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Research Article

Vitamin D Supplementation does not Effect Adiposity in Healthy Adults

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Abstract

Introduction: Vitamin D is crucial for skeletal and extraskeletal health outcomes as Vitamin D binding receptors are located through out body, and epidemiological data supports its link with many conditions. Data on vitamin D levels and especially Vitamin D supplementation in U.A.E. is essentially inadequate.

Design: Subjects (n = 20) in this 1 month prospective study were given 2000 IU of daily Vitamin D without any special dietary or physical activity changes. Anthropometrics (weight, waist circumference, hip circumference), Vitamin D/ Calcium food frequency questionnaire and 24 –Hour recall were collected.

Results: Mean age of subjects was 28.7 years, and baseline mean serum Vitamin D level of 17.5 ng/mL ±6.47. It increased Vitamin D serum levels by a mean of 6.76 ng/mL. Hip Circumference also reduced statistically significantly by moderate 2% (p 0.03 ± 0.59),

Conclusion: Vitamin D supplementation moderate dose daily can be pivotal in acquiring health benefits and reducing adiposity related factors. However, this surely calls for further investigation for longer period.

Keywords: Vitamin D; weight loss; body mass index; Calcium, VDR

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1. Introduction

Literature reviews have abundantly identified Vitamin D deficiency and insufficiency as a pandemic since decades, with initial review specifically addressing this issue in terms of skeletal importance [11, 23]. According to the Institute of Medicine (IOM) Committee, the scientific evidence supports key role of Vitamin D in skeletal health and extraskeletal health, however, the extraskeletal health research outcomes are not yet consistent to establish cause-and-effect relationship (Institute of Medicine [14]. Vitamin D is considered to mediate its genomic role through Vitamin D binding receptors that are transcription factor responsible for extensive biological responses. It is shown to play role in cell proliferation inhibition, cell maturation, or in many other tissues, such as, skin, immune system, and possibly colonic, breast and prostate cancer [26]. This Hypovitaminosis D would be further discussed in terms of its potential relationship with chronic diseases, specially focusing on obesity as the basic agenda.

In the 2011 conference of Institute of Medicine, the RDA for Vitamin D was set at 600 IU/d for ages 1-70 years and 800 IU/d for ages 71 years and older(Institute of Medicine [14]. However, the doses are still subjective, especially in obese population. Vitamin D deficiency is defined as a 25(OH)D below 20 ng/ml (50 nmol/liter) and vitamin D insufficiency as a 25(OH) D of 21–29 ng/ml (52.5–72.5) nmol/liter [12]. Humans may meet these needs through endogenous production, but the dietary sources support increased demand.

Factors to explain Vitamin D deficiency have been described from long times. Sunlight exposure is the key player in natural production of Vitamin D, and any factor influencing the access to the specific Ultraviolet B rays range for Vitamin D effect cutaneous synthesis of Vitamin D. This can include sunscreen use, increased skin pigmentation, angle at which sun reaches the earth (angles at zenith), time of day, season covering body completely at all times outside, aging as precursor of Vitamin D_3 reduces in body, and obesity due to fat storage in adipocytes [13, 24].

WHO states that in 2014 more than 1.9 billion adults were overweight, of which 600 million were obese(WHO, 2015). The avoidable risk factors for the healthy years lost due to rising disease burden include high BMI and physical inactivity according to the Global Burden of Disease report of USA, [14]. Obese people had two fold higher chances of having multi-morbidities [1]. In many studies. on various chronic conditions, overweight and obesity were considered to be major contributors to burden of chronic diseases [6, 16, 18]. Obesity is also linked as a risk factor for several cancers, with obese patients having poorer prognosis and response to standard treatment [21]. Obesity is majorly an imbalance between energy intake and expenditure. The key to manage obesity and chronic conditions could be through diet.

Many studies report changes in Vitamin D status with BMI changes. A change in serum Vitamin D levels as a function of adiposity/weight loss was noted over 1-2 years [4, 8]. An inverse relationship between Vitamin D and BMI was recognized in mendelian randomization analysis [29], and link with visceral or subcutaneous adipose tissue was also recognized [10, 17]. In meta-analysis of observational studies until April 2014 in PubMed/Medline, an association between obesity and Vitamin D was found, irrespective of age, latitude and cut-offs to define vitamin D deficiency [22]. BMI was strongly associated with plasma 25(OH)D and PTH concentrations with possible contribution of plasma 25(OH)D in the pathogenesis of hypertriglyceridemia and atherogenic dyslipidemia through inflammation, because the association disappeared when uCRP (ultrasensitive C Reactive Protein) was introduced as covariable [9]. 25OHD low levels and unfavorable lipid patterns has been found in children too [25].

The purpose of this study is:

1. To identify Vitamin D status of Emarati females in a convenient sample from Abu Dhabi and their dietary Vitamin D and Calcium consumption.
2. To explore changes in Vitamin D levels with supplementation of 2000 IU of Vitamin D3 for 1 month in Vitamin D deficient and insufficient females.
3. To explore changes in selected anthropometrics after intervention.
4. Compare changes in selected anthropometrics of Vitamin D deficient and insufficient subjects after intervention.
5. Compare changes in selected anthropometrics between marginally underweight + normal weight and overweight + marginally obese subjects after intervention

2. Methodology

The prospective intervention study included 24 healthy female residents and nationals of Abu Dhabi, U.A.E with end-results subject size of 21 females. Full Ethical Clearance from Zayed University research committee was obtained for this study, and all subjects signed a consent form.

2.1. Participants

Females from Zayed University and in general community between 18-45 years were conveniently asked to participate in this research. The exclusion criteria with potential participants were discussed before recruit to prevent dropout, however, all participants were finalized after screening by their first blood results. The exclusion criteria included pregnancy, breast-feeding status, renal disease, pre-existing parathyroid, thyroid, or calcium metabolism disorders, sarcoidosis, intake of calcium channel blockers, diabetes, active malignancies (other than non-melanoma skin cancer), Vitamin D supplementation intake in past 6 months.

Participants were invited and recruited from 1st February 2016 until 28th February 2016. An information sheet was circulated disclosing the detail of the procedure to provide complete information. Subjects signed consent from to voluntarily agree and commit to protocol.

2.2. Anthropometric Information

Adiposity measures were measured using weight, BMI, Waist Circumference, Hip Circumference, Waist-to-hip ratio. Anthropometric information was collected at the baseline and after 1 month. The height measurement was taken using portable stadiometer standing in an upright position, to the nearest 0.5 cm, and weight on an electronic scale with accuracy of ±0.1 kg without shoes and light clothing before breakfast in early morning between 6am to 10am. Waist and Hip circumference were recorded at each visit using non-stretchable measuring tape (measured to nearest ± 0.5cm) according to the standard procedure by World Health Organization (WHO) [13]. Waist circumference was taken with placement of measuring tape around the midpoint between the bottom of the rib cage and above the tip of the iliac crest. Subjects stood with arms at the sides, feet positioned close together, and weight evenly distributed across the feet. They were requested to inspire and expire normally first, and then waist was measured, in accordance to WHO standards [13]. Hip circumference to further calculate Waist-to-Hip ratio was taken as the largest circumference of the buttocks with tape running parallel to the floor [30]. Women: > 88 cm (35 inches), Men: > 102 cm (40 inches) waist circumference were classified as abdominally obese (National Institute of Health). Abdominal obesity is further defined as waist–hip ratio above 0.90 for males and above 0.85 for females, or a BMI above 30.0 [30]. Body mass index will be calculated as bodyweight divided by body height squared.

2.3. Questionnaires

A general questionnaire was given to all participants for screening purposes with questions regarding their medical conditions, age, smoking status, and were also asked to self-identify their weight and physical activity status.

2.4. Dietary Information

Food frequency questionnaire that has previously been validated in Zayed University students was used to assess Vitamin D and calcium intake amongst participants at beginning of the study and at the end (Papandreou et al., 2014). It includes foods with Vitamin D and Calcium commonly consumed in U.A.E , such as, Milk, tea, yogurt, cheeses, greens, breads, fish, eggs etc, and was listed in standard serving/ portion sizes with pictures to assist further. Participants mentioned their average serving per day and per week, which was then used to find an average consumption of Vitamin D and Calcium per day.

	Frequency	Percent	Cumulative Percent
Deficient	9	43	43
Insufficient	11	52	95
Sufficient	1	5	100
Total	21	100	

Table 1: Sample distribution by Vitamin D sufficient, insufficient and deficient categories.

24-Hour recall was collected at baseline and at the end to identify the patient's intake and assess if it was maintained throughout the study period. As per study protocol, all subjects consumed 2 tablets for 1000IU (as available in pharmacies) together before food, every day for 1 month. The tablets consumed were counted in the periodically.

2.5. Statistics

The data accumulated was processed using SPSS version 18 software. Descriptive statistics were used to explore baseline characteristics and normal distribution using the histograms, kurtosis, skewness and Q-Q plots. Final decision for normality was based on Kolmogorov-Smirnova test. In descriptive analyses, continuous variables were reported as mean +/- SD (Standard Deviation) and/or median with IQR (interquartile range) in the case of non-normally distributed continuous data. Levene's test was used to look at variances in group for normaly distributed data. Paired sample T-test was used to analyze changes from baseline after treatment in normally distributed data. Mann-whitney U test for analyzing heterogeneity between two independent groups for non-normal data and Wilcoxon for after intervention effects in continuous data in paired samples.

3. Results

The final subject size includes 20 females for which results were analyzed statistically.

3.1. Subject Characteristics

Subjects from this sample included almost equal size of females with deficient and insufficient category of Vitamin D serum levels. For observing changes in Vitamin D levels with supplementation in deficient or insufficient categories, the participant with sufficient Vitamin D level was excluded.

BMI Categories	Frequency	Percent	Cumulative Percent
Underweight	2	10	10
Normal weight	8	40	50
Overweight	8	40	90
Obese	2	10	100
Total	20	100	

Table 2: Subject distribution by BMI categories Obesity.

	Mean	Std. Deviation	Median	Interquartile Range
Age (yrs)	28.7	9.26	24.5	17
Calcium (mg/dL)	9.3593	0.28901	9.34	0.3
Vitamin D (ng/mL)	17.51	6.47	16.2	8.25
Calorie Intake (Kcal/day)	1248.2	359.8	1167	479
MET-minutes/week	2036.45	1976.83	1234	2392
Dietary Vitamin D intake (IU/day)	289.25	246.11	180	410
Dietary Calcium Intake (mg/day)	1618.6	858.38	1505	1428
Weight (Kg)	62.63	11.89	64.3	20.52
BMI (Kg/m^2)	24.54	4.66	25.9	8.1
Waist Circumference (inches)	29.65	3.96	29.5	5.88
Hip Circumference (inches)	39.75	4.05	40.5	8.5
Waist-to-hip ratio	0.74	0.05	0.74	0.07

Table 3: Baseline Characteristics of the subjects.

Subjects by their BMI were equally distributed. 10 females were in normal weight and by a small margin in underweight category, and other 10 subjects in overweight or marginally obese category.

Baseline characteristics of subjects are demonstrated in the following table with mean values and their standard deviations for all normally distributed data, and/or median with their interquartile ranges for non-normally distributed data indicated with. Calcium, Vitamin D, Calorie intake, Dietary Calcium intake, Weight, BMI, Waist Circumference, Hip Circumference and Wasit-to-hip ratio are normally distributed, and their mean and standard deviation are more representative of sample population. Whereas, for rest of the variables, due to non-normal distribution, Table 3. shows the average age for this study subjects was 28.7 and Vitamin D was 17.5 ng/mL. The Dietary Vitamin D consumption was low as compared to the guidelines by Endocrine society [12].

All the subjects improved their Vitamin D status, and many reached optimal levels.

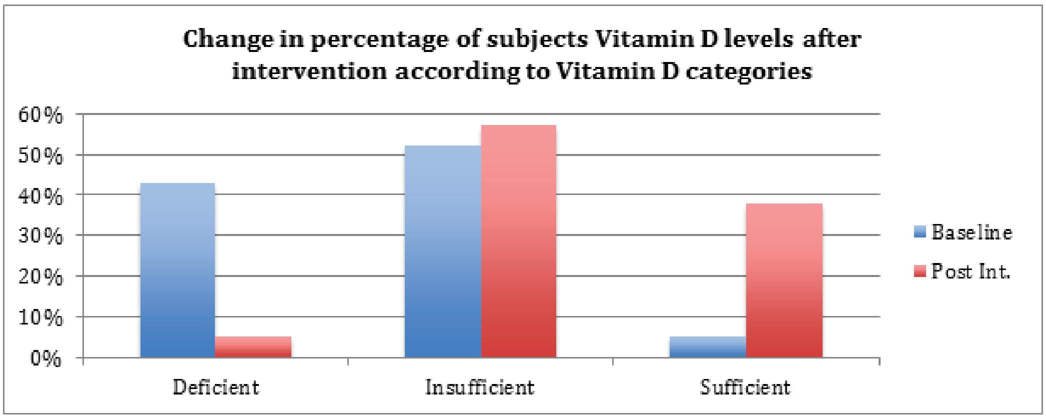

Figure 1: Improvement in Vitamin D status depicted as percentage change from baseline.

4. Discussion

Endocrine society recommends adults aged 19-50 years to consume 600 IU/d to maximize bone health and muscle function. And, to further rise Vitamin D serum levels above 30 ng/mL they require at least 1500 – 2000 IU of Vitamin D. However, as observed in this data the dietary Vitamin D is inadequate to meet the regular needs and thus can explain deficiency in U.A.E. females. Moreover, since this study was conducted during spring and/or early summer it is assumed that outdoor exposure to sunlight was more than rest of the year, but still the Vitamin D levels did not reach above 30ng/mL to sufficient levels in this sample. This study supports the previous results of very high Hypovitaminosis D in U.A.E. females [3, 19, 28]. Other significant result noticeable is that dietary Vitamin D is not linked to Vitamin D status in general population of Emarati females from Abu Dhabi, and this was also observed in previous studies in university sample from Abu Dhabi [2], hence supplement use might me be the best way to achieve Vitamin D sufficient levels in this temperate country females. In this study Vitamin D supplementation of 2000IU for 1 month yielded 39% increase in Vitamin D level from baseline (mean change of 6.76 ng/mL), thus supporting the thesis.

The results of this study do not report significant changes in weight or BMI, and this is consistent with a meta-analysis which concludes that BMI and body weight were less meaningful measure for reporting adiposity change after Vitamin D supplementation compared to fat mass and distribution [5]. Although clinically mild change of -2%, but statistically significant relationship was observed between Vitamin D supplementation and hip circumference, and only a small change in waist circumference of 1% reduction was observed, which is better than changes in BMI or weight (0% change), and thus also supports the previous conclusion. This could be explained by the alteration in expression of inflammatory cytokines, as it was previously discussed that cytokines may be differently expressed in subcutaneous or visceral adipose tissue. Some studies do not support any link between Vitamin D supplementation and obesity. Supplementation with vitamin D showed no effect on adiposity measures in adults [5] An increase in serum levels of 25OHD or other inflammatory markers in overweight and obese youths with 150,000IU supplementation every 3 months was not registered in one study, which demands investigation regarding potential dosage and frequency [27] since, another trial with dosage as low as 400IU up till 4800IU daily yielded serum changes when administered for 12 months [7]. Hypovitaminosis D in overweight or obese individuals is registered in many studies, usually accompanied with other health conditions.

5. Study Limitations

One of the major limitation of this study was that in the last 2 weeks of intervention period it was spring break, due to which few subjects were active by maximum 100 MET-minutes/week more than baseline. This also resulted in weight increments for few subjects as 4 subjects reported overeating or out-of-normal eating, and this was also reflected by increment in their calorie consumption in 24-hour recall at the end of the study. Other limitation was the small subject size due to exclusion criteria, blood test, and especially going to a specific facility for blood test because this was the main reason of refusal upon invitation for participation.

Most of the studies have been carried out for atleast 8 weeks and commonly 12 weeks, and even endocrine society recommends Vitamin D supplementation for 8 weeks to achieve optimal serum levels. This study due to time restraints could be carried for 1 month, however, the strength lies in its results, which are in accordance with previous studies, and it also demonstrates strong statistical significance for those results. Longer duration trial would surely be helpful and would allow to further asses the requirement of maintenance plan. One variable that was missed in this study for investigation was to assess the sun exposure or sun avoidance in the subjects to find any relationship with improvement in Vitamin D status. A control group similarly could have assisted further in comparing the results.

6. Conclusion and Recommendations

The latest research supports Vitamin D role in obesity prevention and occurrence. Vitamin D supplementation trials reflect the benefits too, however, due to heterogeneity in dosage, biochemical analysis, trial period, BMI variations etc, further trials are needed because some review analysis do not support the conclusion, and specifically designed trials with minimal heterogeneity can answer those questions.

This study supports the high Hypovitaminosis D figures in UAE females as reported previously. It can be concluded that Vitamin D supplementation has mild effects on reducing weight or BMI, however, as per previous study it supports changes in fat mass by reduction in hip and waist circumference in subjects. This study also evaluates the dietary role of Vitamin D but there was no relationship with serum Vitamin D, hence in this population supplements could be more pivotal. Further studies on variable doses of Vitamin D and maintenance therapy are needed because data on Vitamin D in UAE population is higly inadequate to make references to the whole population. Supplementation can be the best approach, because it has been shown from a previous study on UAE population and in this study that serum Vitamin D and dietary Vitamin D do not follow a strong correltion.

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