

# Vitamin D and its Relation with Insulin Resistance in Obese Children.

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## ABSTRACT

**Background:** Deficiency of vitamin D leads to mal skeletal growth in children; moreover it is becoming an epidemic throughout the world. Decrease level of vitamin D can cause diverse of skeletal disorders in children like rickets, osteopenia etc. The relationship of vitamin D, obesity and insulin resistance is still not clear in the literature. Vitamin D deficiency may induce the altered glucose tolerance in obese children. Therefore the present study was designed to investigate the relationship of vitamin D and insulin resistance in obese children. **Methods:** The present study was a cross sectional type of study which was conducted in paediatric department of TMMC & RC, Moradabad. This study included 120 obese children (60 males and 60 females) of mean age  $12 \pm 2.6$  years in group I. Control group II contained 100 healthy none obese children (50 males and 50 females) of  $12.2 \pm 1.8$  years. Insulin resistance was calculated from fasting plasma measurements using HOMA-IR (insulin (mU/L)  $\times$  glucose (mmol/l)/22.5). Insulin resistance criteria were HOMA-IR  $>2.5$  for children. Vitamin D was measured by ELISA method (kit manufactured by Cayman chemical company, Ann Arbor, USA). **Results:** There was an insignificant difference in the FBG ( $>0.05$ ) of group I obese children and group II control. Insulin ( $<0.05$ ) and HOMA-IR ( $<0.01$ ) were significantly low in obese children in comparison of none-obese children. Vitamin D ( $<0.01$ ) was significantly lower in obese children compare to healthy children. vitamin D was negatively correlated with BMI ( $r = -0.42$ ,  $r^2 = 0.1764$ ,  $p < 0.05$ ) in obese children. There was a negative correlation between vitamin D and insulin resistance ( $r = -0.52$ ,  $r^2 = 0.2704$ ,  $p < 0.05$ ) in obese children. **Conclusion:** Present study suggests that there was strong relation between insulin resistance and obesity. Vitamin D was negatively correlated with BMI and insulin resistance. These findings strongly suggest vitamin D level may found insufficient or deficient in obese children. Therefore, obese children should be screened for vitamin D deficiency for their normal skeletal growth.

**Keywords:** Obesity, Insulin resistance, vitamin D, BMI.

## INTRODUCTION

Deficiency of vitamin D leads to mal skeletal growth in children; moreover it is becoming an epidemic throughout the world. Decrease level of vitamin D can cause diverse of skeletal disorders in children like rickets, osteopenia etc.<sup>[1-3]</sup> Vitamin D is found in inactive form in body which is converted to active vitamin D by sun rays.<sup>[4-5]</sup> Vitamin D deficiency is common in India; moreover tendency to cover the skin to avoid pigmentation may lead to deficiency of vitamin D.<sup>[6-8]</sup> Vitamin D have various other important functions like cellular differentiation and replication in many tissue and organs, including metabolism of calcium.<sup>[9,10]</sup> Vitamin D is considered very important for insulin secretion and sustain the normal glucose homeostasis.<sup>[11]</sup> Reports recorded it

also has an important role in paracrine and autocrine in adipose tissue.<sup>[12,13]</sup>

The relationship of vitamin D, obesity and insulin resistance is still not clear in the literature. Vitamin D deficiency may induce the altered glucose tolerance in obese children.<sup>[14,15]</sup> Insulin resistance has been found associated with low vitamin D level in adults. However, no relation has been established in obese children yet.<sup>[16,17]</sup> Therefore the present study was designed to investigate the relationship of vitamin D and insulin resistance in obese children.

## MATERIALS AND METHODS

The present study was a cross sectional type of study which was conducted in paediatric department of TMMC & RC, Moradabad. This study was carried out from January 2017 to February 2018. This study included 120 obese children (60 males and 60 females) of mean age  $12 \pm 2.6$  years in group I. Control group II contained 100 healthy none obese children (50 males and 50 females) of  $12.2 \pm 1.8$

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years. Detailed physical examination was done of each and every participant of the study.

Weight and height were measured in shorts and barefoot. Weight was measured using a weighing scale manufactured (CAS company ltd, S korea) and height was measured by Holtain wall stadiometer (reading interval 60 to 210 cm, precision 0.1 cm).

Weight was divided by height (kg/m<sup>2</sup>) for calculation of Body mass index (BMI). BMI > 97th percentile was considered as obese.<sup>[18,19]</sup> Waist circumferences was measured between the xiphoid process and iliac crest. Children suffering for hormonal disorders or any type of chronic diseases were excluded from the study. Children taking any type of medications, vitamins or supplements were excluded from the study.

**Biochemical Parameters**

Glucose was estimated by the glucose oxidase technique and insulin levels were assessed by direct chemiluminescence technique (Siemens centaur, USA). Insulin resistance was calculated from fasting plasma measurements using HOMA-IR (insulin (mU/L) × glucose (mmol/l)/22.5).<sup>[20]</sup> Insulin resistance criteria were HOMA-IR >2.5 for children.<sup>[21]</sup>

Total Cholesterol (TC), Triglyceride (TG) and High density lipids (HDL) were estimated by the enzymatic CHOD-POD method, GPO-PAP method and CHOD-POD/ Phosphotungstate method. Low density lipoprotein (LDL) was measured by using Friedewald’s formula: LDL cholesterol = total cholesterol – HDL cholesterol – [triglycerides/5]. Vitamin D was measured by ELISA method (kit manufactured by Cayman chemical company, Ann Arbor, USA). Serum vitamin D level <10 ng/ml, 10–20 ng/ml, and >20 ng/ml were considered as deficient, insufficient, or sufficient respectively.<sup>[22]</sup>

**Statistical Analysis**

All the results of the present study were expressed as mean ± SD. Unpaired student t-test was used to calculate the difference of various parameters of both groups. Pearson correlation coefficient was used to assess if there was any correlation between HOMA-IR, vitamin D and BMI.

**RESULTS**

**Table 1: Comparison of anthropometric parameters in group I and group II.**

Parameters	Group I (Obese children, n = 150)	Group II (Non-obese children, n = 100)	p value
Age (Years)	12 ± 2.6	12.2 ± 1.8	>0.05
Waist circumferences (Cm)	78.9 ± 10.6	56.2 ± 7.7	<0.01
BMI (Kg/m <sup>2</sup> )	29.8 ± 3.8	21.4 ± 2.1	<0.01
BMI %	95.5 ± 11.4	55.2 ± 16.8	<0.01

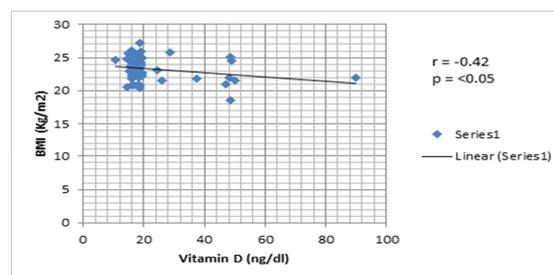
[Table 1] show that there was an insignificant difference in the age (>0.05) of group I obese children and group II control. Further, waist (<0.01), BMI (<0.01) and BMI% (<0.01) were significantly high in obese children in compare to healthy children.

There was an insignificant difference in the FBG (>0.05) of group I obese children and group II control. Insulin (<0.05) and HOMA-IR (<0.01) were significantly low in obese children in comparison of none-obese children. Vitamin D (<0.01) was significantly lower in obese children compare to healthy children. Further, TC (<0.01), TG (<0.05), and LDL (<0.01) were significantly high; whereas HDL (<0.05) was significantly low in obese children in comparison of none-obese children.

**Table 2: Comparison of metabolic markers in group I and group II.**

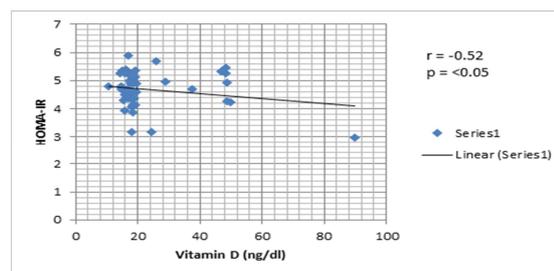
Parameters	Group I (Obese children, n = 150)	Group II (Non-obese children, n = 100)	p value
FBG (mg/dl)	93.2 ± 10.8	91.8 ± 11.4	NS
Insulin (µu/ml)	18.6 ± 8.7	13.4 ± 7.8	<0.05
HOMA-IR	4.1 ± 2.3	3.2 ± 2.1	<0.01
Vitamin D (ng/dl)	12.6 ± 6.8	20.8 ± 7.2	<0.01
ALT (U/L)	26.6 ± 12.3	15.2 ± 11.8	<0.01
TC	213.8 ± 28.4	170.6 ± 23.5	<0.01
TG	116.9 ± 33.2	88.7 ± 30.9	<0.05
HDL	46.6 ± 16.4	53.2 ± 18.4	<0.05
LDL	143.8 ± 20.6	99.7 ± 18.9	<0.01

It is evident from [Figure 1] that vitamin D was negatively correlated with BMI (r = -0.42, r<sup>2</sup> =0.1764, p<0.05) in obese children.



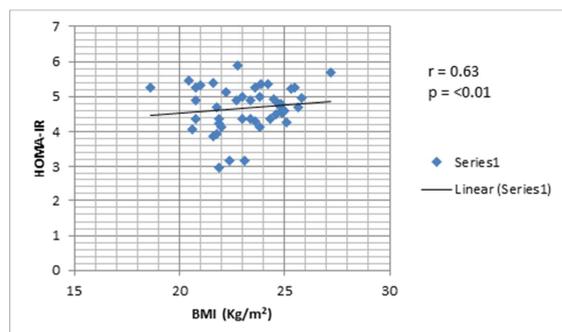
**Figure 1: Correlation of vitamin D with BMI in obese children**

[Figure 2] shows that there was a negative correlation between vitamin D and insulin resistance (r = -0.52, r<sup>2</sup> =0.2704, p<0.05) in obese children.



**Figure 2: correlation of vitamin D with HOMA-IR in obese children**

There was a positive correlation between insulin resistance and BMI ( $r = 0.63$ ,  $r^2 = 0.3969$ ,  $p < 0.01$ ) in obese children. [Figure 3]



**Figure 3: correlation of HOMA-IR with BMI in obese children**

## DISCUSSION

Deficiency and insufficiency of vitamin D remains undiagnosed in obese children; moreover, it is becoming an epidemic for obese children.<sup>[23]</sup> Various reports from different countries have shown that vitamin D is commonly associated with obesity in children.<sup>[24]</sup>

Findings of the current study have shown that vitamin D was significantly low in obese children compare to control children. These findings are consistent with the previous study of Hatun S et al,<sup>[8]</sup> Kadowaki S et al and Lee S ea al in which they observed a significant decrease of vitamin D in obese children compare to non- obese children.<sup>[9,10]</sup> Similarly, Scragg R et al,<sup>11</sup> Holick MF et al,<sup>[12]</sup> and Reis AF et al,<sup>[13]</sup> recorded significantly low vitamin D in comparison of higher BMI. This decrease of vitamin D in obese children may be due low quality food.<sup>[25]</sup>

Insulin release mechanism and glucose homeostasis are influenced by vitamin D. Earlier reports suggest that decrease of vitamin D may alter the glucose homeostasis.<sup>[26-28]</sup> However, role of vitamin D in children is still unclear. Various studies suggested that decrease vitamin D level is increased insulin resistance in adults.<sup>[8-11]</sup>

Findings of the present study show that insulin resistance was significantly higher in obese children compare to healthy children. However, there was an insignificant difference of HOMA-IR in comparison of deficient, insufficient and sufficient level of vitamin D in obese children. Results revealed that vitamin D was negatively correlated to BMI as well insulin resistance. Further, insulin resistance was negatively correlated with BMI.

These findings are consistent with earlier studies of Kelly et al.<sup>[29]</sup> and Alemzadeh et al.<sup>[30]</sup> as they recorded a significant deficiency of vitamin D in obese children. Moreover, Alemzadeh et al.<sup>[30]</sup> observed a negative correlation between vitamin D and insulin resistance. Similarly, Garanty-Bogacka

et al,<sup>[31]</sup> showed vitamin d deficiency in obese children compare to healthy children and a positive correlation between vitamin D and insulin resistance. In contrast to the present study previous study Rajkumar R et al,<sup>[32]</sup> Reinehr T et al,<sup>[33]</sup> did not observed any relation between vitamin D and obesity in children.

This decrease of vitamin D in obese children as observed in the present study seems to be due to overloaded adiposity has been found associated with vitamin D deficiency.<sup>[34]</sup>

Moreover, more than 90% obese children suffer from hypovitaminosis D.<sup>[35,36]</sup> Studies suggested that vitamin D deficiency is directly related to degree of adiposity in obese children.<sup>[36]</sup> Further, low vitamin D and insulin resistance causes impaired insulin action as well as glucose metabolism in adipose tissue.<sup>[18]</sup> Vitamin D is activated on the vitamin D receptors in the cells which produce insulin.<sup>[12]</sup>

## CONCLUSION

Present study suggests that there was strong relation between insulin resistance and obesity. Vitamin D was negatively correlated with BMI and insulin resistance. These findings strongly suggest vitamin D level may found insufficient or deficient in obese children. Therefore, obese children should be screened for vitamin D deficiency for their normal skeletal growth.

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