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The relationship between vitamin D and insulin levels in obese children referred to Children of Southeast Iran

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Abstract

Introduction: Vitamin D deficiency is one of the most important medical problems, especially in children.. Vitamin D deficiency is associated with decreased insulin secretion, insulin resistance and type 2 diabetes. The purpose of this study is to investigate the relationship between vitamin D and insulin levels in obese children referred to Zahedan Aliasghar Hospital

Materials and methods: In this study included 100 obese children referred to Ali Asghar Clinic in Zahedan, which They were investigated in 1402. The samples analyzed for insulin level and vitamin d level .The data was collected using observation and examination and experiments. Data analysis was done in SPSS version 24 software using independent T and Chi-square statistical tests. A significance level of less than 0.05 was considered.

Results: In this study, there was 45% vitamin D deficiency, which was more common in obese boys (27 male ,18 female) and vitamin D insufficiency was 44% which was more common in female. Vitamin D deficiency was more prevalent in obese children over the age of 10 .This study showed that obese children with vitamin D deficiency have higher insulin levels and insulin resistance.

Discussion and conclusion: This study showed that obese children and adolescents are more at risk of vitamin D deficiency, Vitamin D deficiency is associated with increased inflammatory markers. In addition, genetic polymorphisms of vitamin D-related genes may predispose to dysglycemia and type 2 diabetes.

Keywords: Obesity, Vitamin D Deficiency, Children

Introduction

Vitamin D (in English: Vitamin D) is a group of fat-soluble vitamins, which increase the absorption of calcium, phosphate and magnesium in the intestine, and in this way, help the growth and strength of bones. In addition, these vitamins have several other vital functions in the human body. The most important types of vitamin D in the human body are vitamin D3 or cholecalciferol and vitamin D2 or ergocalciferol.(1)

The main natural source of this vitamin is the production of cholecalciferol in the deeper layers of the epidermis by a chemical reaction dependent on sunlight, especially ultraviolet B (UVB). Ergocalciferol and cholecalciferol, available in foods and supplements, can also be are absorbed Only the meat of some fatty fish such as salmon, sardine, herring and some other fatty fish contain a significant amount of this vitamin [and the frying process itself can reduce half of the vitamin. Destroy them.

In order for the human body to absorb vitamin D through sunlight, the sun must be in a position in the sky where the length of the body's shadow is shorter than the person's height. The shorter the length of the shadow and the higher the height of the sun, the higher the absorption of vitamin D. Also, air pollution reduces the absorption of vitamin D through sunlight. In addition, the human body does not absorb vitamin D from the sunlight behind the window and glass.(2)

Vitamin D absorbed from foods or produced in skin layers is initially an inactive compound that becomes active after hydroxylation in the liver and then in the kidneys. A compound called calcitriol is the active form and has the function of vitamin D. Vitamin D is able to be produced in the body of many mammals if there is enough sunlight; Therefore, this substance is not actually a type of vitamin and is considered a type of hormone that actively helps brain growth and is estimated to interact with 200 to 2600 genes .The result of these interactions is from improving the amount of magnesium, phosphorus and calcium in the bones, to the better functioning of the immune system, the balance of parathyroid hormones, the sexual system, muscle strength, the cycle of sleep and wakefulness, and all kinds of body metabolism; which is also through translation. Genes in the cell nucleus also help cells grow.(3)

Although the effects of vitamin D are very wide, the lack of this vitamin is usually considered more related to osteoporosis, the imbalance of parathyroid hormones and the weakness of the body's immune system.

This vitamin plays a very important role in preventing diseases and helping them recover, even simple respiratory diseases; From cold to Corona, (Covid-19) the correct function of many genes has the correct and better growth and development of children even in their future ages, so that those who did not suffer from vitamin D deficiency at a young age, in the later stages of Their growth has also been much healthier.(4)

Vitamin D1, the molecular composition of ergocalciferol is equal to lomistrol. Vitamin D2 is ergocalciferol (made from ergosterol). Ergocalciferol is produced by invertebrates, fungi and plants in response to ultraviolet radiation from sunlight. Humans and other vertebrates do not produce vitamin D2. Vitamin D3 is made from cholecalciferol

originating from 7-dehydrocholesterol in the skin. 7-Dehydrocholesterol reacts to ultraviolet light, and in the wavelength of 270-300 nm, vitamin D3 is made in the epidermis of the skin. The peak of vitamin D3 production occurs at a wavelength between 295-297 nm(5)

One of the complications of this vitamin deficiency in childhood is rickets, which due to lack of absorption of calcium and phosphorus during growth, the person's bones will have few minerals and will not be able to support the person's weight properly and as a result will be curved. Other complications are skull size, button-like appendages on the spine and breast prominence. Also, wrists and feet widen, which can be detected by radiography.

In adulthood, the lack of this vitamin in the body causes osteomalacia. By reducing bone density, this disease causes severe pain in the legs and back, and long bones are easily broken. If a person starts receiving vitamin D during this period, this complication will be resolved.(6)

Insulin resistance, which is the inability of cells to respond adequately to normal levels of insulin, occurs primarily in muscle, liver, and adipose tissue.In the liver, insulin normally suppresses glucose secretion. However, in conditions of insulin resistance, the liver inappropriately releases glucose into the blood.

The ratio of insulin resistance to beta cell dysfunction varies among individuals, with some having predominantly insulin resistance and only partial defects. show in insulin secretion and some others manifest with mild insulin resistance and primarily lack of insulin secretion.(7)

Other potentially important mechanisms associated with type 2 diabetes and insulin resistance include increased breakdown of lipids in adipocytes, incretin resistance and deficiency, high blood glucagon levels, increased salt and water retention by the kidneys, and improper regulation of metabolism by the nervous system. Central. However, not all individuals with insulin resistance develop diabetes because impaired insulin secretion by pancreatic beta cells is also required.(8)

In the early stages of insulin resistance, the mass of beta cells expands and increases insulin output to compensate for the lack of insulin sensitivity. But when type 2 diabetes manifests, a type 2 diabetic loses about half of his beta cells.] Fatty acids in beta cells activate FOXO1 and as a result beta cells undergo apoptosis (programmed cell death).(9)

The causes of age-related insulin resistance seen in obesity and type 2 diabetes are unclear. Effects on intracellular lipid metabolism and ATP production in liver and muscle cells may contribute to insulin resistance. Meanwhile, a gene called Dusp8 is associated with an increased risk of diabetes. New evidence also points to the role of a region of the brain called the hypothalamus in causing insulin resistance. First, a gene called dual specificity phosphatase is associated with an increased risk of diabetes. This gene encodes a protein that regulates nerve signals in the hypothalamus. Also, injecting a hormone called leptin into the hypothalamus normalizes blood sugar and reduces insulin resistance in diabetic animals. The activation of hypothalamus cells by leptin plays an important role in maintaining normal blood glucose levels; Therefore, both pancreatic endocrine cells and hypothalamic cells may play a role in the etiology of type 2 diabetes. Hypothalamus cells regulate blood glucose

through projections to the autonomic nervous system. Automatic innervation of liver and muscle cells increases glucose absorption. In a person with diabetes, blood glucose control by the autonomic nervous system is abnormal. Leptin-sensitive and glucose-regulating neurons become resistant to leptin during aging or during exposure to a high-fat diet. These leptin-resistant neurons cannot inhibit food intake, obesity, and blood glucose. The reasons for this decrease in responsiveness to leptin are unclear, and it is considered part of the puzzle of the causes of type 2 diabetes(10)

Essential component D Animal studies have shown that vitamin which is for the natural secretion of insulin through the influence on calcium metabolism and insulin receptor gene regulation, (reduces insulin resistance)

Material and method:

Study was cross-sectional and Study community were The relationship between vitamin D and insulin levels in obese children referred to Zahedan Aliasghar Hospital

Inclusion criteria were Obese children suffering from vitamin D deficiency referred to Ali Asghar clinic in Zahedan city in 1402 And (at least one parent) satisfy to participate in the study

If the patients had the following conditions, they were excluded from the study

1- Parents' lack of consent to participate in the study

2- pediatrics have chronic disease

3- Using any medicine or supplement that affects the skeletal system

At the beginning, 100 obese patients were identified, of which 3 patients did not return to answer the tests and 3 patients were excluded from the study due to the diagnosis of another disease.

The information of the patients was entered in the questionnaire, and all patients were taken with the same studiometer, and the children's weight was measured with the same scale. Then BMI was calculated, and if it was above the 95th percentile for the age and sex of the child, he was included in the study as obese. Blood samples were taken for vitamins. D and insulin levels were obtained

This research code IR.ZAUMS.REC 1402-473. It was approved by the Ethics Committee of Zahedan University of Medical Sciences. In this study, all ethical principles in accordance with the general guidelines of ethics in medical science research with human subjects in the Islamic Republic of Iran, including the following codes, were considered.

Finding:

In this study, At the beginning, 100 obese patients were identified, of which 3 patients did not return to answer the tests and 3 patients were excluded from the study due to the diagnosis of another disease.

in the study were 46 male and 54 female that after exclude 6 patients ,94 patients included the study.

Table 1: Gender distribution in obese children (body mass index within normal range) referring to Ali Asghar Clinic in Zahedan city in 1402

all N(%)	Female N(%)	Male N(%)	sex weight
100	54(54%)	46(46%)	Obese

In this study, there was 45% vitamin D deficiency, which was more common in obese boys (27 male ,18 female) and vitamin D insufficiency was 44% which was more common in female . and sufficiency vitamin D was only in 5 patients .that showed in obese children , The prevalence of vitamin deficiency is higher in obese children.

Table 2: Frequency distribution of vitamin D level in obese children referred to Ali Asghar Zahedan Hospital according to gender

all N(%)	Sufficient N(%)	Insufficiency N(%)	Deficient N(%)	vitD sex
46	2	17	27	Male
48	3	27	18	Female
100(94)	5	44	45	all

Vitamin D deficiency was more prevalent in obese children over the age of 10 .And vitamin D insufficiency was more common above 10 years.

Table 3: Frequency distribution of vitamin D level in obese children referred to Ali Asghar Zahedan Hospital by pediatric age

all N(%)	Sufficient N(%)	Insufficient N(%)	Deficient N(%)	vitD	Age	
33	2	16	15	obese		<10yr
61	3	28	30	obese		>10yr

This study showed that obese children with vitamin D deficiency have higher insulin levels and insulin resistance.

Table 4 : Frequency distribution of vitamin D level in obese children referred to Ali Asghar Zahedan Hospital by insulin level

all N(%)	Sufficient N(%)	Insufficient N(%)	Deficient N(%)	Vitamin D / Insulin level

32	2	20	10		Normal
62	3	24	35		High

Discussion :

Vitamin D receptors are present in almost all cells of the body, which indicates the important role of vitamin D in the body's chemical processes. But this vitamin plays a significant and important role in regulating the function of pancreatic beta cells (insulin-secreting cells in the pancreas).(11)

In type 1 diabetes, in which insulin secretion is impaired, the beta cells of the pancreas are destroyed by the body's immune system, and in type 2 diabetes, the beta cells try to produce more insulin because there is insulin resistance in other tissues of the body. and this hormone cannot have the necessary function. Among the most important factors that cause insulin resistance; Overweight, lack of physical activity, high abdominal fat and genetic background.(11)

Studies have shown that vitamin D affects insulin production and secretion in pancreatic beta cells. Insulin secretion is dependent on calcium and calcium absorption is also influenced by vitamin D. Some animal studies have shown that vitamin D deficiency leads to decreased insulin production. Also, researchers have shown that vitamin D deficiency reduces tissue sensitivity to insulin and as a result type 2 diabetes occurs.(12)

In a report published in 2006, 80,000 women were followed for 20 years. The risk of type 2 diabetes was reduced by 33% in women whose intake of calcium was more than 1200 mg and vitamin D was more than 800 units.(13)

Another study published in 2011 showed that people who received high amounts of vitamin D had a 43% lower risk of type 2 diabetes compared to people who received low amounts of this vitamin.

Another 2013 study found that higher levels of vitamin D in mice were associated with a reduced prevalence of type 2 diabetes. (14)

Vitamin D may have a beneficial effect on improving pancreatic β-cell function, decreasing insulin resistance, and improving systemic inflammation

In a study conducted on 304 patients by Pittas et al , it was shown that 700 units of vitamin D daily for 3 years reduced insulin resistance.(15)

In the study of Inomata , consumption of 400 units of 1 alpha hydroxylase decreased insulin levels and reduced free fatty acids(16)

In the study of Afsaneh talaei showed significant improvements in serum FPG, insulin and in HOMA-IR after treatment with vitamin D, suggested that vitamin D supplementation could reduce insulin resistance in T2DM (17)

In the study of Christiano Argano showed Vitamin D is involved in several non-skeletal health diseases, including common metabolic disorders like Metabolic Syndrome (MetS), Type 2 Diabetes (T2DM), Impaired Fasting Glucose (IFG), Non-Alcoholic Fatty Liver Disease (NAFLD), and Polycystic ovarian syndrome (PCOS), which are all characterized by insulin resistance (IR) and Treatment with vitamin D reduced these

complications and improved insulin resistance and reduced the development of type 2 diabetes.(13)

Zixin Xu et al also showed that the level of vitamin D has a negative relationship with the level of insulin and Vitamin D3 is a risk factor for insulin resistance in Other-Hispanic and Non-Hispanic-Black.(12)

In other study in 2021 in Spain by Victoria Contreras-Bolívar explained Vitamin D deficiency is a common problem in the population and may be associated with the pathogenesis of diseases related to insulin resistance.(18)

Conclusion :

This study showed that vitamin D deficiency aggravates insulin resistance in obese people and its cause can be explained as follows:

1- Vitamin D Associated Gene Polymorphisms and Insulin Resistance
2- Effects of Vitamin D on the Immune System and Insulin Resistance
3- Inflammation, Vitamin D, and Insulin Resistance
4- Other Molecular Actions of Vitamin D to Alter Glucose Homeostasis

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