ORIGINAL ARTICLE

Impact of Vitamin D3 Supplementation on Overweight and Obese Individuals

Muaz Bin Sajjad[1], Muhammad Imran Sohail[2], Ghulam Mujtaba Nasir[3], Juwayria Omar[4], Haroon Rashid Khan[5], Saba Sohail[6]

Author`s Affiliation

[1]Polio Eradication Officer WHO. Sawabi
[2]Polio Eradication Officer WHO. Rawalpindi
[3]Ministry of Health, Saudi Arabia
[4]Assistant Professor, Fazaia Medical College, Air University, Islamabad
[5]Senior Lecturer, Department of Community Medicine Islamabad Medical and Dental College, Bahrakahu Islamabad
[6]Clinical Assistant at May Van Clinic, Canada

Author`s Contribution

[1,2]Conception, Synthesis and Planning of the research
[3,5]Active participation in active methodology
[4,6]Interpretation, analysis and discussion

Article Info

Received: April 22, 2018
Accepted: Sept 18, 2018

Funding Source: Nil
Conflict of Interest: Nil

Address of Correspondence
Dr. Ghulam Mujtaba Nasir
gnnasir@moh.gov.sa

Cite this article as: *Sajjad MB,Sohail MI, Nasir GM, Omar J. Khan HR, Sohail S. Impact of Vitamin D3 Supplementation on Overweight and Obese Individuals Ann. Pak. Inst. Med. Sci. 2018;14(3): 239-244.*

ABSTRACT

Objective: To determine the effect of Vitamin D3 supplementation on overweight and obese individuals

Methodology: This descriptive Cross Sectional Study was done. The participants in the study were selected from medical outpatient departments of three public sector hospital of Islamabad and Rawalpindi, from January to June 2018. All overweight of obese patients were randomly divided into two equal groups of 88 participants in each group, by random number table method. Group A was an intervention group who were given vitamin D3 and Group B, was given placebo. Vitamin D3 (dose) supplementation was given for 12 weeks. Anthropometric parameters including BMI, waist circumference, and waist to hip ratio was recorded at the start of the study and was noted on a predesigned performa. After completion of treatment repeat serum Vit. D3 level and anthropometric measurements were done.

Results: The mean age in vitamin D group was 38.46 ±7.28 years and in placebo group 37.85±8.25 years. There was insignificant (p-value > 0.05) difference in body weight (76.56±11.25 vs. 75.85±10.76) before and after intervention among participants of vitamin D group. The comparison of waist circumference (92.78±7.35 vs. 92.24±7.21) and hip circumference (107.74±7.45 vs. 106.45±7.12) showed no any significant (p-value > 0.05) change after the intervention. There was a minor change in BMI on baseline 29.65±3.26 and after three months of intervention 29.38±3.1 kg/m2 but this difference was not statistically significant (p-value > 0.05).

Conclusion: The supplementation with vitamin D3 during 12 weeks did not improve the anthropometric parameters like body weight, waist and hip circumference and BMI. So the correction of serum vitamin D3 level does not help in decreasing the anthropometric parameters.

Keywords: BMI, Vitamin D3 supplementation, anthropometric parameters, Obesity

Introduction

The increase in sedentary lifestyle due to decreasing physical activity in our routine life and augmented caloric intake has become a major reason for the rise in obesity. Obesity is a medical condition which results due to excessive fat deposit in the body and have many serious consequences. There are severe effects of obesity on health and is one of the major independent risk factor for many non-communicable diseases like hypertension, diabetes mellitus, cardiovascular diseases, hyperlipidemia, osteoarthritis and certain types of cancers.[1] Obesity has terrible effect on financial loss due to health-related expenditures and significantly increased chances of non-communicable diseases and reducing overall productivity of the society.[2]

The global epidemic of obesity has not spared Pakistan and warrants immediate attention. This is especially important in South Asia, where malnutrition is given its due attention, and obesity tends to be overlooked. Not only is obesity an independent determinant of poor health outcomes, it also contributes to other potentially fatal downstream effects.[3] According to the 2016 World Health Organization (WHO) statistics, 20.8% of the population is overweight and 4.8% is obese. The constancy of these numbers over a decade implies that overweight has become endemic to Pakistani society.[4] This health problem, which is becoming alarming requires urgent consideration because it is preventable with appropriate measures. A lot of factors are responsible for the pathogenesis of obesity. The main contributing factors include genetic, hormonal, metabolic and nutritional factors, similarly one of the major contributors is the sedentary lifestyle and eating habits.[5] Caloric imbalance based upon energy intake and poor energy consumption behaviors are mainly responsible for overweight and obesity. The population especially of developing countries including Pakistan have changed the concept of healthy diet and physical activity in the routine life. The imbalance of energy intake and consumption make the population more prone to obesity. The diet in Pakistan is usually based upon the high saturated fats, trans-fatty acids and free sugar which contribute towards the high caloric intake.[6]

A series of data in the literature has established the relationship between obesity and vitamin D deficiency, correlated with an elevated level of the parathyroid hormone. The pandemic incidence of obesity and vitamin D deficiency are real public health problems worldwide. The reversed relationship between obesity and vitamin D deficiency is well-known, while the inflammation of the adipose tissue is the underlying cause of the metabolic syndrome. The action of vitamin D on the adipose tissue via VDR is still a controversial subject.[7,8]

Vitamin D deficiency might be a risk factor for developing obesity; various studies have reported its association with obese or over weight individuals. Study by Salehpour et al. has reported that if Vitamin levels were brought back to normal has a positive impact on weight loss as well. However some other studies have reported an uncertain relationship between Vit D levels and BMI.[9] The objective of our study was to determine the association of vitamin D3 and Body Mass index (BMI) in obese or over weight individuals and also determine the effect of Supplementation of Vit D3 on BMI in our setup

Methodology

This randomized controlled trial study was started after taking approval from the hospital ethical committee. The participants in the study were selected from medical outpatient departments of three public sector hospital of Islamabad and Rawalpindi including Pakistan Institute of Medical Sciences (PIMS), Holy Family hospital and Poly Clinic hospital. The study duration was six months from January to June 2018. In this study a total of 176 subjects were included and the sample size was calculated with the help of WHO sample size calculator taking the level of significance 5%, the power of study 80%, population standard deviation 2, mean BMI in intervention group 26.9 and mean BMI of 27.5 in control group.[10]

All the participants in the study were apparently healthy as reported by the subjects themselves. The inclusion criteria for the study was all the subjects having age between 18-50 years of both genders and presented with obesity based on BMI $>$ 25 kg/m2 were enrolled for the study. The subjects with any chronic disease like metabolic, gastrointestinal, cardiovascular, or renal disease, and subjects on any medication or taking vitamin supplements, and subjects following any weight loss program were excluded from the study.

The total sample of 176 subjects was randomly divided into two equal groups of 88 participants in each group, by random number table method. Group A was an intervention group that is vitamin D group which were given vitamin D3 supplement tablet of 25 µg/d as cholecalciferol. Group B, the placebo group took the tablet of 25 µg/d as lactose. The placebo tablets were similar in color, size, and packing. Vitamin D3 supplementation was given for 12 weeks. Vitamin D supplementation was issued at baseline, 4 weeks and 8 weeks. All the participants were advised to maintain their usual dietary plan for 12 weeks of the

intervention period and contact the study staff by telephone if they had any inquiries.

The body weight and height were measured close to 0.1 unit in light routine clothes using digital scales. The iliac crest level on the horizontal plane was used to measure the waist and hip circumferences. The body mass index (BMI) was calculated by the following formula

$$BMI = \text{Weight in Kg} / (\text{Height in meters})2$$

Information regarding demographics like name, age, gender and anthropometric parameters including BMI, waist circumference, and waist to hip ratio was recorded at baseline at the time of inclusion in the study and was noted on a predesigned performa. After completion of treatment repeat serum Vit. D3 level and anthropometric measurements were taken after 3 months. Data was also collected about the dietary habits and their daily exposure to sun light. Daily exposure was taken as less than or more than 20 minutes of sunlight.

All the collected data was entered and analyzed by SPSS v. 21. Mean and standard deviation was calculated for quantitative data and frequency with percentages were presented for qualitative data. Independent and paired sample t-tests were applied to compare the quantitative data within and between both groups. P-value < 0.05 was taken as significant.

Results

In this randomized controlled trial study a total of 176 participants were enrolled consisting on 88 participants in both intervention and placebo groups. The mean age in vitamin D group was 38.46 ±7.28 years and in placebo group 37.85±8.25 years. The mean body weight and height of the subjects in the intervention group was 76.56±11.25 kg and 158.65±6.38 cm and in placebo group it was 75.48±12.09 kg and 159.75±5.95cm. The average waist and hip circumference was recorded as 92.78±7.35cm and 107.74±7.45 cm in the intervention group and 91.49±8.25cm and 108.39±8.09cm in placebo group. Mean body mass index at baseline in the intervention group was 29.65±3.26 kg/m2 and in placebo group it was 28.85±4.36 kg/m2. The value of mean vitamin D level on the basis of 25(OH)D was recorded 37.34±29.3 (nmol/L)2 in the intervention group and 41.64±31.28 (nmol/L)2 in the placebo group at baseline as elaborated in table I.

Table I: Baseline characteristics of the participants

characteristics	Vitamin D group		Placebo group	
	Mean	SD	Mean	SD
Age of the participants	38.46	7.28	37.85	8.25
Body Weight (kg)	76.56	11.25	75.48	12.09
Height (cm)	158.65	6.38	159.75	5.95
Waist Circumference (cm)	92.78	7.35	91.49	8.25
Hip Circumference (cm)	107.74	7.45	108.39	8.09
Body Mass Index (BMI) kg/m2	29.65	3.26	28.85	4.36
25 (OH) D (nmol/L)2	37.34	29.3	41.64	31.28

The comparison of baseline anthropometric parameters with results of after intervention parameters showed that there was some difference in body weight (76.56±11.25 vs. 75.85±10.76) before and after intervention among participants of vitamin D group but this difference was not statistically significant (p-value >0.05). The comparison of waist circumference (92.78±7.35 vs. 92.24±7.21) and hip circumference (107.74±7.45 vs. 106.45±7.12) showed no any significant (p-value > 0.05) change after intervention and remained almost same after three months intervention of vitamin D.

The comparison of BMI at baseline and after the intervention to see the effect of vitamin D intervention on body mass index, showed a minor change in BMI on baseline 29.65±3.26 and after three months intervention 29.38±3.1 kg/m2 but this difference was not statistically significant (p-value > 0.05). The comparison of mean 25(OH)D level showed a significant (p-value < 0.05) improvement after three month vitamin D supplementation and it improved form 37.34±29.3 (nmol/L)2 to 71.66±26.5 (nmol/L)2. Similarly, there was no significant (p-value > 0.05)

difference in placebo group in mean values of anthropometric parameters at baseline and after three months as elaborated in table II.

There was no significant (p-value > 0.05) difference in mean body weight (75.85±10.76 vs. 75.29±11.78, p-value = 0.742) of the treatment group and placebo group. The waist circumference showed no significant (p-value > 0.05) difference between vitamin D group (92.24±7.21) and placebo group 91.15±8.08 after three months. Hip circumference had some difference between intervention group 106.45±7.12 and placebo group 107.78±7.68 but this difference was not statistically significant (p-value > 0.05). According to the results the mean BMI in intervention group 29.38±3.1 after three months intervention was similar to mean value of BMI in placebo group 28.82±4.26 after three months.

There was significant (p-value < 0.05) difference in mean level of vitamin D on the basis of 25(OH)D after three months. The mean value of 25(OH)D in vitamin D group was noted 71.66±26.5 and in placebo group it was found 48.46±28.6 as elaborated in table III.

Discussion

Calcium homoeostasis and bone health have a significant relationship with vitamin D. It has been observed that it has an anti-obesity effect. There is an inverse relationship of vitamin D level with body weight, BMI, abdominal fat and skin fold thickness.[11] Adipose tissues are storage place for vitamin D. It has been observed in in-vitro studies that 10-20% of vitamin D supplementation is deposited in adipose tissue. The concentration of vitamin D in adipose tissue is directly proportional to vitamin D release from fat tissue, which is a very slow process. The accumulation of vitamin D in the adipose tissue might explain why obese people have low vitamin D blood levels.[12, 13] The effect of vitamin D on weight loss has been observed but the mechanism by which it affects the weight loss has not been studied in detail. But it is consider that lipid metabolism has a link with it. Adiponectin is an important hormone, involved in lipid metabolism and is considered to be related with mechanism of vitamin D's effect on weight loss. [14]

It has been reported that serum 25(OH)D3 concentration, the best indicator of body vitamin D

Table II: Comparison of Baseline and after intervention anthropometric parameters in study group

Anthropometric Parameters	Baseline		After Intervention		P-value
	Mean	SD	Mean	SD	
Body Weight (kg)	76.56	11.25	75.85	10.76	0.669
Waist Circumference (cm)	92.78	7.35	92.24	7.21	0.698
Hip Circumference (cm)	107.74	7.45	106.45	7.12	0.242
Body Mass Index (BMI) kg/m2	29.65	3.26	29.38	3.1	0.574
25 (OH) D (nmol/L)2	37.34	29.3	71.66	26.5	0.000

Table III: Comparison of anthropometric parameters between Vitamin D and Placebo groups

Anthropometric Parameters	Vitamin D group		Placebo group		P-value
	Mean	SD	Mean	SD	
Body Weight (kg)	75.85	10.76	75.29	11.78	0.742
Waist Circumference (cm)	92.24	7.21	91.15	8.08	0.346
Hip Circumference (cm)	106.45	7.12	107.78	7.68	0.235
Body Mass Index (BMI) kg/m2	29.38	3.1	28.82	4.26	0.32
25 (OH) D (nmol/L)2	71.66	26.5	48.46	28.6	0.000

status, has an inverse relationship with bodyweight and the risk of obesity decreases in people with a high concentration of serum 25(OH)D3.[15] The presence of vitamin D receptor (VDR) in adipose tissues may suggest that this vitamin possibly plays a role in the control of fat metabolism and is linked to bodyweight management.[16] A recent meta-analysis has shown that low 25(OH)D3 concentration is independently linked to abdominal obesity and hyperglycemia.[17] One study showed that low circulating levels of calcidiol could predispose individuals to fat accumulation.[18]

According to the result of this present study the comparison of baseline anthropometric parameters with results of after intervention parameters showed that there was some difference in body weight (76.56±11.25 vs. 75.85±10.76) before and after intervention among participants of vitamin D group but this difference was not statistically significant (p-value >0.05). The comparison of waist circumference (92.78±7.35 vs. 92.24±7.21) and hip circumference (107.74±7.45 vs. 106.45±7.12) showed no any significant (p-value > 0.05) change after intervention and remained almost same after three months intervention of vitamin D. The comparison of BMI at baseline and after intervention to see the effect of vitamin D intervention on body mass index, showed a minor change in BMI on baseline 29.65±3.26 and after three months of intervention 29.38±3.1 kg/m2 but this difference was not statistically significant (p-value > 0.05).

In this study it was observed that the anthropometric measurements, body weight, BMI, waist and hip circumference were not significantly affected by vitamin D supplementation. Though some studies have shown a substantial association of body fat mass and lean body mass regulation with serum 25(OH)D level.[19, 20] but the results are not consistent in different clinical trials. A meta-analysis of 12 clinical trials has revealed that there was no significant decrease in body fat mass or body weight with vitamin D supplementation without restricting the caloric intake.[21] In another study by Sadiya et al it was observed that vitamin D supplementation did not change the percentage of body fat mass or waist circumference.[22]

Many studies have concluded that weight, body fat mass and waist circumference decreased considerably after vitamin D supplementation but our current study showed contrasting results of no effect of vitamin D on anthropometric parameters that vitamin D supplementation with 1000 IU vitamin D for three months has no impact on BMI, waist circumference and percentage of body fat mass. [23.24]

There are credible mechanisms and some in vitro evidence supporting a role for vitamin D in weight reduction but it remains difficult to determine which effects are due to vitamin D itself and which are mediated via calcium or other factors.

Many clinical trials could not establish any clear outcome from the study. Results from different studies were contradictory some have shown a significant effect of vitamin D supplementation on body fat and fat free mass and some other have shown no effect of vitamin D supplementation on anthropometric parameters and body fat mass. It can be inferred that vitamin D supplementation do not affect the anthropometric markers like body weight, BMI, waist and hip circumference but it can affect the fat mass distribution. To clarify the relationship of vitamin D and weight loss among obese and overweight individuals, high quality interventional studies are required. The available knowledge and literature do not have enough scientific evidence, which can be used as a basis to prevent or treat the obesity with vitamin D supplementation.

Conclusion

It can be concluded that in healthy adults with low in vitamin D level, the supplementation with vitamin D3 during 12 weeks did not improve the anthropometric parameters like body weight, waist and hip circumference and BMI. So the correction of serum vitamin D3 level does not help in decreasing the anthropometric parameters. There is no statistically significant association of a reduction in BMI status with the correction of serum vitamin D levels.

References

1. Tanzil S, Jamali T. Obesity, an emerging epidemic in Pakistan - a review of evidence. J Ayub Med Coll Abbottabad 2016;28(3):597–600.
2. Swinburn BA, Sacks G, Hall KD, McPherson K, Fine good DT, Moodie ML, et al. The global obesity pandemic:

shaped by global drivers and local environments. Lancet 2011;378(9793):804–14.
3. Jafar TH, Haaland BA, Rahman A, Razzak JA, Bilger M, Naghavi M, et al. Non-communicable diseases and injuries in Pakistan: strategic priorities. Lancet 2013; 381: 2281-90.
4. World Health Organization 2016. [online] [cited 2017 Dec 23]. Available from: URL: http://www.who.int/diabetes/countryprofiles/pak_en.pdf?ua=1.
5. Samir N, Mahmud S, Khuwaja A. Prevalence of physical inactivity and barriers to physical activity among obese attendants at a community health-care center in Karachi, Pakistan. BMC Research Notes 2011; 4(1): 174.
6. Sherin A. Obesity: How to prevent Pakistani people from getting heavier? Khyber Med Univ J 2013; 5(2):59-60.
7. Stoian AMP, Badiu, Andronache LF, Carniciu, Negoiță O, Hainarosie R, et al. Supplementation with vitamin D – new opportunities in obesity. Proc. Rom. Acad., Series B. 2017;19(3):161–6.
8. Vanlint S. Vitamin D and Obesity. Nutrients. 2013;5(3), 949–56.
9. Rasheed N, Zia S, Naqvi SU, Rasheed MI. Effect of Vit.D3 Supplementation on BMI of Obese or Over Weight Individuals. Isra Med J. 2018;10(2):109-12.
10. Madar AA, Knutsen KV, Stene LC. Effect of vitamin D3 supplementation on glycated hemoglobin (HbA1c), fructosamine, serum lipids, and body mass index: a randomized, double-blinded, placebo-controlled trial among healthy immigrants living in Norway. BMJ Open Diabet Res Care. 2014;2:e000026.
11. Vimaleswaran KS, Berry DJ, Lu C, Tikkanen E, Pilz S, Hiraki LT, et al. Causal relationship between obesity and vitamin D status: bidirectional Mendelian randomization analysis of multiple cohorts. PLoS Medicine 2013;10:e1001383.
12. Ding C, Gao D, Wilding J, Trayhurn P, Bing C. Vitamin D signalling in adipose tissue. British Journal of Nutrition 2012;108(11):1915–23.
13. Holick MF. Vitamin D deficiency. New England Journal of Medicine 2007;357(3):266–81.
14. Abdullah Thani NSI, Khairudin R, Ho JJ, Muhamad NA, Ismail H. Vitamin D supplementation for overweight or obese adults. Cochrane Database of Systematic Reviews 2015, Issue 4. Art. No.: CD011629.
15. Arunabh S, Pollack S, Yeh J & Aloia JF (2003). Body fat content and 25-hydroxyvitamin D levels in healthy women. J Clin Endocrinol Metab 88:157-61.
16. Sun X & Zemel MB (2008). 1Alpha, 25-dihydroxyvitamin D and corticosteroid regulate adipocyte nuclear vitamin D receptor. Int J Obes (Lond) 32:1305-11.
17. Pittas AG, Lau J, Hu FB & Dawson-Hughes B (2007). The role of vitamin D and calcium in type 2 diabetes. A systematic review and metaanalysis. J Clin Endocrinol Metab 92: 2017-29.
18. Grineva EN, Karonova T, Micheeva E, Belyaeva O & Nikitina IL (2013). Vitamin D deficiency is a risk factor for obesity and diabetes type 2 in women at late reproductive age. Aging (Albany NY) 5: 575-81.
19. Nikooyeh B, Neyestani TR, Farvid M, Alavi-Majd H, Houshiarrad A, Kalayi A, et al. Daily consumption of vitamin D- or vitamin D+calcium-fortified yogurt drink improved glycemic control in patients with type 2 diabetes: a randomized clinical trial. Am J Clin Nutr. 2011;93(4):764–71.
20. Salehpour A, Hosseinpanah F, Shidfar F, Vafa M, Razaghi M, Dehghani S, et al. A 12-week double-blind randomized clinical trial of vitamin D (3) supplementation on body fat mass in healthy overweight and obese women. Nutr J. 2012;11:78.
21. Pathak K, Soares MJ, Calton EK, Zhao Y, Hallett J. Vitamin D supplementation and body weight status: a systematic review and meta-analysis of randomized controlled trials. Obes Rev. 2014;15(6):528–37.
22. Sadiya A, Ahmed SM, Carlsson M, Tesfa Y, George M, Ali SH, et al. Vitamin D supplementation in obese type 2 diabetes subjects in Ajman, UAE: a randomized controlled double-blinded clinical trial. Eur J Clin Nutr. 2015;69(6):707–11.
23. ZhouJ, Zhao LJ,Watson P, Zhang Q, Lappe JM. The effect of calcium and vitamin D supplementation on obesity in postmenopausal women: secondary analysis for a large-scale, placebo controlled, double-blind, 4-year longitudinal clinical trial. Nutr Metab (Lond). 2010;7:62.
24. Rosenblum JL, Castro VM, Moore CE, Kaplan LM. Calcium and vitamin D supplementation is associated with decreased abdominal visceral adipose tissue in overweight and obese adults. Am J Clin Nutr. 2012;95(1):101–8.