Association between vitamin D deficiency and weight gain in children: A cross-sectional study.

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Abstract

Introduction: Obesity in children is a serious and growing health problem. Its prevalence has significantly increased over the past decades. Obesity is a risk factor for increased morbidity and mortality and is a multifactorial condition. Recently, studies on the association between vitamin D deficiency and obesity have been conducted. This study aimed to determine the relationship between vitamin D deficiency and weight gain in children in Jeddah, Saudi Arabia.

Methods: This cross-sectional study included 321 healthy children (176 girls and 145 boys) from an ambulatory pediatric clinic at King Abdul-Aziz University Hospital between November 2017 and April 2018. The anthropometric variables of each child were obtained, and blood samples were obtained to measure vitamin D, thyroid and parathyroid hormone, and calcium levels.

Results: The participants included 176 (54.8%) girls and 145 (45.2%) boys with a mean age of 9.8 ± 3.8 yrs. The average body mass index was 18.01 ± 3.5 kg/m², and the mean vitamin D level was 26.4 ± 10.6 nmol/L for both sexes. Vitamin D deficiency was identified in 96.5% of the participants, and only 3.5% had normal vitamin D levels. A significant association was observed between body weight and vitamin D deficiency (P value=0.013 and Pearson correlation coefficient=-0.2). The results showed an inverse relationship between vitamin D deficiency and body weight, i.e., any decrease in vitamin D levels inversely affected body weight.

Conclusion: Vitamin D deficiency was inversely associated with weight gain in children.

Keywords: Obesity, Children, Vitamin D, BMI.

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Introduction

Childhood Obesity has become a serious public health problem in the 21st century [1]. The prevalence of childhood obesity has significantly increased over the past few decades in both developed and developing countries, and a recent report showed that the worldwide prevalence had increased by 47.1% in 30 yrs, affecting approximately one-third of the world’s population [2]. In 2016 the number of overweight children under the age of five is estimated to be over 41 million across the world [1]. The prevalence of childhood obesity in Saudi Arabia has been increasing, and the eastern and central regions have the highest percentage of overweight and obese children than in other regions in the country [3,4]. Overweight is defined as a Body Mass Index (BMI) greater than or equal to the 85th percentile and below the 95th percentile for children of the same age and sex. Obesity is defined as a BMI greater than or equal to the 95th percentile for children of the same age and sex [5]. There are multiple medical and psychosocial consequences of obesity including, hypertension, hyperlipidemia and increased risk of cardiovascular diseases, impaired glucose tolerance and type 2 Diabetes, liver disease, anxiety, depression, Low self-esteem and Social problems such as bullying [6]. Prevention of childhood obesity needs to be a high priority as its complications can be prevented. Obesity is a multifactorial condition and is a complex interaction between environmental, socioeconomic, and genetic factors [2]. Over the past decade, the number of studies on the association between vitamin D deficiency and obesity has increased, and meta-analysis results have indicated that obesity was associated with vitamin D deficiency [7]. Vitamin D deficiency has been recognized as major public health problems worldwide, the problem is observed profoundly in those from the Middle East.
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Table 1. Baseline characteristics of the study population

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male Mean ± SD</th>
<th>Female Mean ± SD</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>9.5 ± 3.5</td>
<td>10.2 ± 4.1</td>
<td>0.217</td>
</tr>
<tr>
<td>Weight (sds)</td>
<td>1.4 ± 2.3</td>
<td>1.2 ± 1.7</td>
<td>0.579</td>
</tr>
<tr>
<td>Log10 weight</td>
<td>1.5 ± 0.2</td>
<td>1.5 ± 0.12</td>
<td>0.838</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>18.2 ± 3.7</td>
<td>17.8 ± 3.3</td>
<td>0.549</td>
</tr>
<tr>
<td>BMI (sds)</td>
<td>0.9 ± 1.2</td>
<td>0.7 ± 1.2</td>
<td>0.286</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>28.6 ± 11.5</td>
<td>25.8 ± 11.1</td>
<td>0.050</td>
</tr>
</tbody>
</table>

Vitamin D status

- Vitamin D less or equal to 50 (nmol/L)
- Vitamin D greater than 50 (nmol/L)

Figure 1. Vitamin D among population of the study
Approximately 96.5% of the participants presented with vitamin D deficiency, whereas only 3.5% had normal vitamin D levels. The mean vitamin D level was 26.4 ± 10.6 nmol/L (95% CI: 24.5, 28.2). Approximately 92.5% of the participants had normal calcium levels. FT4 levels were normal in 83.3% of the participants. Furthermore, the parathyroid hormone levels were normal in 86.6% of the participants.

A significant difference was observed in the mean vitamin D level among both boys and girls (P=0.050). The mean vitamin D level of the boys was higher than that of the girls (28 ± 11.5 nmol/L vs. 25.8 ± 11.1 nmol/L. Figure 2 shows the vitamin D levels of both sexes. No significant difference was observed in both girls and boys in terms of body measurements (weight [sds] and BMI [kg/m² and sds]). Table 2 shows the correlation between vitamin D levels (nmol/L) and body measurements.

By contrast, a correlation was observed between vitamin D levels and log weight (kg) (P-value=0.01), and this result indicates that body weight was significantly associated with vitamin D levels in both sexes. Moreover, an inverse relationship was observed between vitamin D levels and body weight (r=-0.2). That is, any decrease in vitamin D levels will inversely affect body weight. Moreover, these results were similar to those obtained in the linear regression analysis (log weight=1.61 and vitamin D level=0.004; P-value=0.013). Figure 3 shows an inverse relationship between vitamin D levels (nmol/L) and log weight (kg).

**Discussion**

In this study, we examined the association between vitamin D deficiency and weight gain in children. A significant inverse relationship was found, as the decrease in vitamin D leads to an increase in weight gain. Obesity has become a significant public health problem [1]. Its complications can lead to increased morbidity and mortality [6], it is a multifactorial condition, and by knowing the modifiable risk factors we can interfere early and prevent the progression of obesity [2]. In the past decade, an increased number of studies have assessed the association between vitamin D deficiency and Obesity [7]. A study by Al Asoom yielded the same results as our present study; it included Young Females in Dammam, Saudi Arabia. Showed a significant negative correlation of plasma 25-OH vitamin D with BMI and waist circumference [15]. A Cross-Sectional Study was conducted by some investigators of Ethiopia, they assessed over-weight/obesity with regard to vitamin D status in Ethiopian schoolchildren, and their results comply with the same results of the current study. It has been estimated that Vitamin D deficiency in schoolchildren was significantly associated with overweight and/or obesity [16]. Another study was conducted on healthy pre-pubertal children in Varna, Bulgaria. Vitamin D deficiency was identified in 51.7% of pre-pubertal boys and in 65.0% of the girls. The study resulted that there is an inverse relationship between 25-hydroxyvitamin D and waist circumference [17]. Also, multiple prospective studies and randomized clinical trials yielded the same results [18-20].

The mechanism behind this relationship between vitamin D and obesity is still not completely established. It can be explained by various hypothesis, some past studies suggest that the connection between vitamin D deficiency and obesity can occur because of the influence of vitamin D metabolites on adipokine production and the inflammatory response in adipose tissue.
tissue [21]. Therefore, vitamin D deficiency can lead to dysregulation of adipose tissue [22]. In contrast to our results a study was done by Karani S Vimaleswaran et al, indicates that a higher BMI leads to a lower vitamin D, while any effects of vitamin D deficiency increasing BMI are likely to be small [23].

This study has some limitations. It represents the eastern region of Saudi Arabia and can’t be generalized to other populations.

The findings of our study have an important implication. Obesity has major complications that can be prevented. It is important to know and understand its modifiable causes, for early intervention and prevention. As our results indicated that vitamin D deficiency is a cause, awareness of this problem must be implicated to the public.

Conclusion

Vitamin D deficiency and Obesity are universal public health issues, for all ages. Both can cause serious health consequences, particularly among young children. This study has demonstrated a significant impact of Vitamin D deficiency on weight gain development in children. So, to prevent this problem it is important to raise awareness and education to involve healthy nutrition for children that contain rich sources of vitamin D and the addition of vitamin D supplement. Further studies that include more regions in Saudi Arabia are recommended.

References


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