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# The Association between Overweight and Some Biological Markers among Fewer than 6 Years Aged Children

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## ABSTRACT

Body mass index (BMI)is an important indicator of overweight and obesity in childhood and adolescence. When measurements are taken carefully and compared with appropriate growth charts and recommended cutoffs, BMI provides an excellent indicator of overweight and obesity that is sufficient for most clinical, screening, and surveillance purposes. Accurate measurements of height and weight require that adequate attention be given to data collection and management. Recent years have seen a rapid increase in the incidence of obesity in children and adolescents, leading to widespread concern.Obesity is a significant health problem world-wide, particularly in developed nations it is often associated with vitamin D deficiency and secondary hyperparathyroidism. The roles of vitamin D , and parathyroid hormone (PTH) are discussed controversially in obesity, and studies of these hormones in obese children are limited. Therefore, we studied the relationships between PTH, vitamin D (25-OH) , weight status, and calcium before and um level in Iraqi patients Patients and Methods: This study assessed 45 overweight/obese children and 30 healthy (control) children .The distributions of Age , gender , serum 25-hydroxyvitamin D (25(OH)D) concentration PTH and calcium level were compared among different groups Results: The serum 25-hydroxyvitamin D (25(OH)D) concentration , calcium level was significantly lower ($p< 0.05$) in overweight/obese children as compared with control group while the parathyroid hormone and body mass index was showed significantly higher($p< 0.05$) in overweight/obese children as compared with control group Conclusions: This studies was showed an association between calcium , parathyroid hormone and vitamin D with childhood obesity. So the Children with obesity have higher risk of vitamin D deficiency

**Keywords**

parathyroid hormone; vitamin D; obesity; overweight

## Introduction

Childhood obesity is top of mind for health professionals and the public because of heightened media attention about this issue. Obesity is now undoubtedly a growing worldwide health problem. Lifestyle behaviors and diet play an important role in developing childhood obesity ( 1 )

Vitamin D is considered a prohormone, and must be metabolized to its hormonal form in order to functionand it is an essential nutrient, is primarily involved in calcium homeostasis and bone mineralization After entering systemic circulation via the skin or the lymph, vitamin D is cleared within hours via uptake by the liver or peripheral tissues, particularly adipose and skeletal muscle.The primary

role of vitamin D is in the development and maintenance of good bone health, through regulation of calcium and phosphorus homeostasis (2) In the absence of sufficient vitamin D, production of parathyroid hormone (PTH) is upregulated as a compensatory measure, resulting in secondary hyperparathyroidism.(3) Hypovitaminosis D and hyperparathyroidism are risk factors for bone loss(4)
Vitamin D deficiency and childhood obesity have been classified as epidemics throughout the world, and both share some common risk factors including poor diet and inactivity. Observational and clinical studies show that vitamin D status and fat mass are inversely correlated. It is not clear whether vitamin D deficiency contributes to, or is a consequence of obesity, or whether there are regulatory interactions between excess adiposity and vitamin D activity. The effects of this deficiency in childhood obesity appear to have negative influences on overall health, including insulin resistance, inflammation, and impeded bone mineralization, as well as increased future risk of type 2 diabetes, cardiovascular disease, and osteoporosis. The rather ubiquitous distribution of the vitamin D receptor and the 25-hydroxyvitamin D 1a-hydroxylase throughout the body, including evidence for a role of vitamin D in adipogenesis and adipocyte metabolism, may in part explain these widespread effects. Most of the findings to date suggest that the vitamin D needs of obese children are greater than the non-obese. Although ultraviolet B-induced skin synthesis is a main source of vitamin D, its use is neither feasible nor prudent due to limited sun availability for many and concerns for skin cancer. Likewise, obtaining adequate vitamin D from natural food sources alone is generally not achievable, and even in countries that allow fortification, vitamin D intakes are low. Therefore, in obese children, vitamin D supplementation is warranted. Weight loss interventions using energy restriction and physical activity may also improve the poor vitamin D status associated with obesity. More research is needed to define optimal vitamin D status in this vulnerable population, including investigations to determine the efficacy of vitamin D supplementation in attenuating the conditions associated with childhood obesity, and to further elucidate the mechanisms by which vitamin D exerts its effects on health (4)
The synthesis and secretion of parathyroid hormone (PTH) is higher in those with vitamin D
deficiency (5,6). Both PTH and 25OHD play important roles in calcium homeostasis (5).
Beside the parathyroid hormone and vitamin D , Calcium plays a role in many biological functions, especially in skeletal mineralization, as well as in muscle contraction and cell division in glycogen metabolism.(7) Calcium metabolism in the human body can be controlled by negative feedback mechanisms such as intestinal absorption, renal reabsorption, and bone storage.(8) Various hypotheses have been proposed regarding the metabolic effect of calcium on adipose tissue in the treatment of obesity.(9)

## Patients and Methods

This study enrolled children(49 boys and 26 girls) from the general pediatric population who were under 6 years old . All patients included in the study were Iraqi children in Al-Ramadi Hospital in the period January 2021 to May 2021.

**Blood testing**

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Fasting calcium serum levels were measured by colorimetric methods using a COBAS E411 analyzer (Roche Diagnostic, Mannheim, Germany). 25(OH)D levels were calculated by a high-specific chemiluminiscence-immunassay (LIAISON Assay, Diasorin, Dietzenbach, Germany), and PTH levels were determined by a highly specific solid-phase, two-site chemiluminescent enzyme-labeled immunometric assay using an Immulite analyzer (DPC Biermann, Bad Nauheim, Germany). In addition, we assessed the dynamics of annual BMI increments, defined as the change in BMI standard-deviation score per year, during childhood in 75 children.

**Result and Discussion**

Childhood obesity has both immediate and long-term effects on health. According to age and gender, this study was showed no significantly difference ($p < 0.05$) between overweight/obese children and controlgroup.

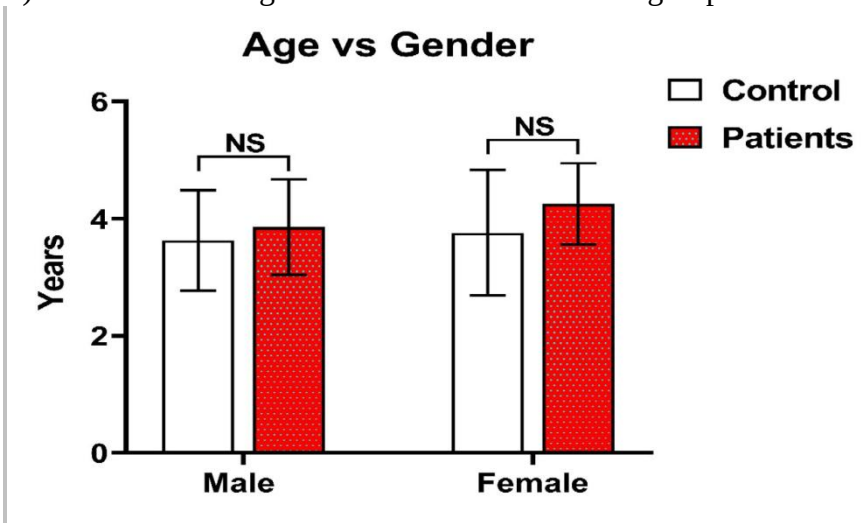


**Figure (1)** The comparison between the patients and control according to Age and Gender

While when we analyzing the result of samples according to BMI we observed there are a higher significantly differences ($p < 0.05$) in overweight/obese children as compared with control group

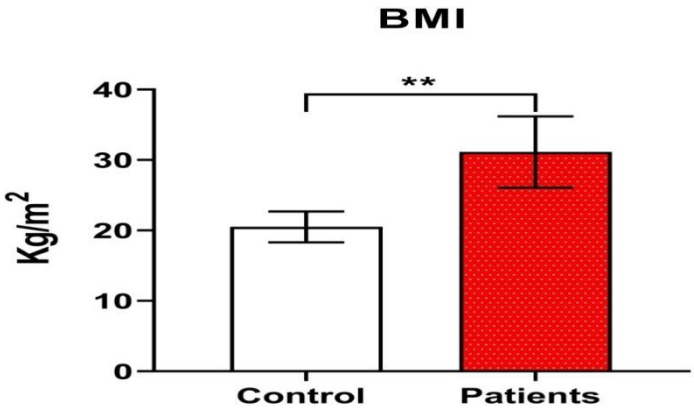


**Figure (2)** The comparison between the patients and control according to Body mass index

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Previous studies found the temporal changes in BMI from age 3 years to 6 years are significantly associated with both environmental and behavioral factors at age 6 years. The results of this study may be useful for health promotion programs designed to prevent obesity during the early stages of childhood. (10)
Increases in prevalence of overweight and obesity among both adults and children have been observedinmany countries throughout the world (11, 12 )
Many obese children already manifest some metabolic complications, and these children are at high risk for the development of early morbidity. Understanding the underlying pathogenesis of this peculiar phenotype is of critical importance (13)
Vitamin D and parathyroid hormone (PTH) are well known for their essential role in bone metabolism and calcium homeostasis.
In this study the Obesity has been found to be associated with lower levels of serum 25-OH Vit D , Calcium and higher levels of serum PTH
when we analyzing the result of samples according to Vitamin D we observed there are a lower significantly differences ($p < 0.05$) in overweight/obese children as compared with control group

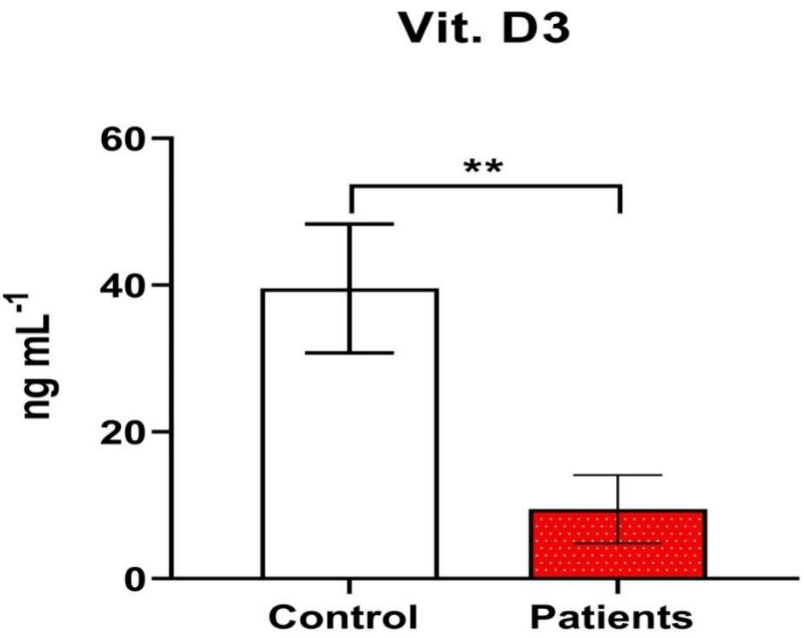


**Figure (3)** The level of 25-hydroxy-vitamin D in obese and normal weight children

A low vitamin D intake was associated with increased body mass index (BMI) (14)
The low levels of 25-OH Vit D in obese children in our study are in concordance with most studies in adults (15,16,17)
The higher vitamin D levels in normal weight subjects seem to be more a surrogate parameter for healthy nutrition than a real causal factor in the prevention of obesity. Intervention studies in obese children with vitamin D supplementation are necessary to prove this hypothesis. Furthermore, the low levels of 25-OH Vit D may be attributed to several other factors such as decreased exposure to sunlight in obese subjects due to limited mobility, clothing habits, or the excessive deposition of vitamin D in adipose tissue ( 18,19)

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Some studies reported other factors associated with vit D deficiency. Khor *et al*. demonstrated higher prevalence of vit D deficiency in girls (77.5%) than boys (66.1%), with statistical significance ($p < 0.01$). Rajakumar*et al*. show there was evidenced lower prevalence of hypovitaminosis D in individuals with white skin color, and in the summer and autumn seasons.

While in figure (4) when we analyzing the result of samples according to Parathyroid hormone we observed there are a higher significantly differences ($p< 0.05$) in overweight/obese children as compared with control group

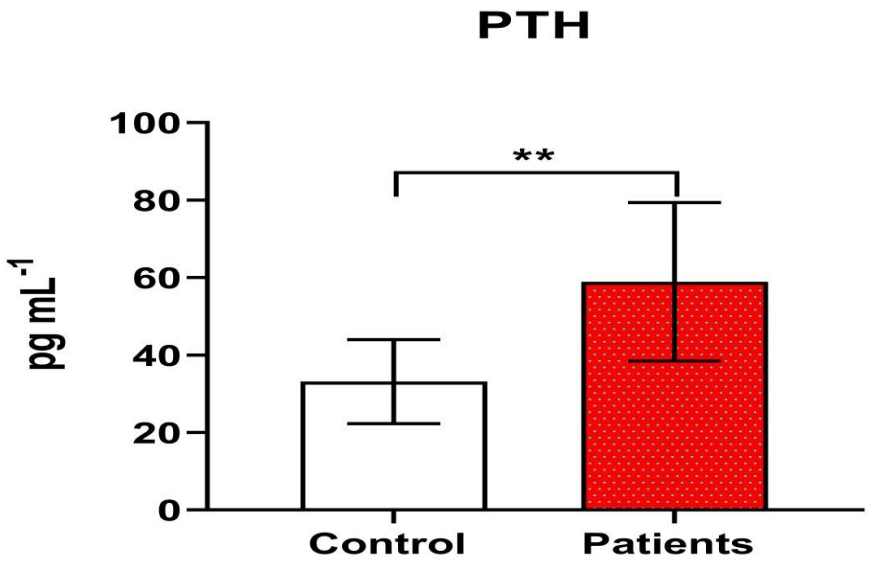


**Figure (4)** The level of Parathyroid hormone in obese and normal weight children

Parathyroid hormonehas been postulated as an independent predictor of obesity. Since patients with primary or secondary hyperparathyroidism were heavier than those in the control group, it has been postulated that increased PTH levels contribute towards obesity (22, 23, 24).

PTH stimulates the renal hydroxylation of 25-OH Vit D to its active form, 1,25-OH Vit D, which in turn elevates the calcium influx into adipocytes. In these cells, intracellular calcium enhances lipogenesis through the activation of fatty acid synthase and inhibits lipolysis via activation of phosphodiesterase 3B, which subsequently reduces catecholamine-induced lipolysis (25 ,26, 27)

Both these effects would promote lipid storage in fat tissue. Additionally, studies support a direct role for PTH in suppressing lipid oxidation in the muscle (28)

However, these hypotheses are discussed controversially since in obese adults with weight loss, increasing and decreasing 25-OH Vit D as well as decreasing and increasing PTH concentrations have been reported ( 29,30) so that the question whether the alterations of these hormones are a consequence or cause of overweight remains open.

And when we analyzing the result of samples according to Calcium level we observed there are a lower significantly differences ($p< 0.05$) in overweight/obese children as compared with control group

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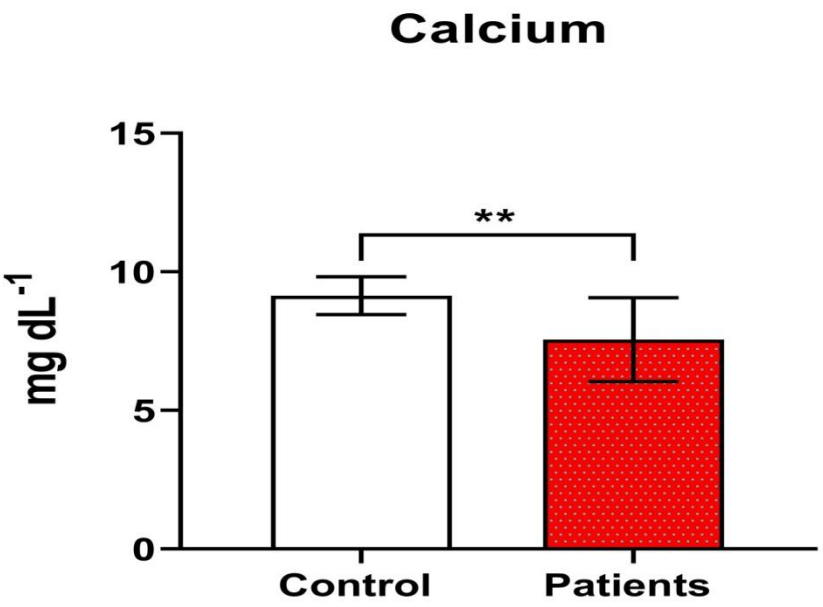


**Figure (5)** The level of Calcium in obese and normal weight children

This can be explained by the role of calcitriol in calcium absorption. Calcitriol influences active transport by increasing membrane permeability, regulating calcium migration through the intestinal cells and increasing the levels of calbindin. The fraction of absorbed calcium increases as its intake decreases, due to a partial adaptation to this micronutrient restriction, resulting in increased active transport mediated by calcitriol. Thus, the active transport becomes the main mechanism of calcium absorption when its ingestion is low. (31)

Other studies have associated the role of calcium in obesity to the effect of this micronutrient on fecal excretion of fat and appetite regulation. Dietary calcium and calcium supplements may increase the fecal excretion of fat by forming insoluble complexes in the intestine (32)

However, studies have shown that this effect is relatively small (especially with calcium supplements).(33 , 34 )

Du, X*et al* . suggested that a low supply of both vitamin D and calcium contribute to the etiology of vitamin D deficiency and both deficiencies should be corrected .Thus, this mechanism contributes to the antiobesity effect of calcium, but cannot explain it fully (32,33 ,36)It is suggested that calcium intake may interfere with appetite regulation; however, this effect was assessed in only a few studies and the hypothesis has not been confirmed. So It can be observed that many of the mechanisms that explain adiposity and its association with the assessed micronutrients demonstrate the close association between calcium and the vitamin D present in the metabolic eventsof adipogenesis, and the fact that the presence or absence of one of them can bring damage not only to bone, but health as a whole. The mechanisms involved in the association between obesity and serum levels of vitamin D have not been described specifically for children. (37)

Figure 6 shows the possible mechanisms involved in the association between vitamin D and obesity

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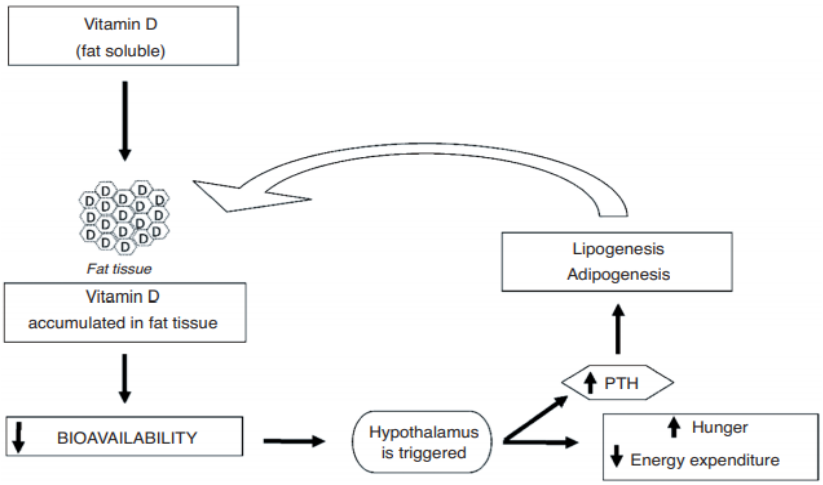


**Figure (6)** The cyclical association between vitamin D deficiency and increased body fat deposition.

## Conclusions

This study showed there are an association between calcium and vitamin D with childhood obesity. Considering the possible protective effect of these micronutrients in relation to childhood obesity, preventive public health actions should be designed, with emphasis on nutritional education

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