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ORIGINAL PAPERS

THE RELATIONSHIP BETWEEN VITAMIN D DEFICIENCY AND OBESITY

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Abstract. *Nowadays, the obesity and the vitamin D deficiency present a significant increased prevalence worldwide. The consequences of obesity and vitamin D deficiency are numerous and reduce the quality of life. We have proposed to summarize the published research regarding the association between the obesity and the vitamin D deficiency and its different consequences. The association between obesity and level of vitamin D, although intensively studied, it is not fully known. Future research is needed to clarify this complex link between obesity and vitamin D deficiency.*

Keywords: obesity, vitamin D, oral lesion, restrictive diets

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INTRODUCTION

This review aims to study the association between the vitamin D deficiency and obesity, the role that supplementing the diet with vitamin D could play in the treatment of obesity as a complementary treatment to current medical strategies.

The relationship between deficiency of vitamin D and excess of adiposity has been widely studied in the last years both in children and adults [1].

The metabolite 25-hydroxy vitamin D (25(OH)D) represents the best biological marker to assess vitamin D status used in clinical practice, with diagnostic value for vitamin deficiency screening [1-3].

The National Romanian Vitamin D Deficiency Prevention Program recommends the following standards to define vitamin D status in healthy children and adolescents

(in line with the 2016 Global Consensus recommendations [4], which are similar to those supported by the Society of Pediatric Endocrinology 2011) [5] and is based on serum 25(OH)D concentrations (Tabel 1) (Evidence level: I B).

Table. 1. Value of the serum 25(OH)D concentrations to define the vitamin D status in healthy children and adolescents

	Vitamin D status	**Value of the serum 25(OH)D concentrations**	
		nmol/l	ng/ml
1	Sufficient	50 - 250	20-100
2	Insufficient	30-50	12-20
3	Deficiency	< 30	< 12

Vitamin D deficiency and excess adiposity have mutual many negative effects, associating comorbidities such as the dysbiosis of the oral and gut microbiota, cardiovascular diseases, metabolic dysfunction-associated steatosis liver disease (MASLD), diabetes mellitus or various forms of cancer. [1,6].

Deficiency of the active forms of vitamin D in addition to increased insulin resistance stimulate chronic immune-mediated inflammation [1,6] (Figure nr 1).

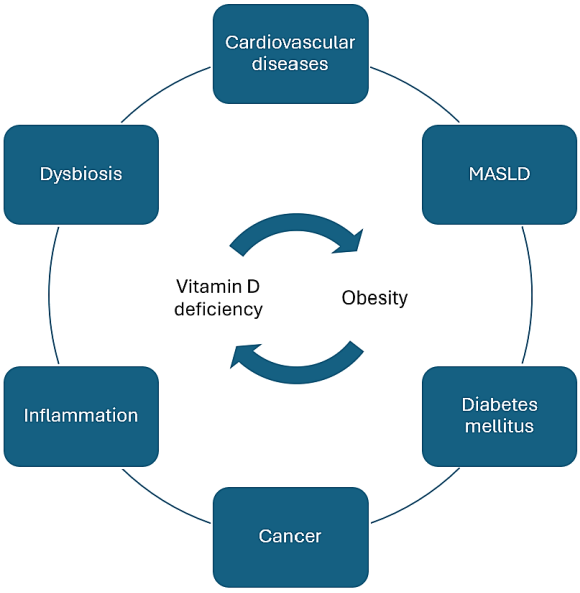

Fig. 1. The consequences of obesity and vitamin D deficiency (MASLD - metabolic dysfunction-associated steatosis liver disease)

The association between vitamin D deficiency and obesity has been studied in adults too. The meta-analysis, which included 15 studies (3,867 obese individuals and 9,342 healthy subjects) performed by Yao Y et all in 2015, in China, demonstrated a high risk of vitamin D deficiency prevalence among obese adults, the OR (95%) was 3.70 (2.33–5.06) [7].

A study in United States of America determined incidence and risk of obesity in adulthood by adolescent adiposity excess status. The N.S. et al. followed up during 2001-2002 and during 2007-2009 a cohort of 8834 adolescents aged 12 to 21 years enrolled in 1996.

The results showed that obese adolescents were a higher risk to develop severe obesity in adulthood than adolescents with BMI < 30Kg/sqm (hazard ratio, 16.0; 95% CI, 12.4-20.5). The analysis used multivariate hazard models and showed variation across race/ethnicity (prevalence obesity at black individuals was higher, prevalence obesity at asian adults was lower) and sex (prevalence obesity at male was higher) [8].

Another systematic review and meta-analysis conducted by Simmonds et al. included 15 prospective cohort studies and 200,777 participants were followed up. Slightly more than half (55%) of obese children keep on to be obese in the period of adolescence, around 80% of obese adolescents keep on to be obese in adulthood. The results showed that obese children and adolescents have a risk five times more likely to have BMI > 30Kg/mp in adulthood than those without obesity [9].

Vitamin D deficiency, obesity and oral lesions

In a recent study conducted by Cazzolla et al. showed that certain nutritional vitamin deficiencies founded in the diet of the children included in this research (expressed as percentages) such vitamin D (66%) or A (30%) and nutritional excesses such cholesterol (64%), or saturated fats (63%) were associated with differently oral pathologies. The results identified the following associations between oral pathologies and nutrition: enamel hypoplasia and vitamin D deficiency, periodontal disease and excess saturated fats and carbohydrates [10].

Studies published so far which investigating the association between serum level and intake of the vitamin D with periodontal disease have reached conflicting results [11].

A study conducted in Finland on 1,262 non-smoking patients showed that between vitamin D deficiency and prevalence of periodontitis was no associations, whereas Lou and colleagues founds a protective association between dietary vitamin D intake and lower severity of periodontal disease [12,13].

Although more studies revealed protective effects of the dietary vitamin D intake, the association between deficiency of the vitamin D and periodontal diseases is still unclear [11].

Periodontal diseases are generally chronic conditions caused by a chronic inflammatory process that produce progressive destruction in soft and hard periodontal tissues (periodontal ligament, gingiva, alveolar bone) [14].

The prevalence of the periodontal diseases increases with aging, has a positive association with smoking, metabolic syndrome, Diabetes mellitus and obesity among the population [14,15].

A narrative review conducted by Federica et al. found that only one study of the 35 studies included reported a positive association between obesity and periodontal diseases in women, the other were not conclusive [16].

Chronic inflammation is indeed the underlying biological mechanism, one of the common risk factors in the etiopathogenesis in obesity, periodontal diseases being at the same time the consequence of the deficiency of vitamin D and explaining the severity of periodontal diseases under these metabolic conditions [15]. Hence, as a family practitioner should have the thorough knowledge regarding the association between obesity and periodontal diseases to increase awareness among people, one of the prevention actions in primary care [15,17].

Vitamin D deficiency, obesity and restrictive diets

Due to the fact that the amount of vitamin D obtained from food does not ensure the vitamin D requirement, restrictive diets (vegetarian or vegan diet) do not cause deficiency of the vitamin D [18].

The regular and actual diet turned out to be positive association between deficiency of vitamin D and obesity by increasing the consumption of fats and carbohydrates [19].

A prospective epidemiologic study conducted on 428 patients from USA by Chan J et al. has assessed dates of serum 25-hydroxyvitamin D concentrations, a food-frequency questionnaire and sun exposure information. The primary end-point of this study was to assess serum 25-hydroxyvitamin D concentrations in vegetarians - ate meat and/or fish <1 time/month, partial vegetarians - ate meat and fish <1 time/week or ate meat <1 time/ month and fish ≥1 time/ month, and nonvegetarians patients -ate meat and fish totaling ≥1 time/week [20].

The results suggest that serum 25-hydroxyvitamin D concentrations are not associated with restrictive diets, rather greater association with the degree of skin pigmentation and the sun exposure [20,21].

Vitamin D deficiency, obesity and systemic inflammation

Both, the D vitamin deficiency and obesity cause a systemic inflammatory response. The immune cells from excess adipose tissue have an altering immune function and induce a low-grade systemic inflammation [22]. On the other hand, macrophages also endure transformations and contribute to the increase in the release of IL-6, and consequently to the hepatic activation of the release of C

reactive protein [23]. Several studies have documented mighty link between the C reactive protein levels and obesity [24,25,26].

The increased level of CRP is a nonspecific marker of a single disease, it has received considerable attention as an important modulator against bacterial infection, tissue injury, cardiovascular diseases, pulmonary diseases, cancer or autoimmunity [27-29]. However, there are studies that have shown that vitamin D does not remarkably mediate systemic inflammation in obesity [30]. Studies regarding the use of vitamin D supplements have shown slightly beneficial effects for extraskeletal consequences of vitamin D deficiency [31]. Vitamin D-deficiency can carry to dysfunction of macrophage and T cell so increase the risk of inflammatory autoimmune disease [32]. Immune cells present in excess adipose tissue expressing vitamin D receptor [30]. One of the possible mechanisms reported by different studies is Leptin, considered the key between the obesity and autoimmunity [33].

CONCLUSIONS

The consequences of obesity and vitamin D deficiency are numerous, the association is considered strongly related to chronic diseases, inflammation, cancer.

The association between obesity and level of vitamin D, although intensively studied is not without controversy. There are no studies that emphasize the opposite correlation: supplementing the diet with vitamin d is not associated with weight loss and the weight loss has little effect on improving the level of D vitamin. Losing weight and supplementing with vitamin D reduce the risk factors for systemic inflammation, cardiovascular and metabolic diseases. Future research is needed to clarify this complex link between obesity and vitamin D deficiency.

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