EVALUATION OF THE VITAMIN D DEFICIENCY AMONG OBESE CHILDREN AND ADOLESCENTS- AN ORIGINAL RESEARCH

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ABSTRACT

Aim

The purpose of our research was to evaluate the Vitamin D deficiency amongst obese children and teens.

Methodology

A double–blind randomized placebo–controlled trial. Vitamin D deficient patients (<30 ng/ml level of vitamin D) aged 6–14, participating in multidisciplinary weight management program were randomly allocated to receiving vitamin D (1200 IU) or placebo for the first 26 weeks of the intervention.

Results

Out of the 130 qualified patients, 109 (72%) completed a full cycle of four visits scheduled in the program. There was no difference in the level of BMI (body mass index) change – both raw BMI and BMI centiles. Although the reduction of BMI centiles was greater in the vitamin D vs. placebo group (4.28± 8.43) vs. (2.53± 6.10) the difference was not statistically significant (p = 0.319).

Conclusion

Our study ads substantial results to support the thesis on no effect of vitamin D supplementation on body weight reduction in children and adolescents with vitamin D insufficiency undergoing a weight management program.

Keywords vitamin D; obesity; weight–loss; body composition.

INTRODUCTION

Childhood obesity is a worldwide problem.1It is known that overweight in childhood and adolescence is an important risk factor for obesity in adulthood, as well as for the development of comorbidities.[1]Regarding vitamin D (vit D), in addition to its role in bone health and calcium and phosphorus metabolism, its role in immune functions and in decreasing the risk of chronic illnesses has been considered.[2,3] Vit D deficiency varies by geographic region, with an estimated prevalence of 15% in a study with the general pediatric population in the United States of America from 1 to 11 years of age.[4]A similar prevalence of 14% was found in a cross-sectional survey in a representative sample of adolescents from that country aged 12-19.[5]A variety of factors have been highlighted as underlying variables to explain this large variance in serum vitamin D status; besides nutrition, the extent of sunlight exposure is arguably the most important determinant.[6] Sunlight exposure eventually depends on some other factors like geographical location, people's skin colour, attitude towards

sunlight exposure, clothing practice, etc. As such, understanding comparative variation within a region may reveal crucial clues regarding the potential determining factors of vitamin D deficiency or insufficiency (hypovitaminosis D).[7]According to UNICEF, around 627 million children (< 18 years of age) live in South Asian countries and cover up approximately 36% of the total population (1.8 billion).[8] Reported data indicates a high prevalence of nutritional rickets and other bone-related diseases, cardiovascular problems, diabetes, acute respiratory infections, tuberculosis, and other communicable diseases among South Asian children.[9] All of these can be potentially linked to the high prevalence of hypovitaminosis D in this region.

The best indicator to assess vit D status is the metabolite 25-hydroxy vitamin D (25[OH]D).[10]The relationship between hypovitaminosis D and obesity has been widely studied in the general population. A meta-analysis published in 2015 showed an association between vit D deficiency and obesity, with OR 3.43 (95% CI: 2.33-5.06).[11] Vit D deficiency and excess body fat have mutual negative effects, resulting from metabolic processes that generate accumulation of inactive forms and decreased vit D bioavailability, in addition to decreased tissue secretion and sensitivity to insulin.[12] There is no consensus as to why vit D levels are lower in obese individuals. The main hypothesis would be the absorption of vit D, which is fat soluble, by the adipose tissue.[13] Thus, it is known that obesity is related with hypovitaminosis D, with consequent greater chance of changes in glycemic control and metabolic syndrome in generalpopulation.[14,15] Although this relationship is clear in the adult population, there is no consensus on the literature regarding a higher frequency of vit D deficiency in children and adolescents with obesity.Consequently, a vitamin D deficiency in obese children seems to be associated with a significant increase of risk of many metabolic disorders associated with obesity, such as insulin resistance, hyperinsulinemia, impaired tolerance of glucose, abnormal fasting plasma glucose, symptomatic diabetes mellitus, lipid disorders and cardiovascular morbidity, namely arterial hypertension.[16] There is a number of observational studies which demonstrate the substantial role of vitamin D deficiency in developing metabolic syndrome and other complications of obesity.[17] However, we lack interventional studies to link these observations to demonstrate a causal relationship.In this study we wanted to assess the influence of 26 weeks of vitamin D supplementation inoverweight and obese children undergoing an integrated 12–months' long weight loss program on body mass reduction, body composition and bone mineral density.

AIM OF THE PRESENT STUDY

The purpose of our research was to evaluate the Vitamin D deficiency amongst obese children and teens.

METHODOLOGY

The program is a multidisciplinary, interventional program dedicated to 130 children aged 6–15 and their parents. A double–blind placebo–controlled trial. Vitamin D deficient patients (<30 ng/ml level of vitamin D) participating in multidisciplinary weight program were randomized to two arms (1:1 ratio): receiving vitamin D (1200 IU) or placebo for the first 26 weeks of the intervention. We hypothesized that the supplementation with vitamin D in obese children showing low serum 25(OH)D3 during weight–loss program could positively influence body mass index (BMI), muscle mass, bone mass and mineral density and biochemical markers of metabolic complications related to obesity compared to placebo. Study was approved by institutional ethical committee and informed consent was also taken from the concerned parents of the children participating in the study. Change in BMI was the primary endpoint.

The study period covered four appointments at the 0, 3, 6 and 12 month mark. All visits included individual meetings with a pediatrician, dietician, physical activity specialist and psychologist. Then participants were randomly assigned to one of the two trial groups of 65 children per group:

GROUP I (Vitamin D group): medical intervention, intervention of dietician, psychologist andphysical education specialist, parental education + oral administration of vitamin D3 (1200 i.u.daily) for 26 weeks.

GROUP II (Placebo group): medical intervention, intervention of dietician, psychologist and physical education specialist, parental education + daily oral administration of placebo for 26 weeks.Descriptive statistics are presented as the mean or median and standard deviation from the mean. Between groups comparisons were carried out using the Mann–Whitney U test. All statistical tests were two–tailed and performed at the 5% level of significance.

RESULTS

The patients were randomly assigned to groups: 65 to the placebo group and 65 to the Vitamin D group. Out of the 130 qualified patients, 109 (72%) completed a full cycle of four visits scheduled in the program. In the placebo group, 65 patients completed the active phase of 26 weeks of supplementation, 53 completed the comprehensive treatment program (52 week duration). (Table 1)There were no statistically significant differences between the vitamin D and placebo groups at the start of the study. Both groups had a reduction in BMI centiles. Although the reduction was greater in the vitamin D vs. placebo group (–4.28 ± 8.43 vs. –2.53 ± 6.10) the difference was not statistically significant ($p = 0.319$).The analysis showed statistically significant differences between the groups only in 25(OH) D3 concentration in the measurements taken after the

supplementation period (24.99 vs. 16.25; p = 0.000) and in the difference between second and first measurement of vitamin D levels (6.06 vs. –4.24; p = 0.000), and in the difference between second and first measurement of bone mineral density in the spine (0.04 vs. 0.06; p < 0.0256). The difference was higher in the placebo group. (Table 2)

Table 1- Basic anthropometric and clinical data of studied groups (vitamin D and placebo)

Variable	vitamin D (n = 65)		placebo (n = 65)		P value
	Mean ± SD	(95% CI)	Mean ±SD	CI (–95%)	
Age (years)	11.10 ± 2.84	10.49–11.72	10.70 ±_ 3.13	9.92–11.47	0.389
body mass (kg)	59.01 ± 21.04	54.47-63.55	56.89 ± 20.08	52.00-61.9	0.706
BMI	24.97 ± 4.12	24.08-25.86	24.53 ± 3.57	23.66-25.41	0.759

Table 2- Results of basic anthropometric and 25(OH)D concentration tests in studied groups.

Variable	vitamin D (n = 65)		placebo (n = 65)		P value
	Mean ± SD	(95% CI)	Mean ±SD	CI (–95%)	
BMI visit 1	24.97 ± 4.12	24.08–25.86	24.53 ± 3.58	23.66–25.41	0.759
BMI visit 4	24.33 ± 3.97	23.27–25.39	24.68 ± 3.46	23.73–25.64	0.479
25 (OH) D level visit 1	19.35 ± 5.46	18.16–20.55	19.79 ± 5.15	18.52–21.06	0.622
25 (OH) D level visit 4	24.99 ± 5.54	23.33–26.66	18.3 ± 6.70	16.25–20.37	0.000

DISCUSSION

Biological role of vitamin D in etiopathogenesis of metabolic syndrome represents an interesting issue. Previous studies conducted among children revealed inverse relationship between blood concentration of vitamin D and waist circumference, systolic blood pressure, insulin resistance, fasting glucose, total cholesterol, triglycerides and LDL cholesterol, as well as positive association between the concentration of vitamin D and HDL cholesterol.[18] It seems that vitamin D can interfere with secretion of insulin both directly—binding to its receptors [VDR] on pancreatic beta cells, and indirectly by modulating concentration of calcium in extracellular space.[19] Results of present study show that supplementation of vitamin D did not have a statistically significant, put potentially clinicallyimportant, influence on body mass (BMI, BMI centile) body composition or bone mineral densitycomparing to placebo groups during an organized obesity management program in children.

The results of previous studies analyzing bone mass and density in obese individuals are highly inconclusive. While some authors claimed a decrease in bone mass relative to body weight [20], others did not document significant di_erences in bone mineral density [21] or showed an increase in body mass and bone size in obese children, adolescents and adults. Increased bone mass and density observed in obese individuals is postulated to be a response to greater mechanical load, direct influence of leptin or enhanced enzymatic activity of aromatase.[22,23] Nevertheless, obesity markedly increases the risk of bone fractures in children.[24] Vitamin D plays important biological role in the process of bone maturation and mineralization. Previous studies documented an inverse relationship between blood concentration of vitamin D and bone mineral density.[25,26] One meta–analysis revealed that supplementation of vitamin D can improve both bone mineral density and bone mass in individuals with low blood levels of this vitamin. The effects of supplementation are particularly favorable in premenarcheal girls with normal body weight, in whom administration of vitamin D resulted in increases of both bone mass and fat–free mass.[27] An analysis of 58 morbidly obese teenagers showed that individuals with physiological blood concentration of PTH (parathyroid hormone) have normal bone mineral density, irrespectively of their vitamin D levels.[28] In contrast, a recently published study involving a small group of adolescents with obesity (n = 24) and normal body weight (n = 25) showed that obese people present with higher bone mineral density, irrespectively their blood concentration of vitamin D and despite lower level of physical activity than their normal-weight peers. Moreover, the differences in bone mineral density turned out to be independent from fat-free mass content. Furthermore, bone mineral density was associated with blood concentrations of leptin and insulin.[29] Our study shows clearly that we can observe an increase of bone mineral density both spinal and subtotal BMD with body mass reduction.

CONCLUSION

Our study shows that there is a limited or no effect of vitamin D supplementation on body weight reduction in children and adolescents with vitamin D insufficiency.

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