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Original Research Article

THE ASSOCIATION BETWEEN VITAMIN D AND INSULIN RESISTANCE IN OBESE CHILDREN

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ABSTRACT

Background: Children with vitamin D deficiency have malformed skeletons, and the condition is spreading like wildfire over the globe. Children who have low vitamin D levels may develop rickets, osteopenia, and other bone conditions. It is currently unclear from the research how vitamin D, obesity, and insulin resistance are related. Obese children may have impaired glucose tolerance due to vitamin D insufficiency. Thus, the goal of the current study was to look into the connection between vitamin D and insulin resistance in obese children.

Materials and Methods: Group A of this study consisted of 48 obese children. There were 48 healthy, non-obese children in control group B. Every study participant underwent a thorough physical checkup.

Results: The FBG of the obese youngsters in group A and the control group B did not differ significantly. Compared to children who were not obese, obese children had considerably lower levels of insulin and HOMA-IR. Compared to children in good health, children who were fat had far lower levels of vitamin D. In children who were obese, there was a significantly positive correlation between insulin resistance and BMI ($r = 0.108$, $r2 = 0.011$, $p = 0.02$).

Conclusion: According to this present study, obesity and insulin resistance are strongly correlated. Insulin resistance and BMI were inversely connected with vitamin D. These results strongly imply that children who are fat may have inadequate or deficient vitamin D levels. Therefore, in order to ensure adequate skeletal growth, obese children should be evaluated for vitamin D deficiency.

Key Words: BMI, vitamin-D, insulin resistance and obesity.

INTRODUCTION

Since the rate at which obesity prevalence is rising globally suggests a pandemic, preventing obesity is one of the most crucial issues facing modern medical research.[1] Research into the function of vitamin D in the human body has seen a dramatic increase in attention in recent years. This is because vitamin D has gathered and resurfaced not only its bone-related (calcemic) effects but also entirely new non-bone-related (non-calcemic) effects.[2] Recent studies communicate vitamin D deficiency to a higher risk of diabetes mellitus, peripheral arterial disease, heart failure, arterial hypertension, acute myocardial infarction, different types of cancer, autoimmune and inflammatory diseases, weakened immune systems, and higher mortality.[3] The control of insulin secretion processes, glucose homeostasis, and inflammation linked to obesity all depend on vitamin D.[4] According to reports, it also plays a significant part in adipose tissue's paracrine and autocrine processes.[5,6] It is currently unclear from the research how vitamin D, obesity, and insulin resistance are related. Obese children may have impaired glucose tolerance due to vitamin D insufficiency.[7,8] Low levels of vitamin D in adults have been linked to insulin resistance. However, in children who are fat, no correlation has yet been shown.[9,10] Thus, the aim of the current study was to investigate into the association between vitamin D and insulin resistance in obese children.

MATERIALS AND METHODS

This cross sectional study was carried out in the Department of Paediatrics at World College of Medical Sciences Research and Hospital, Jhajjar during the period from July, 2023 to August, 2024. Group A of this study consisted of 48 obese children. There were 48 healthy, non-obese children in control group B. Every study participant underwent a thorough physical checkup. Shorts and barefoot were used to measure height and weight. A Holtain wall stadiometer (reading interval 60 to 210 cm, precision 0.1 cm) was used to measure height, and a weighing scale made by CAS Company Ltd. in South Korea was used to assess weight. Body mass index (BMI) was calculated by dividing weight by height (kg/m2). Obesity was defined as a BMI more than the 97th percentile.[11,12] Between the iliac crest and the xiphoid process, waist circumferences were measured. The study did not include children with any kind of chronic sickness or hormone problems. The study did not include children on any kind of medication, vitamin, or supplement.

Biochemical Parameters

The GODPOD method was used to estimate glucose, while the direct chemiluminescence method was used to measure insulin levels. Insulin resistance was computed using HOMA-IR (insulin (mU/L) × glucose (mmol/l)/22.5) from fasting plasma samples.[13] HOMA-IR >2.5 for children was the criterion for insulin resistance.[14] The enzymatic CHOD-POD, GPO-PAP, and CHOD-POD/phosphotungstate methods were used to determine total cholesterol, triglycerides, and high density lipoprotein cholesterol. Friedewald's formula, which reads LDL cholesterol = total cholesterol − HDL cholesterol − [triglycerides/5], was used to assess low density lipoprotein cholesterol. Calbiotech's ELISA kit was used to measure vitamin D levels. Twenty ng/ml of serum vitamin D was regarded as sufficient, inadequate, or deficient, accordingly.[15]

Statistical Analysis

The current study's findings were all presented as mean ± SD. To determine the differences between the two groups' various parameters, the unpaired student *t*-test was employed. To determine whether HOMA-IR, vitamin D, and BMI were correlated in any way, the Pearson correlation coefficient was employed.

RESULTS

[Table 1] shows that the age difference between group A obese children and group B control was not significant (>0.05). Additionally, compared to healthy children, obese children had considerably higher waists, BMIs, and BMI percentages.

The FBG of the obese youngsters in group A and the control group B did not differ significantly. Compared to children who were not obese, obese children had considerably lower levels of insulin and HOMA-IR. Compared to children in good health, children who were fat had far lower levels of vitamin D. [Table 2]

Additionally, compared to children who were not fat, obese children had significantly lower levels of high density lipoprotein cholesterol and significantly higher levels of total cholesterol, triglycerides, and low density lipoprotein cholesterol. [Table 3]

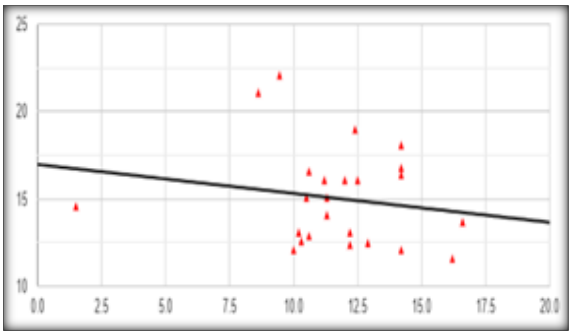

Figure 1: Shows the pearson's correlation coefficient of vitamin D with BMI in obese children

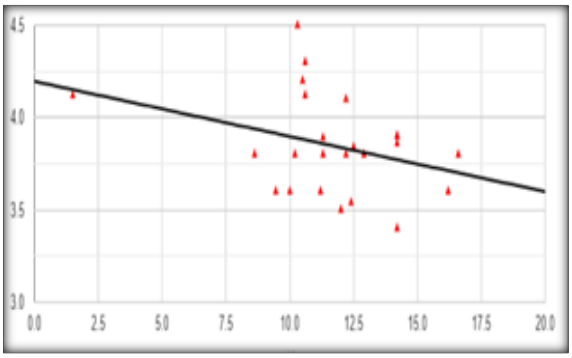

Figure 2: Shows the pearson's correlation coefficient of vitamin D with HOMA-IR in obese children

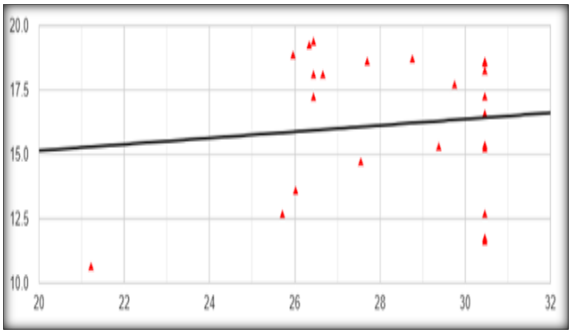

Figure 3: Shows the pearson's correlation coefficient correlation of HOMA-IR with BMI in obese children

In obese children, vitamin D had a negative correlation with BMI (r = -0.173, r2 = 0.029, p = 0.02), as seen in [Figure 1]. Vitamin D and insulin resistance were negatively correlated in obese children (r = -0.33, r2 = 0.109, p = 0.04), as [Figure 2] depicts. In children who were obese, there was a positive correlation between insulin resistance and BMI (r = 0.108, r2 = 0.011, p = 0.02). [Figure 3]

Table 1: Comparison of anthropometric parameters in group A and group B

Anthropometric Variables	Group-A	Group-B	P-value
Age in years	11.8 ± 3.02	11.9 ± 3.21	0.15
Waist circumferences in centimeter	74.56 ± 22.6	58.24 ± 16.32	0.01
Body Mass Index in Kg/m^2	29.7 ± 12.6	22.6 ± 9.62	0.01
Body Mass Index (%)	96.2 ± 25.4	54.62 ± 14.74	0.01

Table 2: Comparison of biochemical parameters in group A and group B

Biochemical Parameters	Group A	Group B	P-value
Fasting Blood Glucose (mg/dl)	98.64 ± 23.52	99.02 ± 23.54	0.16
HOMA-IR	5.04 ± 1.32	4.21 ± 1.3	0.01
Insulin (µu/ml)	16.6 ± 4.32	12.8 ± 4.26	0.01
Vitamin D (ng/dl)	11.34 ± 5.04	19.31 ± 6.46	0.01
Alanine Aminotransferase(U/L)	24.54 ± 10.6	14.24 ± 7.84	0.01

Table 3: Comparison of biochemical parameters in group A and group B.

Lipid profile	Group A	Group B	P-value
Total cholesterol (mg/dl)	208.25 ± 32.06	168.2 ± 26.8	0.02
Triglycerides (mg/dl)	114.5 ± 25.91	86.56 ± 16.23	0.01
High density lipoprotein cholesterol (mg/dl)	44.6 ± 9.36	50.82 ± 14.67	0.01
Low density lipoprotein cholesterol (mg/dl)	141.52 ± 26.32	96.23 ± 25.5	0.01

DISCUSSION

Vitamin D deficiency and insufficiency in obese children are still untreated, and the condition is spreading like wildfire among them.[16] Numerous investigations from various nations have demonstrated that vitamin D is frequently linked to childhood obesity.[17]According to the current study's findings, obese children had considerably lower vitamin D levels than control children. These results are in line with the earlier research by Hatun S et al,[18] Kadowaki S et al., and Lee S et al., which found that children who are obese have significantly lower vitamin D levels than children who are not.[19,20] In a similar vein, Scragg R et al,[21] Holick MF et al,[5]and Reis AF et al,[6] found that vitamin D was considerably lower when compared to higher BMI. Low-quality diet may be the cause of obese children's decreased vitamin D levels.[22] Vitamin D affects glucose homeostasis and the mechanism of insulin release. Previous research indicates that a drop in vitamin D may change glucose homeostasis.[23] Vitamin D's function in youngsters is largely unknown, though. According to several research, persons with lower vitamin D levels had higher insulin resistance.[21] According to the current study's findings, children who were fat had significantly greater levels of insulin resistance than children who were healthy. When comparing the levels of vitamin D in obese children who were deficient, insufficient, and sufficient, there was a negligible variation in HOMA-IR. The findings showed a negative correlation between vitamin D and both insulin resistance and BMI.

Additionally, there was a negative correlation between insulin resistance and BMI. These results are in line with previous research by Kelly et al,[24] and Alemzadeh et al,[25]which found that obese children had a significant vitamin D deficiency. Additionally, Alemzadeh et al,[25] found a negative correlation between vitamin D and insulin resistance, while Garanty-Bogacka et al,[26] found that vitamin D deficiency was present in obese children compared to healthy children and a positive correlation between vitamin D and insulin resistance. In contrast to the current study, previous research by Rajkumar R et al,[27] and Reinehr T et al,[28] found no relationship between vitamin D and childhood obesity. Overloaded adiposity has been linked to vitamin D deficiency, which may be the cause of the vitamin D decline in obese children seen in this study.[29] Furthermore, hypovitaminosis D affects approximately 90% of obese children.[30] According to studies, the degree of adiposity in obese children is directly correlated with vitamin D insufficiency.[31] Furthermore, poor insulin action and glucose metabolism in adipose tissue are caused by low vitamin D and insulin resistance.[11] The cells that make insulin have vitamin D receptors that are triggered by vitamin D.[5]

CONCLUSION

These results show a strong association between obesity and insulin resistance. Insulin resistance and BMI were inversely connected with vitamin D. These results strongly imply that children who are fat may have inadequate or deficient vitamin D levels. Therefore, in order to ensure adequate skeletal growth, obese children should be evaluated for vitamin D deficiency.

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