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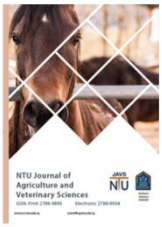

The Effect of deficiency of vitamin D3 on obesity: Review Article

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A B S T R A C T

Obesity and vitamin D deficiency are linked in a substantial way. More research into the mechanism of vitamin D insufficiency is required to analyze this link. The purpose of this review was to examine the published literature on the relationship between obesity and vitamin D deficiency. Obese people are frequently less exposed to sunlight due to their lack of exercise, and the huge size of the fat mass may limit vitamin D production under the skin, where vitamin D is processed in the adipocytes. Vitamin D insufficiency affects adipocyte growth and differentiation consequently weight gain. Several researches have been conducted to investigate the impact of obesity on developing vitamin D insufficiency. Because research on the effect of vitamin D and obesity is still scarce, this study intended to compile studies that explain this effect and brings as many points of view as possible together.

Introduction

According to studies, vitamin D insufficiency increases with body weight [1]. As the body mass unit increases at the rate of one unit, there is a 1.15% deficiency in vitamin D [2]. While the level of vitamin D in plasma increased after a controlled weight loss [3]. The acceptable level of vitamin D in the blood, according to endocrine studies is 20-25% ng/L. [4]. According to this classificatio. there is a link between vitamin D levels and the risk of obesity. It has been proposed that vitamin D plays both a genetic and a non-genetic role in the development of weight gain [5, 6].

What is Vitamin D?

It is a fat-soluble vitamin that is required for the health of bones and teeth due to its involvement in balancing calcium and phosphorus levels. Its receptors are located throughout the body indicating its many and necessary roles for the body. It prevents bone resorption and lowers parathyroid hormone levels. It also has activities outside of the skeletal system, such as lowering first-type collagen formation while improving muscle function and modulating insulin secretion It plays a vital role in immunity [7].

In addition to its function in many various metabolic and pathological problems, including obesity, vitamin D deficiency causes osteomalacia in adults and rickets in children [8]. Calcium inadequacy in plasma and bones is commonly caused by vitamin D deficiency. Since that vitamin D deficiency is linked to visceral obesity, this review will focus on the vitamin D obesity association. The most likely source of this association is current volumetric dilution of vitamin D [9].

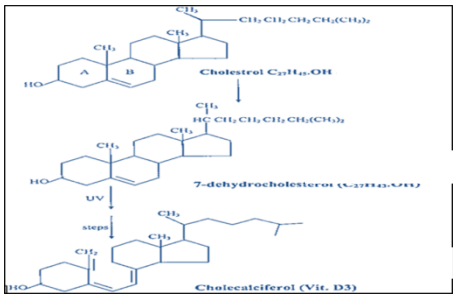

Figure 1: vitamin D3 schedule [10].

The Photochemical synthesis produces vitamin D within the skin's epithelial cells. Vitamin D2 (ergocalciferol) and D3 (cholecalciferol) are the two main forms of vitamin D and are accessible in a variety of food sources. Ergocalciferol is a plant-derived vitamin that is generated in plants, yeast, fungi, mushrooms, and the skin's response to UV radiation. The animal-derived version is known as cholecalciferol, and it is synthesized non-enzymatically from 7-dehydrocholesterol [10]. Vit-D Binding Protein is a unique carrier that transports vitamin D3 from the plasma to the cells (DBP). Transports around 85-90% of the vitamin D in plasma, with the rest attached to a vitamin D binding protein to albumin [9].

Obesity

Instead of a direct estimation of fat mass, define obesity as a body mass index. That BMI is merely a measure of total obesity, with no distinction made between body fat amount and distribution [10], and that there is no difference based on race, gender, or age [11]. Waist circumference (WC) is an excellent predictor of abdominal fat growth [12]. A lot of research has been conducted to investigate the association between vitamin D and weight gain [13,14].

Relationship between vitamin D insufficiency and obesity include:

Lack of exposure to sunlight

When exposed to sunlight, 90% of vitamin D is created [14]. As 7-dehydecholesterol is converted to the active form of vitamin D in the skin by UV radiation [15]. Obese persons, although having a larger surface area of skin, are less exposed to the sun and open air than normalpeople, limiting vitamin D generation in the skin [16].

[17], While another study relats poor climatic circumstances, pollution, and unhealthy lifestyle to the development of obesity and vitamin D insufficiency [18].

The effect of adipose tissue

Vitamin D is stored in the body through adipose tissue [19,20]. Adipose tissue serves as a temporary buffer for vitamin D. Certain amount of vitamin D is released during fasting period, lowering the risk of vitamin D toxicity [21]. Vitamin D deficiency induced by obesity is caused by a decrease in vitamin D bioavailability due to its accumulation in fat cell compartments in the body [22]. It has been established that 17% of vitamin D consumption is retained in body fat and the remainder is digested [22]. Other factors, such as nutrition and lifestyle, also have a role in the development of vitamin D insufficiency and obesity.

Parathyroid hormone (PTH)

A lack of vitamin D induces parathyroid activation and raises calcium levels in fat cells [23]. Raising intracellular calcium promotes the

expression of the fat-synthesis enzyme, which plays a role in fat deposition and degradation [24] Inblacing vitamin D levels and decreasing thyroid hormone levels can thus regulate weight growth [25].

Leptin (the satiety hormone)

The satiety hormone regulates the quantity of food consumed and the desire to eat, which helps to prevent obesity. Since leptin plays a role in the conversion of atocrine to paracrine, it interacts with vitamin D receptors determining fat accumulation and stimulating lipolysis [26]. In rats, vitamin D mRNA promotes leptin expression. As a result, when vitamin D levels fall, leptin levels fall as well causing the human or animal to overeat and become obese [27].

Liver diseases

The non-alcoholic fatty liver disease reduces the vitamin D conversion to the active form in the liver, which is linked to obesity, oxidative stress, poor cellular regeneration, and insulin resistance [28]. Hyperthyroidism and decreased insulin sensitivity are linked to vitamin D insufficiency [29]. Vitamin D modulates calcium levels in insulin-responsive cells such as muscle cells [30]. There are also vitamin D receptors in pancreatic cells which affect insulin synthesis and consequently the quantity of glucose in the blood [31].

Vitamin D receptors

These receptors are present in fat cells and are important for the expression and production of vitamin D metabolism enzymes, helping to modulate vitamin D levels through local synthesis and bioavailability [13]. Low amounts of vitamin D have been shown to suppress programmed death, but high concentrations cause an increase it [32]. Vitamin D receptors are expressed in adipocytes during the early stages of differentiation and decline as differentiation develops. Several functional proteins, enzymes, and transcription factors required for lipid synthesis, such as lipoprotein lipase which are generated in the presence of vitamin D receptors. As a result, a lack of vitamin D causes an increase in fat cells and the creation of adipocytes. vitamin D receptors are not expressed in mature adipocytes [33,34]. It was also shown that there is a link between sex and vitamin D receptors in females more than males [35].

vitamin D and the seasons of the year

Reduced vitamin D generation in the skin during the winter season needs an increase in body volumetric mass to boost thermal conditioning for the cold climate [19].

Vitamin D and nutritional status assessment

The animal source of vitamin D , cholecalciferol, is more useful and accessible in the body than the plant source, ergocalciferol. Whereas vitamin D 3 is the greatest source for treating vitamin D deficiency, it has been demonstrated that vitamin D levels greater than 30 ng/ml improve health and metabolic features including obesity [36]. Although vitamin D is present in eggs, fish, and vegetables, consuming it from fish sources particularly whale liver carries the danger of mercury poisoning [37].

vitamin D and obesity

A 12-week research involving 77 obese women who were given vitamin D supplements resulted in a steady loss of weight [38]. Additionally, the level of vitamin D in the serum of obese women was lower than that of normal weight women.

Conclusions

Obesity and low vitamin D levels have a direct relationship. Various nutritional, health, climatic, and gender factors influence these consequences. Vitamin D has both genetic and non-genetic impacts on fat metabolism, calcium and insulin levels, and its interaction with the satiety hormone leptin**.** The incidence of vitamin D insufficiency in obese people may be due to volumetric dilution. Owing to volumetric dilution, greater dosages of vitamin D are necessary in obese patients to obtain the same normal blood levels. Weight loss is now the only treatment for a number of illnesses associated with metabolic syndrome including obesity, insulin resistance, hyperlipidemia, and arterial hypertension [39]. The primary line of treatment is to improve one's lifestyle by adopting a healthy diet and participating in sports. If the body is deficient in vitamin D, vitamin D pills are the greatest alternative for treating obesity.

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No Conflicted interest

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