Vitamin D status among sample of adolescents in Egypt

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Abstract: Background: During adolescence, an optimal vitamin D level is tremendously important for normal growth and bone mineral deposition. There are in adequate knowledge on the incidence of vitamin D deficiency between healthy adolescents. **Objectives:** This investigation was designed to assessment the frequency of vitamin D deficiency among a sample of adolescents and study the factors linked with vitamin D level. **Methods:** A cross-sectional study was performed on 30 adolescents, their ages 10–19 years, they were selected randomly from middle schools at Cairo governorate, Egypt. Information were obtained from adolescents through face-to-face interview and from their parents via self-administered questionnaire. Vitamin D level was estimated by ELISA technique. Both anthropometric assessment and dietary assessment were performed and interpreted according to WHO references. **Results:** The prevalence of calcium deficiency was 100%. The majority of the studied sample had low serum vitamin D severe deficiency reported in the majority of the cases 22 (73.7%) subclinical deficiency reported in 20-30 3 (10%>30) only 5 (16.3%) % of adolescents were vitamin D-sufficient. In parathyroid function was only high in 3.5%other lab finding regarding hemoglobin or stool parasite or urate were not significant. The incidence of vitamin D deficiency was significantly higher between girls 27 (90%) than boys (10%). In the final model, gender, age, the majority of the studied group 27 (90% sun exposed minority not exposed 3 (10%), Body mass index, dietary intake of vitamin D and calcium rich sources and other food hinder all significantly related to vitamin D and calcium deficiency. **Conclusion:** High prevalence of vitamin D deficiency and calcium deficiency was noted among a sample of Egyptian adolescents despite the abundant sunshine, which may reflect strong Dietary pattern poor dietary habit. Good nutritional education is required to achieve good bone health we demand for locally designed guidelines for supplement of vitamin D.

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1- Introduction

For proper development and bone mineral deposition during adolescence, a maximum vitamin D level is greatly important. The main role of $1,25(OH)_2D_3$ is to sustain serum phosphate and calcium levels within the physiologically acceptable concentration. (1) In addition to its critical role in bone health, It is of greatest importance to sustain standard concentration of calcium in the serum for optimum cellular functions (2). Many previous studies have connected deficiency of vitamin D to appearance of different disease cases e.g asthma and allergies in adulthood or adolescence (3), Depression (5), type II diabetes mellitus (4), Cancer and even all-cause mortality. (6). The discovery of presence of vitamin D in the receptors of nearly all cells and tissues of the body, proposed that vitamin D_3 may possess several biologicalactions that are non-calcaemic in nature (11). The biological role of vit. D comprise cellular growth, the regulation of hormone secretion and the regulation of cell differentiation and development (7.) Though, the findings of randomized control trials which investigated the effect of vitamin D supplementation on the risk of these disease conditions remain inconclusive (8). Many researches have assessed the prevalence of vitamin D insufficiency and deficiency throughout adolescence, showing high occurrence of deficiency of vitamin D worldwide (9.10). There is a over-all agreement that 25(OH)D in the serum/plasma should be used to evaluate vitamin D level, where the estimated level will reveals to the amount ingested in the food counting that from food products and supplements (11). Clinical and laboratory of vitamin D deficiency symptoms appear in the form of abnormal biochemistry such as low serum calcium, phosphorus, vitamin D and high alkaline phosphatase, PTH; tetany, muscle weakness, decreased bone density, bowing deformity of the long bones, deformities of the back, indentation of lower ribs and diffuse bone pain (12). There are many established

factors influencing vitamin D level and elevate vitamin D deficiency in Arab states, like inadequate intake of vitamin D-rich food, high body mass index (BMI) and dietary factors, skin pigmentation, avoiding sun exposure (13). Vitamin D, calcium status in adolescents could be of great importance as adolescence is a serious developing period for bone health (14). A possible adverse effects of vitamin D insufficiency or deficiency can be occur for boney structures as established recently in adolescents. The aims of the present study were to measure vitamin D status between a sample of Egyptian adolescents, where Egypt is a country having a plenty of sunshine, and to investigate factors linked with decrease in vitamin D concentration.

Objectives

1- Explores the vitamin D and calcium status of the sample of adolescence .

2- Assessing dietary intake food rich sources of vitamin D and calcium .

3- Correlate vitamin D and different other risk factors, sun exposure, medication, dietary intake food hinders .

4- Identify potential areas of high priority for nutrition intervention.

2. Subjects and Methods

Study design

A cross-sectional study for 30adolescents aged from 10- 19 years old with both sex who are attending outpatient clinic in NNI. We excluded people who were diabetics or case of chronic disease or used any specific drugs.

Dietary assessment:

Eating behavior and dietary intake were assessed using 24 hours food recall and dietary pattern. All participants receive dietary education. [15]

Anthropometric measurements:

Weight (to the nearest 0.1 kg) and height to the nearest 0.5 cm) and Waist circumferences (in cm): were measured. Weight and height for adults were used to compute BMI {wt (kg)/Ht2 (meter)} WHO, 1995[16].

Laboratory assessment and sampling:-

Five millimeters (5 mls) of venous blood were withdrawn from every participants by complete aseptic procedures. The blood was collected in plain vacutainer tubes then centrifuged at the speed of 3000 rpm for 15 min. to separate serum. The separated serum was kept in special aliquots at -20 cc until assaying.

All subjects participating in this study were subjecting of the following laboratory measurements:

Serum samples have been collected for the estimation of 25-OH vitamin D, total protein and calcium, and then calculate the value for ionized calcium. These investigations were done at Laboratory of outpatient clinic of National Nutrition Institute (NNI).

1-Determination of 25-OH vitamin D was done by ELISA kit (**DRG ELISA**. **LOT: 80k035 Cat.Nr:EIA539**) on the device Stat-Fax (USA). **(Houghton and Vieth.,2006) [17]**

Expected values

Vitamin D status	25-OH Vitamin D (ng\ml)
Deficiency	10 less than
Insufficiency	10-29
Sufficiency	30-100
Toxicity	100 more than

2- The serum total protein (TP) was determined with the biuret reagent method as described by **Cannon (1974)**, [18] using by using a fully automated biochemistry device B T 1500 **(biotecnica instruments, Italy).**

3- Determination of tCa concentration in serum was carried out according **(Sakar, 1967) [19].**

using by using a fully automated biochemistry device B T 1500 **(biotecnica instruments, Italy).** (AAS).

4- Ionized calcium was calculated (in mg/dL) with the formula iCa = (6 x tCa – TP/3)/(6 + TP) where tCa is in mg/dL, albumin and TP are in g/dL**.** normal reference val ues: 4.4-5.2 mg% **(Toffaletti, 2011). [20]**

Statistical analysis

The data obtained was analysed by using SPSS version ( ).

3. Results

Descriptive statistics

Total sample size was 30, female were 27(90%) boys were 3(10%) median age 16. regarding BMI 17(56.7)%was of normal size 9(30%) were obese underweight was 4 (13.3%)

Table (1): Descriptive statistics of the studied group

	No (%)
Age	16.1(2.0)
Age of puberty	12.8(1.0)
Weight	59.6(13.7)
Height	158.5(6.1)
BMI	23.6(4.9)
BMI * Underweight Normal Obese	 4(13.3) 17(56.7) 9(30.0)
Sex * Male Female	 3(10.0) 27(90.0)

* data presented as No (%)

Represents laboratory result of the studied sample

The mean serum vitamin D was 18.2 which is far below mean vitamin D level, Mean serum calcium level was 3.4 which is far below normal level. The prevalence of calcium deficiency was 100%. The majority of the studied sample had low serum vitamin D. Severe deficiency reported in the majority of the cases 22(73.7%) subclinical deficiency reported in 20-30 3(10%>30) only 5(16.3%) % of adolescents were vitamin D-sufficient. In parathyroid function was only high in 3.5%other lab finding regarding hemoglobin or stool parasite or urate were not significant. The frequency of vitamin D deficiency was significantly higher in girls 27 (90%) versus in boys3 (10%).

Table (2): distribution of laboratory data among the studied group

	No (%)
Vitamin D mean (SD)	18.2(10.6)
Calcium mean (SD)	3.8(0.3)
Vitamin D sufficiency * < 20 20 – 30 > 30	22(73.3 3(10.0) 5(16.7)
Calcium sufficiency * Deficiency	30(100.0)
Vitamin D supplement * No Yes	20(66.7) 10(33.3)
Calcium supplement * No Yes	28(93.3) 2(6.7)
Other lab * No finding Uriate + Low Hb Low WBC Urine pus + Stool fungus Stool parasite High Parathyroid High Cholesterol Endoscope High Uric acid	8(27.6) 7(24.1) 9(31.0) 1(3.5) 1(3.5) 1(3.5) 1(3.5) 2(6.9) 1(3.5) 1(3.5) 1(3.5)

* Data presented as No (%)

The majority of the studied sample had low serum vitamin D. Severe deficiency reported in the majority of the cases 22(73.7%) subclinical deficiency reported in 20-30 3(10%>30) only 5(16.3%) % of adolescents were vitamin D-sufficient.

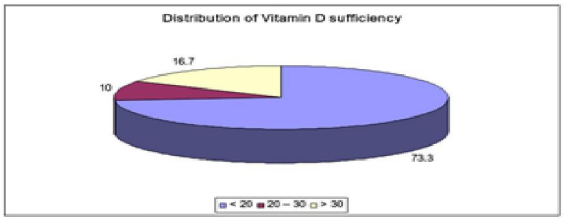


Fig (1) **represents distribution of vitamin D sufficiency of the studied sample**

Correlation between vitamin D level main complain and medication of the studied group

Table (3): Clinical data of the studied group complain, medication and sun exposure and of the studied group

items	No (%)
Complaint Ortho Derma hair Internal Diet Pediatric Behavior Check up Family history	18(60.0) 5(16.7) 4(13.3) 3(10.0) 2(6.7) 1(3.3) 1(3.3) 1(3.3)
Other medication No Tonic Urosolovin Analgesics Iron Folic acid Antiepelitic Herbal Ocp Antibiotic	11(36.7) 12(40.0) 3(10.0) 4(13.3) 1(3.3) 1(3.3) 1(6.7) 1(3.3) 1(3.3) 2(6.7)
Other condition No Urinary Anemia Headache GII Endocrine Gynecology Ah.fever Malariae Diet	9(30.0) 7(23.3) 10(33.3) 1(3.3) 2(6.7) 2(6.7) 1(3.3) 1(3.3) 1(3.3) 1(3.3)
Follow up No Yes	19(63.3) 11(36.7)

Regarding main presenting complain orthopedic complain., Limitation of the movement were the chief complaint in the majority of the studied group (18) 60% while other complain dermal, internal, behavior

represent minority (12) 40% Regarding medication that may affect calcium and vitamin d status 40% receive tonics. 13.3% receive analgesic on regular bases 11 (36.7 %) does not taken any medication with no significant difference Regarding sun exposure the majority of the studied group 27(90%) reported adequate sun exposure minority reported 3(10%) avoidance of sun exposure with significant difference.

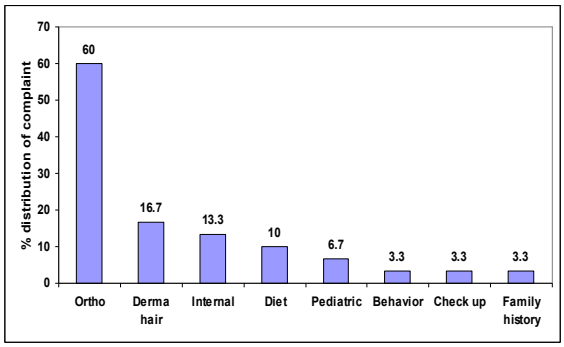
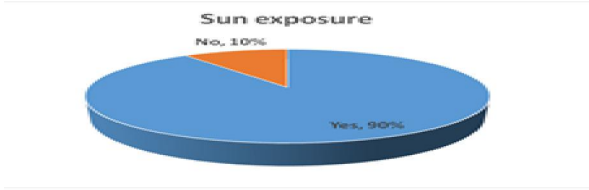


Figure (2): % distribution of complaint.

Distribution of the studied group according to their Dietary intake

All the studied group receive COH, fat on daily bases, regarding animal protein meat intake (15=50%) take meat on daily bases. regarding fish only 9(27%) take fish once per week, milk only 6(20%) receive milk on daily bases while 11(36.7)%twice per week., legumes 7(23.2%) receive legumes on daily bases while (8(26.7) receive legumes twice per week. vegetables 5(16.7 receive vegetables on daily bases While 8(26.7) twice per week fruit only (1)3.3%recieve fruit on daily bases 3(10.1)% receive fruit twice per week.

Table (3.B) correlation between vitamin D level and sun exposure fig (3)



Sun exposure No Yes	3(10.0) 27(90.0)

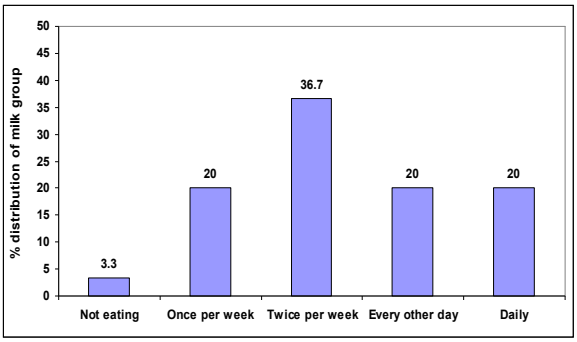


Figure (4): % distribution of milk intake.

Table (4): Distribution of the studied group according to their Dietary intake

Food items	Not eating (N,%)	Once per week (N,%)	Twice per week (N,%)	Every other day (N,%)	Daily (N,%)
Carbohydrate	**0**	**0**	**0**	**0**	**30(100.0)**
Fat	**0**	**0**	**0**	**0**	**30(100.0)**
Meat	**1(3.3)**	**2 (6.7)**	**6(20.0)**	**6(20.0)**	**15(50.0)**
Fish	**10(33.3**	**9(30.0)**	**11(36.7)**	**0**	**0**
Fruits	**1(3.3)**	**3(10.1)**	**15(50.0)**	**10(33.3)**	**1(3.3**
Vegetables	**3(10.0)**	**7(23.3**	**7(23.3**	**8(26.7)**	**5(16.0.**
Dairy products	**1(3.3)**	**6(20.0)**	**11(36.7)**	**6(20.0)**	**6(20.0)**
Legumes	**2(6.7)**	**5(16.7)**	**8(26.7)**	**8(26.7)**	**7(23.2**

Table (5): There was positive correlation between calcium level and vitamin D level. The vitamin D was inversely correlated the higher the age the lower the vitamin D.

Table (5): Correlation between vitamin D and CA level anthropometry parameters, sun exposure,

	Vitamin D	
	R	P
Ca++	0.498	0.005

Age	-0.356	0.054
Age of puberty	0.183	0.382
Weight	-0.181	0.339
Height	-0.133	0.484
BMI	-0.153	0.420

	Vitamin D	
	R	P
Follow up	0.232	0.218
Sun exposure	-0.334	0.071

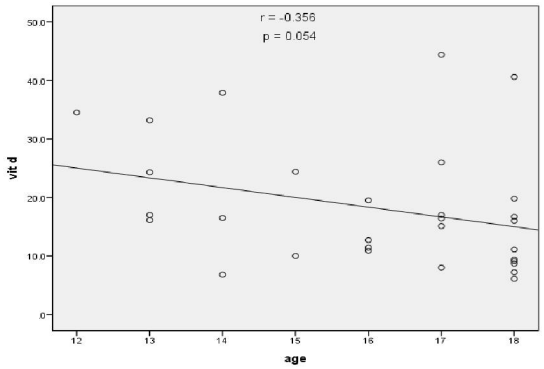


Fig (5) Correlation between vitamin D age

The higher the intake of there was negative correlation between vitamin D and certain dietary elements the higher the dietary intake of legumes, phosphate and oxalate sugar the lower the vitamin D.

Table (6) Correlation between vitamin D and CA level dietary elements

	Vitamin D	
	R	P
Meat	0.124	0.514
Fish	0.272	0.146
Milk	0.309	0.096
Legumes	-0.105	0.580
Vegetables	0.338	0.067
Fruits	0.367	0.046
Sugar	-0.120	0.526
Oxalate	-0.004	0.984
Phosphate	0.067	0.723

Table (7): Correlation between serum calcium level and Anthropometry sun exposure and medication of the studied group

	Ca++	
	R	P
Age	-0.457	0.011
Age of puberty	-0.149	0.478
Weight	-0.422	0.020
Height	-0.398	0.030
BMI	-0.291	0.118
	Ca++	
	R	P
Follow up	0.246	0.190
Sun exposure	-0.324	0.081

There was significant correlation between calcium level and the age weight of the studied group The serum calcium was inversely correlated with the age, the BMI the lower vitamin D the higher the BMI ang age correlation between ca++ and medication. There was no significant correlation between sun exposure and serum calcium level the majority of the studied group exposed to the sun but had low serum calcium level.

Table (8) there was positive correlation between serum calcium and certain dietary elements the higher the dietary intake of milk the higher the calcium level.

Table (8) correlation between ca++ level and food frequency intake

	Ca++	
	R	P
Meat	0.138	0.467
Fish	-0.133	0.483
Milk	0.610	0.000
Legumes	0.052	0.784
Vegetables	0.100	0.599
Fruits	0.179	0.343
Sugar	0.259	0.167
Oxalate	0.056	0.771
Phosphate	0.063	0.740

4. Discussions

The incidence of deficiency of vitamin D (VDD) among adolescents is differ significantly but in many countries, worldwide is substantially high (21,22). Some factors are participating in the deficiency of vitamin D with different degrees such as lack of exposure to sunlight due to veiling, cultural dress codes, less time spent outdoors, or due to pigmented skin, and lower vitamin D intake (23). Recent results from studies of vitamin D status in adolescents give confirmation of a potential side effect of vitamin D insufficiency and deficiency on adolescents bone health condition (24). The current work aimed to study vitamin D status amid a sample of adolescence in Egypt. vitamin D deficiency reported in the majority of the cases (73.7%) subclinical deficiency reported in (10%) only (16.3%) % of studied group were vitamin D-sufficient. Our result find greet evidence of support worldwide., previous study In Egypt (21.3 %) had vitamin D deficiency (24 %), had vitamin D insufficiency other study in Egypt reported that the frequency of subclinical vitamin D deficiency was 45.2% in winter and 6.7% in summer (25.), In Kuwait nearly, 81% of adolescent were showed vitamin D deficiency, while vitamin D-insufficiently was reached 15% of adolescents (26). In USA and Western

countries, insignificant deficient circumstances are more common (27-29). The present data is more parallel to that recorded from previous work in Saudi Arabia, where the prevalence of vitamin D deficiency was (95.6%) (30). Reliable interpreters across these researches for minor vitamin D values were in females which may be due to lack of exposure to sunlight. In our study, the incidence of vitamin D deficiency was significantly elevated between females (90%) than in males (10%). This variation might be concealed by some causes like the irregular distribution of individuals between sexes. Comparable conclusions have been recorded in India between adolescents (31) and China (32) and Arab states in the Gulf region (26). This form is not common in other locations as investigated from a clinic-based, cross-sectional study in Italy (33). Great attention must be paid for the problem of vitamin D deficiency in adolescents and older children, therefore, the American Academy of Pediatrics in 2008 released a new recommendation for giving all children a daily dose of 400 IU of vitamin D from their first days of life along childhood and adolescence but this recommendation needed to widely accepted and applied in Arab countries (34). Presentation of VDD distinctly varies from young children. in adolescents, VDD may be not induced a symptoms to be detected early (35). VDD may appear as indefinite symptoms comprising arthritis (pain in weight-bearing joints), thighs, back, difficulty in walking and/or climbing stairs, (.36) These manifestations may go unnoticed for long periods Furthermore, VDD can be misdiagnosed as simple depression in adolescents or chronic fatigue syndrome (37),. Low levels of exposure to sunlight, poor nutritional intake, impact of psychotropic were the detrimental factors that contributed to vitamin D deficiency. Regarding sun exposure our result showed that the majority of the studied group (90%) reported adequate sun exposure minority reported (10%). despite the abundant sunshine, our result was in line with that carried in Kuwait (26)., this could explained by presence of some causes that may prevent continuous synthesis of vitamin D in spite of exposure to plenty of sunshine such as dust storms indoor lifestyle, (26.). our study showed positive correlation between BMI and vitamin D deficiency which has been returned to the confiscation of vitamin D within the abundant adipose tissue ((38). It has also been proposed that leptin hormone, an adipocyte-derived hormone, might activate a pathway that suppress renal synthesis of the active form of vitamin D. (39). Our work results confirmed previous studies results, Vitamin D deficiency or insufficiency is common in obese and overweight adolescents, (30,40,). Regarding dietary factors that may interfere with calcium bioavailability sugar, phytate phosphate our study showed negative correlation between vitamin D and certain dietary elements the higher the dietary intake of legumes, phytate and oxalate, sugar lower the calcium level. This is in agreement with the finding of the study in Saudi Arabia (41). Poor dietary quality associated with poor vitamin D status Our studied group receive different items of food groups but not on the recommended intake that advised by the Dietary guidelines of the adolescence, (42). Similar result of poor dietary intake was reported in china (32) Kuwait (26).

Conclusion

High prevalence of vitamin D deficiency and calcium deficiency was noted among a sample of Egyptian adolescents, Higher vitamin D and calcium deficiency was noticed among girls, Higher BMI associated with vitamin D deficiency., there was adequate sun exposure with vitamin D deficiency. which may reflect indoor lifestyle, cultural practices.

Recommendations

Good nutritional education is required to achieve good bone health, We call for locally tailored guidelines for vitamin D supplement.

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