Original Article

Hypovitaminosis D and anthropometric measurement association in young healthy females of Karachi

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Abstract

Background: Vitamin D deficiency recognized as a pandemic problem around the globe. In the last few decades, the incidence of hypovitaminosis D is affected severely in both genders of Pakistan. Due to economical hurdles and sociocultural practices, the prevalence of hypovitaminosis D is much higher in females which leads to age-related chronic bone & skeletal deformities. To find out vitamin D profile associated with anthropometric measurement of young healthy Pakistani females.

Methodology: 115 healthy female participants were recruited for the study. Demographic profile, physical activity status, dietary habits and anthropometric measurements of participants were collected by means of a questionnaire designed for the study. Participants were classified into two groups, vitamin D deficient (VDD) group, and vitamin D adequate (VDA) group. Anthropometric measurements of both groups included body mass index (BMI), waist-hip ratio (WHR), mid-upper arm circumference (MAC), triceps skinfold (TSF), corrected mid-upper arm muscle area (CMUAMA) and circumference of thigh size, neck size, biceps size and wrist size. Data were analyzed using Microsoft office 2013. A t-test was applied to find out the associations. P value < 0.05 was considered significant.

Results: P-value for all anthropometric measurements, was found to be non-significant. Unhealthy dietary habits were much higher in VDD group as compared to VDA group. Thus, it was found that there is a high prevalence of hypovitaminosis D in young Pakistani females.

Conclusion: Hypovitaminosis has great influence on physical activity, anthropometric measurement and dietary intake of an individual.

Introduction

Hypovitaminosis D defines serum 25 (OH) D level below to 20 ng/ml[1]. Vitamin D plays an important role in bone mineralization by metabolism of calcium and phosphate, maintain cell proliferation to reduce the risk of cancer[1, 2]. There are many contributing factors which affect the level of vitamin D such as modifiable risk factor including ethnicity, dark skin pigmentation (melanin), reduced production of vitamin D, female gender is more prone to hypovitaminosis D due to wearing abaya or covered body for religious and cultural values[2] and winter season which affect the amount and quality of sunlight. Nonmodifiable risk factor includes low sunlight exposure, low calcium diet, obesity, sedentary lifestyle, geographical location[3] and air pollution[4]. All these factor initiating the later consequence of vitamin D deficiency such as osteoporosis (break down of bone), osteomalacia (softening bone), osteoarthritis (cartilage deformities), different types of cancer like prostate and breast, autoimmune disorder like diabetes, multiple sclerosis, crohn disease and rheumatoid arthritis, many types of infection like urinary tract infection, tuberculosis and different psychiatric conditions like depression and schizophrenia[5].

Nowadays, hypovitaminosis D is recognized as global health problem which affects millions of individual around the world. Since the 19th century

there was no data reported on prevalence. In the 20th century, first available statistics on the prevalence of vitamin D was reported in Indian population which showed that 90% of nearly all age groups of Indian population suffered from vitamin D deficiency[6]. A study conducted in Karachi found that 90% of the study sample had low serum 25(OH) D level. The study also revealed the inverse relation between serum 25(OH) D level and serum parathyroid level[7]. A cross-sectional study conducted in Islamabad

A major source of vitamin D is ultraviolet radiation which is 290-320 nm wavelengths that required for the production of provitamin D through the skin, it is recommended that thirty minutes exposure of sun twice per day[9] (figure 1). Artificially, vitamin D_2 synthesize by yeast with the help of ultraviolet radiation & ergosterol while vitamin D_3 supplement prepared by chemically conversion of cholesterol or conversion from lanolin by irradiation of 7 dehydrocholesterol. Although both forms of vitamin D similar expect their side chain[10]. While recommended consumption of these natural sources of Vitamin D is very low therefore it's better to consume vitamin D supplement to reach the recommended value of vitamin D.

showed that females has a high incidence of hypovitaminosis D as compared to male population irrespective of age[8].

Vitamin D is a fat-soluble vitamin which is present naturally in some foods and in milk products. Sunlight is the major source of vitamin D. Activation of vitamin D required hydroxylation via two ways (Figure 1).

Obesity is one of the important contributing factors of hypovitaminosis D. Higher body mass index along with inactive lifestyle and unhealthy dietary intake contribute to vitamin D deficiency. A series of researchers found different researchers to explain the possible pathway which develops hypovitaminosis D. In obese people, low rate of ultraviolet streak through skin and lesser intensity for absorption of sunlight and reduce production of vitamin D_3 have addressed for hypovitaminosis D. Different studies showed the inverse relation of vitamin D deficiency and adiposity, body fats[11]. The present study investigates the possible relation of hypovitaminosis D and anthropometric measurements on young healthy population.

Figure 1: a Physiological mechanism for Vitamin D synthesis
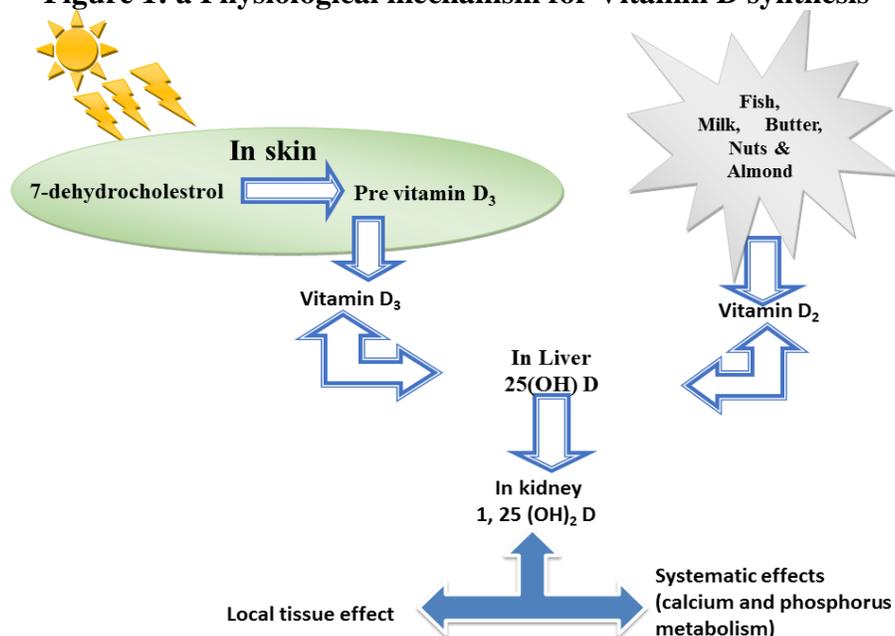
Methodology

A descriptive, cross-sectional study was conducted at University of Karachi form September 2015 to February 2016. Unmarried females of age 20-25 years that were not clinically diagnosed with any disease and were selected from all socio-economic statuses. While the females taking any drug that affects vitamin D levels were excluded from the study sample. A total of 115 healthy female participants were recruited for the study. Demographic profile, physical activity status, dietary habits and anthropometric measurements of participants were collected through a questionnaire designed for the study.Written consent was obtained from all subjects before the start of the study. Required data variables were collected from recruited subjects. Participant's physical activity was recorded which included their working period and type of journey. The activity status was observed on the basis of three categories: sedentary (resting condition), routine activity (Activeness) and excessive activities (3 times a week). The blood sample was collected after an overnight fast to measure 25(OH) D levels in serum. Serum 25(OH) by using Electro-chemiluminescence immunoassay (ECLIA) assay kit[12]. Data were analyzed using Microsoft office 2013. A t-test was used to determine the relationship between various anthropometric indices, with statistical significance taken at $P < 0.01$.

Anthropometric measurements were taken as follows: Weight was measured using a digital scale to the nearest 0.1 kg with subjects wearing light clothing, and height was measured without shoes using detectostadiometer 3P wall-mount height rod, to the nearest 0.5 cm. Weight and height were taken twice and recorded. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m2).Waist circumference (WC) was measured under the clothes, at the narrowest point, midway between the costal margin and the iliac crest, in the horizontal plane with the subject standing. Waist to hip ratio (WHR) was measured by dividing the waist circumference with the hip circumference, the latter taken as the widest point over the buttocks. Waist to height ratio (WHR) was estimated by dividing the waist circumference with the height. Body fat deposition expressed as by first measuring triceps skinfold thickness by skin-fold caliper than measure Mid-arms circumference by locating the midpoint of the upper arm by flexing the elbow at 90 degrees and measure the entire length of the upper arm at the acromion to the tip of olecranon bone. Corrected Mid Upper Arm Muscle Area (CMUAMA) was calculated using the triceps skinfold and MUAC in the following formula: CMUAMA= (MUAC- ($\pi \times$ TSF/10)) ^{2} – 6.5 / 4π. Neck size at the narrowest point, thigh size at widest point and biceps at the widest point were measured by measuring tape.

Results

According to the serum vitamin D level, the study population was divided into two categories; vitamin D adequate (VDA) participants having 23.33 ± 2.44 ng/ml and vitamin D deficient (VDD) participants having 15.12 ±2.60ng/ml.

According to socio-economic status, most the participants were in 28 (24.34%) from lower middle class and 58(13.91%) from the upper class. 94 participants (81.7%) were dependent in the present study. 111 (96.52%) of participants refused to do exercise as shown in table 1.

Table 1: Subjects Demographics

S. No.	Parameters	Groups	N (%)
1	Family System	Joint	35 (30.4)
		Nuclear	80 (69.5)
2	Socioeconomic Status	Lower Class	16 (13.91)
		Lower Middle Class	28 (24.34)
		Middle Class	13 (11.30)

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		Upper class	58(50.43)
3	Dependent Participants		94 (81.73)
	Independent Participants		21 (18.26)
4	Exercise	Yes	04 (3.47)
		No	111 (96.52)

Table 2 shows that around 100% and 81% of participants of Vitamin D deficient were tea coffee consumers (cups/day) and Carbonated beverages as compared to Vitamin D adequate participants which were 88% and 66.6% respectively.

Table 2: Physical and dietary status of Vitamin D adequate and Vitamin D deficient participants

S. No.	Parameters	VDD(N= 73)	VDA(N= 42)
1	Sedentary-resting condition	18 (25)	5 (11.9)
2	Active-routine activity	55 (75)	37 (88.1)
3	Very Active-30 minutes>3 times a week	0	0
4	Tea/coffee (cups/day)	73 (100)	37(88.1)
5	Carbonated beverages	59 (81)	28 (66.6)
6	Intake of dairy product (Milk, Yogurt)	18 (25)	23 (55)

Table 3 shows the difference between an anthropometric measurement of vitamin D deficient and adequate participants. P-value of all the comparisons are greater than 0.05 that is the relationship is significant.

Table 3: Anthropometric measurement of studied participants

S.No.	Parameters	VDD (N= 73)	VDA (N= 42)	p-value
1	Height (feet)	5.2 ± 0.1NS	5.2 ± 0.19	0.9
2	Weight (kg)	50.06 ± 12.2NS	48.77 ± 13.2	0.81
3	BMI (kg/m2)	16.06 ± 3.53NS	15.51 ± 4.3	0.74
4	Waist circumference (inch)	26.75 ± 4.2NS	26.6 ± 4.3	0.93
5	Hip circumference (inch)	34 ± 4.6NS	35.11 ± 2.47	0.96
6	Waist/Hip Ratio	0.78 ± 0.07NS	0.75 ± 0.09	0.44
7	Mid-upper-arm circumference(cm)	23.9 ± 5.6NS	27.09 ± 6.09	0.22
8	Triceps skinfold (cm)	1.8 ± 1.01NS	1.74 ± 0.67	0.81
9	Corrected mid upper-arm muscle area (cm)	10.42 ± 2.22NS	10.23 ± 2.31	0.23
10	Thigh size at widest point (inches)	17 ± 2.65NS	16.88 ± 2.75	0.92
11	Neck at narrowest point (inches)	11.5 ± 0.96NS	$11.3 0.86$	0.66
12	Biceps at widest point (inches)	5.25 ± 1NS	5.55 ± 1.01	0.47
13	Wrist at narrowest point (inches)	5.40 ± 0.58NS	5.44 ± 0.58	0.87
14	Mid-upper-arm circumference (cm)	5.2 ± 0.1NS	5.2 ± 0.19	0.9

* Values in Mean ± S.D.

P value <0.05 is found to be significant.

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Discussion

Vitamin D deficiency recognized as major health problem around the globe. Studies showed that people with high body fat (obese) had low serum 25(OH) D level[13]. In present study, there is a difference between vitamin D deficient participants and Vitamin D adequate participants. According to their anthropometric measurements, vitamin D deficient participants had higher BMI, Waist to Hip Ratio, and mid-upper arm circumference as compared to Vitamin D adequate participants (table 3). Different studies showed that negative relation between BMI and vitamin D status. Vitamin D insufficiency was highly influence on BMI and body weight[14]. Adiposity is associated with low blood 25 (OH) D levels, in obese people vitamin D store in adipocyte by the lipophilic act[15]. A strong inverse relation between serum 25(OH) D level and obese people were seen in children and adolescence[16].

Anthropometric measurement are influenced by calcium availability in diet. Studies showed that there is inverse relation between calcium and body weight. Reason is that the intracellular calcium concentration regulates lipid (triacylglycerol) storage and adipocyte lipid metabolism [17]. Present study showed that Vitamin D adequate participants having low body weight and better dietary status as compared to vitamin D deficient participants (Table 2, 3).

Vitamin D status is highly associated with muscle power. Recent studies showed that lesser activity, female gender, higher education and higher BMI are associated with vitamin D deficiency[18]. Physical activity influence bone health via increasing osteoblast and osteocyte activity for bone resorption or remoulding by the formation of 1, 25 $(OH)_2$ D. Our study also revealed that 11% of Vitamin D adequate participants had sedentary lifestyle while 25% of Vitamin D deficient participants had sedentary lifestyle (Table 2).

As discussed, dietary habits have very strong influence on vitamin D level. Pakistan is one of the country which lacks fortification of vitamin D. Present study also showed that 44% of participant from vitamin D adequate (VDA) group and 75% of participant from vitamin D deficient (VDD) group didn't consume milk at all. In order to maintain bone homeostasis, it is necessary to maintain nutritional requirement of vitamin D in a body[19].

Physical activity associated with calcium and phosphate balances and increase bone mass. Physical activity helps to enhanced 1, 25 $(OH)_2$ D level in blood which increase efficiency of calcium absorption in intestine. Recent study showed that self-reported moderate-to-vigorous activities per day was associated with an increase in circulating vitamin D levels[20].

Present study shows that the sedentary resting condition of vitamin D deficient participant was much high as compare to adequate participant (Table 2). Similarly, a population-based survey showed that a higher 25(OH) D level was associated with better neuromuscular function and exercise improved muscle strength, balance, and mobility[21].

Nutritional factors that can negatively impact bone health include binge drinking, caffeinated beverages and carbonated beverages due to the interference of mineral absorption, dietary fibre. A study conducted on adolescence showed that high rate of consumption of carbonated soft drink may lead to different disease conditions like anaemia, bones weakness as well as increase in blood sugar level and body weight[22]. Similarly present study large population of vitamin D deficient participant consumed carbonated beverages as compared to adequate vitamin D level (Table 2).

Conclusion

Our research study showed the high prevalence of hypovitaminosis D. Different conditions like dietary insufficiency, reduced sun exposure, physical activity status are contributing factor to develop

hypovitaminosis D which lead to increased BMI, mid upper arm circumference and waist to hip ratio, thereby increasing the risk of cardiovascular diseases. Pakistan needs fortification of vitamins in food product. Government should make the strategy for betterment of food policy towards fortification. Active life style, outdoor activity, and sun exposure at least 10-30 minutes and sufficient diary product intake make life stronger and healthy.

Conflicts of interest

None.

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