Frequency of vitamin D deficiency and insufficiency in a Jordanian cohort -a hospital based study

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ABSTRACT

Objective: The aim of the study is to determine the frequency of vitamin D deficiency and insufficiency in a Jordanian cohort.

Methods: This is a prospective cohort study of all subjects' blood samples that were analysed at Princess Iman Centre for Research and Laboratory Sciences at King Hussein Medical Centre in Amman-Jordan, from 1/9/2016 to 28/2/2017. A total of 3007 subjects were included in the study. A single 10 ml One blood sample was collected, from each subject, into gel separator (with clot activator) tube. After samples were allowed to clot, samples were centrifuged at room temperature, and the sera were collected in cap-closed tubes. Samples were analysed for vitamin D level using the electrochemiluminescence/magnetic particle method by Cobas e411 analyzer (Roche, Japan/Germany), which provides a wide measuring range and excellent low-end sensitivity. Gender and age groups differences in vitamin D levels were tested and compared using ANOVA test.

Results: Subjects were divided into four categories according to the result of vitamin D as follows: the optimal, adequate, insufficient, and deficient. 1208 (40.17%) subjects were deficient, 833 (27.7%) insufficient, 512 (17.02%) adequate, and 454 (15.11%) were optimal. In females (total of 2297) optimal vitamin D level were 349 (15.19 %), adequate were 386 (16.80 %), insufficient were 574 (24.98 %), and deficient were 988 (43.01 %). In males (total of 710) optimal were 105(14.8%), adequate were 126 (17.75%), insufficient 259 (36.48%), and deficient were 220 (30.97%). Results showed statistically significant differences in vitamin D levels between males and females as well as between children and adults; females had deficiency (43.01%) more than males (30.97%) with a P-value of 0.039, children (41.17%) more than adults (40.05 %) with a P-value of 0.008.

Conclusion: The study showed a high frequency of vitamin D deficiency and insufficiency in this cohort of patients. Frequency was higher in females than males as well as in children than adult age group. Further studies are recommended that correlates patients medical illnesses and Vitamin D supplementation to prevent clinical effects of vitamin D deficiency.

Key words: Deficiency, Insufficiency, Jordan, Vitamin D.

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Introduction

Vitamin D is one of the metabolic products of the cholesterol synthetic pathway. Various organs are involved in the synthesis of vitamin D such as the skin, liver, and kidneys, on the other hand, Vitamin D affects many organs mainly the gut, bone, and parathyroid glands [(1)]. Adequacy of vitamin D stores depends on age, degree of exposure to sunlight influence (ultraviolet light 290-315nm) and dietary sources (egg yolk, oily fish, butter and milk) [(1)]. Elderly individuals with little or no sunlight exposure are more frequently prone to develop vitamin D deficiency if not supplemented in the diet [(1)]. Vitamin D is a fat-soluble vitamin and has important function in intestinal absorption of calcium and phosphate [(2)]. The serum

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concentration of vitamin D reflects endogenous synthesis from exposure to sunlight and exogenous intake in diet [(2)]. Several forms of Vitamin D are known, the two major types, are vitamin D3 (cholecalciferol), and vitamin D2 (ergocalciferol) [(3)]. The causes of vitamin D insufficiency and deficiency include; limited dietary sources of vitamin D, inadequate supplementation of the vitamin in food, and factors that protect ultraviolet light reaching the skin (clothing, time of day, altitude, latitude, season, pigmentation) [(4)]. The deficiency of vitamin D can lead to osteomalacia and rickets in children, osteoporosis among elderly, and increase risk of many medical conditions [(5)]. Low vitamin D concentration in blood is an important international health problem, whereby the deficiency is common in Middle East countries, Japan, Italy, Norway, India, and the Netherlands[(6)]. This study is designed for assessment of vitamin D status in a Jordanian cohort.

Methods

Our study was approved by the research ethics committee of the Royal Medical Services, Amman-Jordan. This is a prospective cohort study of all subjects' blood samples that were analysed at Princess Iman Centre for Research and Laboratory Sciences at King Hussein Medical Centre in Amman-Jordan, from 1/9/2016 to 28/2/2017. Routine samples were received as part of patient's laboratory workout. A total of 3007 subjects were included with age range between 1year and 83 years, of which 23.62% (710) were male and 76.38% (2297) were female. Depending on individuals age 89.82% (2701) were adult and 10.18% (306) were children. One blood sample (10ml) was collected, from each subject, into gel separator (with clot activator) tube. After samples clotting, samples were centrifuged at room temperature, and the sera were collected in cap-closed tubes. Icteric, lipemic, and haemolysed samples that may give erroneous results were set as criteria of exclusion. Samples were analysed for vitamin D level using the electrochemiluminescence/magnetic particle binding assay (ECLIA) for the in-vitro determination of total 25-hydroxyvitamin D (according to Roche Diagnostics protocol) by Cobas e411 analyzer (Japan/Germany), which provides a wide measuring range and excellent low-end sensitivity. All sample results were analyzed using the statistic function of Microsoft Excel. Depending on vitamin D level, subjects were placed in four categories namely optimal (>30 ng/ml), adequate (21-30 ng/ml), insufficient (10-20ng/ml), and deficient (<10ng/ml) (Rubaida M et al). Gender and age groups differences in vitamin D levels were tested and compared using ANOVA test as shown in table four and five.

Results

Subjects were divided into four categories according to the result of vitamin D as follows: the optimal, adequate, insufficient, and deficient. 1208 (40.17%) subjects were deficient, 833 (27.7%) insufficient, 512 (17.02%) adequate, and 454 (15.11%) were optimal (Table I). In females (total of 2297) optimal vitamin D level were 349 (15.19 %), adequate were 386 (16.80 %), insufficient were 574 (24.98 %), and deficient were 988 (43.01 %) (Table II). In males (total of 710) optimal were 105(14.8%), adequate were 126 (17.75%), insufficient 259 (36.48%), and deficient were 220 (30.97%) (Table III). Furthermore, subjects were classified into two groups according to age; children with age ranges 1-14 years (total of 306) and adults 15-83 years (total of 2701). Results showed statistically significant differences in vitamin D levels between children and adults as well as between males and females. In children, optimal level were 57(18.62%), adequate 21 (6.86%), insufficient 102 (33.33%), and deficient 126 (41.17%). In adults, optimal level were 397 (14.69%), adequate 491 (18.17%) and insufficient 731 (27.06%), and results showed different vitamin D level between male and female as well as between children and adults (Table IV); females had deficiency (43.01%) more than males (30.97%) (Table V) with a P-value of 0.039, children (41.17%) more than adults (40.05 %) with a P-value of 0.008.

Table I: Vitamin D level in all subjects. Total (3007)

	Optimal (>30ng/ml)	Adequate (21-30ng/ml)	Insufficient (10-20ng/ml)	Deficient (<10 ng/ml)
Number	454	512	833	1208
Percentage	15.11%	17.02%	27.7%	40.17%

Table II: Vitamin D status in females. Number (2297)

	Optimal (>30ng/ml)	Adequate (21-30ng/ml)	Insufficient (10-20ng/ml)	Deficient (<10 ng/ml)
Number	349	386	574	988
Percentage	15.19%	16.80%	24.98%	43.01%

Table III: Vitamin D status in males. Number (710)

	Optimal (>30ng/ml)	Adequate (21-30ng/ml)	Insufficient (10-20ng/ml)	Deficient (<10 ng/ml)
Number	105	126	259	220
Percentage	14.8%	17.75%	36.48%	30.97%

Table IV: Vitamin D status regarding age.

Age	Vitamin D categories				Total	
	Optimal	Adequate	Insufficient	Deficient		
Children	57(18.62%)	21(6.86%)	102(33.33%)	126(41.17%)	306	P=0.008
Adults	397(14.69%)	491(18.17%)	731(27.06%)	1082(40.05%)	2701	

Table V: Vitamin D status regarding gender.

Gender		Optimal (>30ng/ml)	Adequate (21-30ng/ml)	Insufficient (10-20ng/ml)	Deficient (<10 ng/ml)	
	Number	105	126	259	220	
Male	Percentage	14.8%	17.75%	36.48%	30.97%	P=0.039
Female	Number	349	386	574	988	
	Percentage	15.19%	16.80%	24.98%	43.01%	

Discussion

Vitamin D deficiency and insufficiency are common in general population worldwide. Many factors that lead to deficiency and insufficiency include decrease exposure to sunlight, decrease intake of food containing vitamin D, and reduction in cutaneous production [(2)]. Vitamin D deficiency is pandemic, high prevalence of deficiency was reported in adults and children living in Europe, United States, India, Middle East, Australia, and Asia [(3, 7)]. In our study we found that the frequency of vitamin D deficiency and insufficiency in children was more pronounced than in adults, and in female more than male. Batieha A et al reported the prevalence of low vitamin D level in Jordanian was more frequent in female than males; the prevalence in female was around 35% which is consistent with our study, in contract to the prevalence in male which was very low (5%) comparing to our study[(8)]. In Brazil, Betania RS et al found the deficiency of vitamin D more prevalent in 7 to 18 years old girls [(9)]. Another study conducted in United Arab Emirates showed that equal proportions of female and male were severely deficient in serum vitamin D, and there was no relation between gender and serum vitamin D level [(10)]. Daly et al reported vitamin D deficiency affect one-third of adults in Australia [(11)]. A study from Boston showed vitamin D deficiency in about one fourth of healthy adolescent with highest prevalence in African American teenagers [(12)]. Another study from Jordan for assessing vitamin D status among non pregnant women of reproductive age, showed higher frequency of vitamin D deficiency (60.3%) in comparison with our study and showed conflicting result for the vitamin D insufficiency (95.7%), some of the reason for this variation could be the selection of certain

age group and their study was not hospital based [13]. Gharaibeh MA assessed in his study serum 25(OH)D concentration in women of childbearing age and their preschool children in Northern Jordan during summer, 48.9% of women had vitamin D level less than 25.0 nmol/l, which is less than what is shown by our study. The age, geographic location and conducting the study in summer may cause this difference in results. For the preschool children the results were much conflicting as only three children out of 93 studied showed serum 25(OH)D concentration less than 25 nmol/l, which again might be justified by their place of residence and due to conducting the study in summer [14]. Our study showed high frequency of vitamin D deficiency in general, and a higher frequency in females. This is may be due to decreased food intake rich in vitamin D and limited exposure to sunlight. Further studies are needed to elucidate the exact etiology. One important limitation in our study that samples were taken from patients coming seeking medical consultations and were not healthy volunteers. We recommend further studies which could correlate vitamin D level with clinical and pathological information and data. The study was conducted in single center, therefore a multicentric study is recommended to have a better national assessment of vitamin D status in Jordan.

Conclusion

The study showed a high frequency of vitamin D deficiency and insufficiency in this cohort of patients. Frequency was higher in females than males as wells as in children than adult age group. Further study is recommended that correlates patients medical illnesses and Vitamin D supplementation is recommended to prevent clinical effects of vitamin D deficiency.

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