per week 5–10 min [13,14].

To determine, whether a person is Vitamin D (either Vitamin D2 or Vitamin D3) sufficient, deficient, or intoxicated

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the circulating concentrations of 25(OH)D measure. A level of <10 ng/mL indicates severe Vitamin D deficiency, a level of 10–30 indicates insufficient, whereas a level of 30–50 ng/mL is considered as adequate for healthy people.

II. Materials and Methods

A total of 3520 patients include 574 males and 2946 female patients, aged between 16 and 94 years old clinically diagnosed at the beginning of the November 2014 to the end of the June 2017 in Central Laboratory in Sulaimani in Iraq were included in this study.

Control group sample collected from 25 individuals were visiting the ENT hospital in Sulaimani/Iraq suffering from respiratory system diseases were enrolled in our study.

About 5 ml of venous blood was obtained from the patient and control groups collected in clot activator tube for measuring Vitamin D3 1,25-(OH)2D (ng/mL) in serum. Serum level of Vitamin D3 (1,25-(OH)2D) was determined by Cobas e411 (Hitachi-Germany) technique.

III. Results

A total of 3520 subjects were enrolled in this study consisting of 574 men and 2946 women clinically diagnosed in Central Laboratory in Sulaimani/Iraq (Table I).

Using independent *t*-test, F value and the significance of difference between the mean of both male and female participant have been statistically calculated. The mean for the level of Vitamin D in serum of the entire group has been calculated as 13.80 with standard deviation (SD) ± 11.89. However, the mean of the serum level of Vitamin D in male group (16.23) with SD ± 12.86, higher than female group which was 13.32 with SD ± 11.63.

There was a significant difference in male group (M = 16.2323, SD = 12.86351) and female group (M = 13.3282, SD = 11.638) conditions; t (3517) = 1.117, P = 0.0001. These results suggest that the significant difference value of the population was smaller than 0.05 ($P > 0.05$), thus we reject the null hypothesis and statistically confirmed there were differences between the two groups (Table II).

Association between Vitamin D3 deficiency and patients age was assessed in our study; for this purpose, 3520 cases were included 16–94 years old with a mean age of 46 ± 15.1. Subject population has been grouped into five groups: The first group (16–30 years), the mean of Vitamin D level in their serum was 8.5 ng/ml; the second group (30-45 years old), the mean of Vitamin D level in their serum was 9.6 ng/ml; the third group (45–60 years old) with the mean of Vitamin D level in their serum was 10.5 ng/ml; the fourth group (60–80 years old), the mean of Vitamin D level in their serum was 11.6 ng/ml; and finally, the fifth group (80 years old and above), the mean of Vitamin D level was 14.84 ng/ml (Table III).

The population based on the level of Vitamin D in their serum in respective with Roche company reference range for Vitamin D level, of 3527 objects, 2869 were at Vitamin D3 deficiency level (<20 ng/ml) with a mean of 8.4 ± 4.43, 383 of patients were at Vitamin D3 insufficiency level (20-30 ng/ml) with a mean of 24 ± 2.9, whereas 264 of patients were at Vitamin D3 sufficient level (30–100 ng/ml) with a mean of 40.3 ± 14.1 and just 4 patients were at excess level of Vitamin D (100–150 ng/ml) with a mean of 102.5 ± 1.8, no patients were at intoxication level of Vitamin D3 >150 ng/ml (Fig. 1 and Table IV).

The sample tests have been grouped based on the collection time of the year, to find the effect of the season on the Vitamin D level within samples. The first group

TABLE I
Percentage of the Study Population with Respect to Gender

Gender	Frequency (%)
Female	2945 (83.5)
Male	574 (16.3)
Total	3527 (100.0)

TABLE II
Mean (±SD) Values of Serum 25(OH)D of Both Gender Groups

Gender	N	Mean	Std. deviation	Std. error mean
Female	2945	13.328	11.63816	0.21446
Male	574	16.232	12.86351	0.53691

TABLE III
An Independent Sample *T*-Test was Conducted to Compare the Mean of Vitamin D Level in Blood Between Male and Female Groups

F	Sig.	T	D f	Sig. (two-tailed)
1.17	0.291	−5.373	3517	0.000
		−5.023	766	0.000

TABLE IV
Association between Age and Vitamin D3

Vitamin D3 levels	Age				
	16–30	30–45	45–60	60–80	80–94
Mean±SD	8.53±11.4	9.6±11.5	10.5±12.1	11.6±11.8	14.84±15.9
Deficiency	443 (86.5)	983 (85.5)	859 (80.3)	560 (52.3)	26 (60.5)
Insufficient	44 (8.6)	98 (8.5)	124 (11.6)	112 (15.1)	4 (9.3)
Sufficient	29 (5.7)	69 (6)	87 (8.1)	71 (9.6)	13 (30.2)

SD: Standard deviation

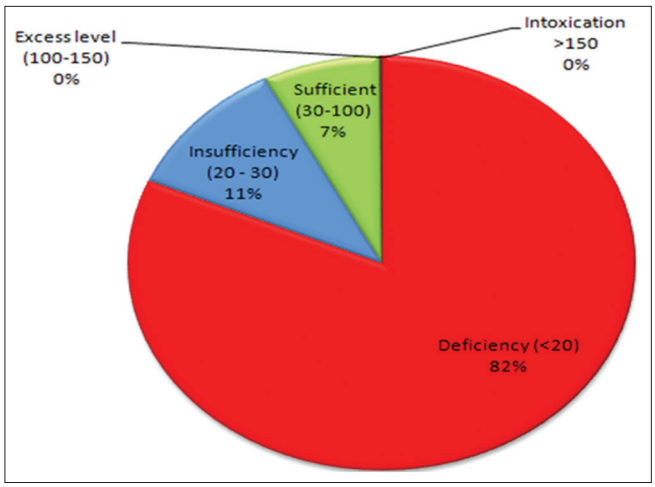

Fig. 1. Vitamin D3 levels in Sulaimani population.

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TABLE V
Mean±SD of Sample Tests Grouped Based on Season

Season	September to December	December to March	March to June	June to September
N	534	958	1330	697
Mean±SD	12.73±11.49	13.54±11.72	13.53±12.21	15.48±11.65

SD: Standard deviation

TABLE VI
An Independent Sample *T*-Test was Conducted to Compare the Mean of Vitamin D Level of Grouped Subjects Based on Seasons

Mean difference between seasons		T	Df	Sig. (two-tailed)
Pair 1	(December To March)–(March To June)	2.137	957	0.033
Pair 2	(December To March)–(June To September)	−2.929	696	0.004
Pair 3	(December To March)–(September To December)	0.348	533	0.728
Pair 4	(March To June)–(June To September)	−5.103	696	0.000
Pair 5	(March To June)–(September To December)	−0.532	533	0.595
Pair 6	(June To September)–(September To December)	3.339	533	0.001

TABLE VII
The Mean and SD of Both Control and Study Groups

Groups	N	Mean±SD
Control group	21	28.9564±13.17817
Study group	3519	13.8019±11.89327

SD: Standard deviation

(December–March), the mean of Vitamin D level in their serum was 9.7 ng/ml; the second group (March–Jun), Vitamin D level median in their group was 9.84 ng/ml; the third group (June–September), the median of Vitamin D level in their group was 12.3 ng/ml; and finally, the fourth group (September–December), the median of Vitamin D level in their serum was 8.99 ng/ml (Table V).

t-test used to determine the difference in the mean of Vitamin D level within the serum of patients that have been grouped based on the months in the year; we have compared every 3 months of the year together. Table VI summarizes the result of sample *t*-test for each group.

Finally, 21 subjects taken from ENT department as a control group, the mean of control group was 28.95 ng/ml, whereas the mean of studied group was 13.8019 ng/ml (Table VI).

Then, using one sample *t*-test, the study found that $P < 0.005$, thus we rejected the null hypothesis and assumed that the samples mean is significantly different than the average Vitamin D level of the overall control population (Table VII).

IV. Discussion

The main goal of this prospective study was to determine the deficiency level of Vitamin D in Sulaimani city - IRAQ. Then, to determine the effect of age, sex, and season on the level of Vitamin D, high level of Vitamin D deficiency has been reported in IRAQ [15].

Sulaimani area has semi-arid climates that are very hot and dry during summer while in winter, it is wet and cold. However, this area has four seasons, but most of the time there is sunny day. Thus, the expectation for the Vitamin D level in the serum of the population should be high.

This study concluded 3520 subjects with 25 control groups from ENT department. The test subjects are grouped based on sex and found to be 574 men and 2946 women clinically diagnosed in Central Laboratory in Sulaimani in Iraq (Table I).

The mean of Vitamin D level in the serum has been identified to be 13.32 and 16.23 ng/ml for both female and male groups, respectively (Table II).

In our study, we found that *P* value was <0.05 and the null hypothesis was accepted (Table III). This indicating that there was difference in the level of Vitamin D in serum between both male and female groups which may be due to men tend to be working outside more than women in this region which has a direct effect on the amount of sun exposure.

Total patients diagnosed to have Vitamin D deficiency were 2869 patients of total 3520, and they had Vitamin D level in serum (<20 ng/ml) with a mean of 8.4 ± 4.43, whereas 383 of patients were at Vitamin D3 insufficiency level (20–30 ng/ml) with a mean of 24 ± 2.9. Moreover, 264 of patients were at Vitamin D3 sufficient level (30–100 ng/ml) with a mean of 40.3 ± 14.1 and just 4 patients were at excess level of Vitamin D (100–150 ng/ml) with a mean of 102.5 ± 1.8, no patients were at intoxication level of Vitamin D3 >150 ng/ml (Fig. 1). The reason for high percentage of Vitamin D deficiency within this study population may be due to the sun been very hot most of the time in the year, which makes the people living in this area tries stay away from direct exposure to sun, thus causing less acquirement of Vitamin D from sun exposure.

In another hand, when the subjects grouped based on ages, the mean of the Vitamin D level increase with age as shown in Table IV that the mean of Vitamin D level for the first group age between 16 and 30 was 8.53 ng/ml, the second group age 30–45 was 9.6 ng/ml, the third group age 45–60 was 10.5 ng/ml, the fourth group aged 60–80 years old was 11.6 ng/ml, and the fifth group was 80 years old above with the mean of Vitamin D level 14.84. The reason for this difference in mean of Vitamin D level can be due to elders may have more healthy foods and expose to sunlight more frequently than younger. However, this result is in disagree with previous study by Gallagher [8].

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Moreover, season has a great impact on the level of Vitamin D3, as it is found in this study that during the September–December the level of Vitamin D less than other seasons with median of 12.73 ng/ml. Whereas, June–September scored highest level of Vitamin D within the subjects with the mean 15.48 ng/ml. In another hand, December–March the mean of Vitamin D level was 13.54 ng/ml and March–June the level was 15.53 ng/ml (Table V). Then, when paired sample *t*-test used to compare the mean between every 3 months of the year, *P* value between seasons was <0.05, which indicates there was difference in the mean of Vitamin D level between the mentioned periods of the year. Thus, this study found the difference in Vitamin D level according to the season time of the year which is in disagree with previous study conducted by Heidari and Haji Mirghassemi [16].

Finally, we have collected samples from ENT department to use them as a control group. Then, the mean and SD of the control group were calculated and compared with the study group(Table VII). $P < 0.005$, thus we reject the null hypothesis and found that there was difference in the control group to those of the study group.

V. Conclusion

This study found that age, sex, and season affecting the level of Vitamin D level within the population of Sulaimani. Thus, it is recommended to be mandatory to have periodic Vitamin D detection for populations living in Sulaimani city.

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