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DIETARY INTAKE OF VITAMIN D AND ITS RELATION TO AN INFLAMMATORY MARKER IN OBESE WOMEN

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ABSTRACT

The aim of this study was to evaluate dietary vitamin D intake and its relationship with an inflammation marker in obese women. A cross-sectional study was designed involving obese women (n=44) and women with normal weight (n=44). Anthropometric assessment using weight and height measurements and classification of nutritional status according to body mass index and waist circumference measurement was performed. The intake of vitamin D was assessed using food diaries kept for three days and the Dietpro 5.i program. Determination of C-reactive protein in serum was carried out by turbidimetry measurement. About the results, the mean values of vitamin D intake by obese women were lower than those of the control group and the reference values (p=0.001). The mean C-reactive protein concentrations for obese women and the control group were 2.45±1.72 mg/L and 1.79±0.48 mg/L, respectively. The results of the analysis of correlation between the intake of vitamin D and the inflammatory marker evaluated in this study revealed no significant association. About the conclusion, the obese women evaluated in this study ingested vitamin D at an amount lower than the recommended value. The study does not show any relationship between vitamin D intake and serum C-reactive protein concentrations in obese women evaluated. However, considering the important anti-inflammatory function of vitamin D, it is necessary to deepen knowledge about the impact of this vitamin on obesity.

Key words: Obesity. Vitamin D. Inflammation.

RESUMO

Ingestão Dietética de Vitamina D e sua Relação com Marcador Inflamatório em Mulheres Obesas

O objetivo deste estudo foi avaliar a ingestão dietética de vitamina D e sua relação com um marcador de inflamação em mulheres obesas. Um estudo transversal foi desenhado envolvendo mulheres obesas (n=44) e mulheres com peso normal (n=44). Foi realizada avaliação antropométrica utilizando medidas de peso e altura e classificação do estado nutricional de acordo com o índice de massa corporal e a medida da circunferência da cintura. A ingestão de vitamina D foi avaliada usando diários alimentares mantidos por três dias e o programa Dietpro 5.i. A determinação da proteína C-reativa no soro foi realizada por meio de turbidimetria. Sobre os resultados, os valores médios de consumo de vitamina D pelas mulheres obesas foram menores que os do grupo controle e os valores de referência (p=0,001). As concentrações médias de proteína C-reativa para as mulheres obesas e o grupo controle foram de 2,45 ± 1,72 mg / L e de 1,79 ± 0,48 mg / L, respectivamente. Os resultados da análise de correlação entre o consumo de vitamina D e o marcador inflamatório avaliado neste estudo não revelaram associação significativa. Como conclusão, as mulheres obesas avaliadas neste estudo ingeriram vitamina D em quantidade inferior ao valor recomendado. O estudo não evidencia relação entre a ingestão de vitamina D e as concentrações séricas da proteína C reativa nas mulheres obesas avaliadas. No entanto, considerando a importante função antiiflamatória da vitamina D é necessário aprofundar conhecimentos sobre o impacto dessa vitamina na obesidade.

Palavras-chave: Obesidade. Vitamina D. Inflamação.

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INTRODUCTION

Obesity is a chronic disease characterized by excessive accumulation of body fat that has a complex and multifactorial etiology.

This disease is associated with several disorders such as diabetes, dyslipidemias, cardiovascular diseases, and several types of cancer (Morais e colaboradores, 2017; Oliveira e colaboradores, 2015).

Adipose tissue is considered an endocrine organ which, when in excess, can compromise the metabolism of macro and micronutrients.

This tissue is involved in the production of proinflammatory adipokines, which are substances that increase the production of free radicals, and the anatomical location of fat deposits influences the production of these molecules, particularly in visceral fat, which is metabolically more active (Cardoso-Saldana e colaboradores, 2015; Martins e colaboradores, 2014).

Several research have been conducted to elucidate the mechanisms involved in the pathogenesis of obesity. In this sense, nutritional changes like reduced dietary intake of some nutrients, such as vitamin D, have been of great interest to researchers, mainly due to the role of this vitamin in several vital cellular processes, for example cell differentiation and proliferation, hormonal secretion, and modulation of the immune system (Santos e colaboradores, 2017; Ruiz e colaboradores, 2014; Vanlint e colaboradores, 2015).

The active metabolite of vitamin D, 1,25-dihydroxyvitamin D (1,25 (OH) 2 D), inhibits the production of inflammatory cytokines by promoting monocyte differentiation. In addition, it plays an important role in biochemical and molecular reactions through its vitamin D receptor (VDR) that contributes to intestinal calcium absorption and activation of CD4 T lymphocytes (Bellan e colaboradores, 2015; Kuwabara e colaboradores, 2009).

In this perspective, there is a report of vitamin D deficiency in obese individuals contributing to the manifestation of low-grade chronic inflammation (Bellan e colaboradores, 2015).

In the studies of Amer and Qayyum (2012) an inverse correlation was verified between the serum concentrations of vitamin D and the C-reactive protein in obese individuals.

It is worth mentioning that some other factors may also justify vitamin D deficiency in obese individuals, such as high consumption of processed food, low exposure to sunlight, and reduced consumption of dietary sources of vitamin D, such as egg yolk, butter, salmon, and liver oil (Earthman e colaboradores, 2012).

Studies carried out in Brazil on the subject show a high probability of inadequacy in the consumption of this micronutrient in food. In the study conducted by Peters and Martini (2012), a reduced amount of vitamin D in the diet (4.2 µg / g) of adult women was demonstrated, which was lower than the reference values. In addition, Peters e colaboradores (2009) found an inverse correlation between the amount of this nutrient in the diet consumed by adolescents and the gain of body weight.

Considering the metabolic and nutritional disorders associated with obesity, the relevant performance of vitamin D as an anti-inflammatory nutrient, and the inconsistency of data on this subject, the objective of this study was to evaluate the intake of vitamin D and its relation to an inflammation marker in obese women.

MATERIALS AND METHODS

This was a cross-sectional study that included 88 women, aged between 20 and 50 years. Participants were subdivided into two groups: the obese (n=44) and the control (n=44) groups.

The participants were selected according to the following criteria: body mass index between 18.5 and 24.9 kg/m^2 (control group) or between 30 and 39.9 kg/m^2 (obese group); nonsmokers; not pregnant or lactating; without diabetes mellitus, cardiovascular disease, cancer, chronic renal failure, and liver disease; and not taking vitamin and mineral supplements.

This study's protocol was approved by the Research Ethics Committee of the Federal University of Piaui (protocol No. 13489613.5.0000.5214) and it was conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent.

Evaluation of Nutritional Status

To assess the nutritional status of the participants, we determined their body-mass index, calculated as the participant's body

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weight divided by the square of the height. The classification of nutritional status was performed according to the recommendations of the World Health Organization (2008).

The measurement of waist circumference was performed using a flexible, inelastic tape surrounding the natural waistline; the narrowest area between the chest and the hips served as a reference value, as proposed by the World Health Organization (2011).

Measurement of Vitamin D intake

Food consumption was recorded by means of a 3-day food diary, and subsequently, the vitamin D content of the diet was calculated using the analysis software Dietpro, 5.i version. The estimated average requirements (EAR) for vitamin D were used as a reference value for the suitable intake at 10 µg/day for females aged between 19 and 50 years (Institute of Medicine, 2011).

Determination of Ultrasensitive C-Reactive Protein

Analysis of serum C-reactive protein was carried out by turbidimetry using an automatic biochemical analyzer, Vita Lab Flexor E® (Spankeren, Netherlands) and the Spinreact® kit (SantEsteve de Bas, Spain) according to manufacturer's instructions. The reference value used was <3 mg/L, as recommended by the manufacturer.

Statistical Analysis

Data were analyzed using the SPSS software, version 20.0 for Windows® (Chicago, SPSS Inc.). The Kolmogorov-Smirnov test was used to verify data normality. To compare the outcomes between the two groups, Student's t test and the Mann-Whitney U test were conducted for parametric and non-parametric data, respectively. Associations between variables were assessed using the Chi-square test.

In addition, Spearman test was performed to identify any potential correlations between data sets. A difference was considered statistically significant when the p value was <0.05, with a 95% confidence interval.

RESULTS

The mean ages of obese women and the control group were 37.50 ± 7.05 and 39.59 ± 6.94, respectively (p=0.164).

The mean values and standard deviations of the anthropometric parameters used to evaluate the nutritional statuses of obese women and the control group are shown in Table 1.

A significant difference was observed between the values of weight, body mass index and waist circumference between the two groups (p <0.05).

Table 1 - Mean values and standard deviations of body weight, height, body mass index and waist circumference of the control group and obese participants.

Parameters	Obese (n=44) Mean ± SD	Control (n=44) Mean ± SD	p
Body Weight (kg)	85,94 ± 8,02*	53,44 ± 5,87	< 0,001
Height (m)	1,55 ± 0,05	1,56 ± 0,07	0,900
BMI (kg/m^2)	35,84 ± 2,28*	22,05 ± 1,55	< 0,001
WC (cm)	102,34 ± 7,62*	74,21 ± 4,30	< 0,001

Legenda: * Significantly different values between obese patients and control group, Student's t- test or Mann-Whitney test (p<0,05). BMI = body mass index; WC = waist circumference.

The mean values and standard deviations for energy and macronutrients found in the diets consumed by the obese and control groups are described in Table 2.

No significant statistical difference was found in relation to macronutrient and energy intake (p>0.05).

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Table 2 - Mean values and standard deviations of energy intake and macronutrients from the obese participants and control group.

Energy/ Macronutrients	Obese (n=44) Mean ± SD	Control (n=44) Mean ± SD	p
Energy (Kcal)	1947,29 ± 833,97	1677,44 ± 377,80	0,395
Carbohydrate (%)	49,61 ± 7,22	52,59 ± 7,08	0,054
Protein (%)	19,20 ± 3,96	20,98 ± 7,89	0,388
Lipid (%)	31,57 ± 5,57	29,61 ± 7,46	0,166

Legenda: Student's t-test or Mann-Whitney test (p<0.05). Reference Values: 45 to 65% carbohydrate, 10 to 35% protein, and 20 to 35% lipid (17).

Table 3 shows the median values of the minimum and maximum intake of vitamin D by obese women and the control group. It was observed that obese women presented reduced dietary vitamin D intake in relation to the control group (p=0.001).

Table 3 - Median values, minimum and maximum of vitamin D by obese and control.

Group	Median (µg)	Minimum (µg)	Maximum (µg)
Obese (n=44)	2,41	0,31	105,31
Control (n=44)	19,81	0,67	347,31

Legenda: Mann-Whitney test (p=0,001). Reference values: EAR=10 µg; RDA=15 µg (16).

Figure 1 shows the percentage distribution of patients according to the reference values of dietary intake of vitamin D.

It was found that 65.9% of obese women ingested a reduced dietary amount of this nutrient. In addition, an association was observed between dietary intake of vitamin D and the occurrence of obesity (p=0.01).

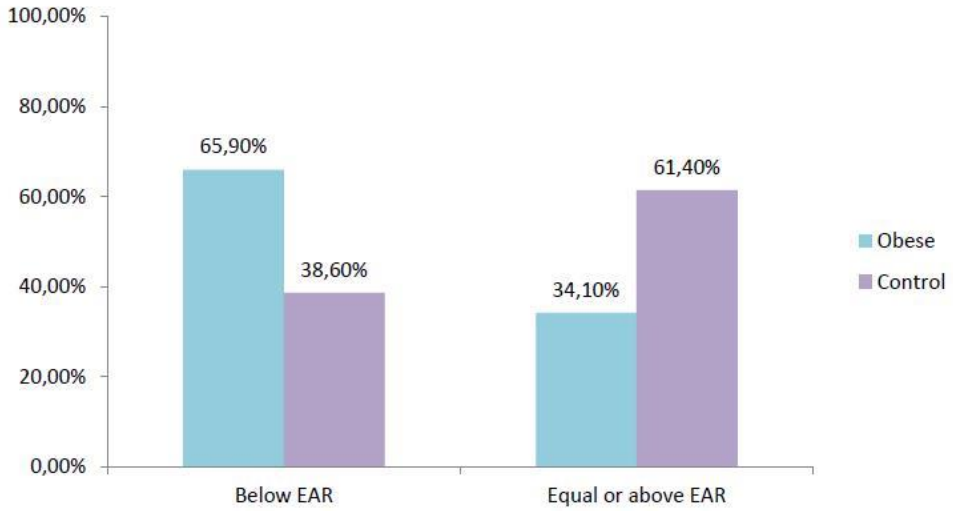

Figure 1 - Prevalence of inadequate habitual vitamin D intake obese women and the control group according to the cut by EAR.

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The mean values and standard deviations of the C-reactive protein concentrations of obese women and the control group are shown in figure 2.

It was verified that there was no statistical difference between the groups in relation to this parameter (p=0.089).

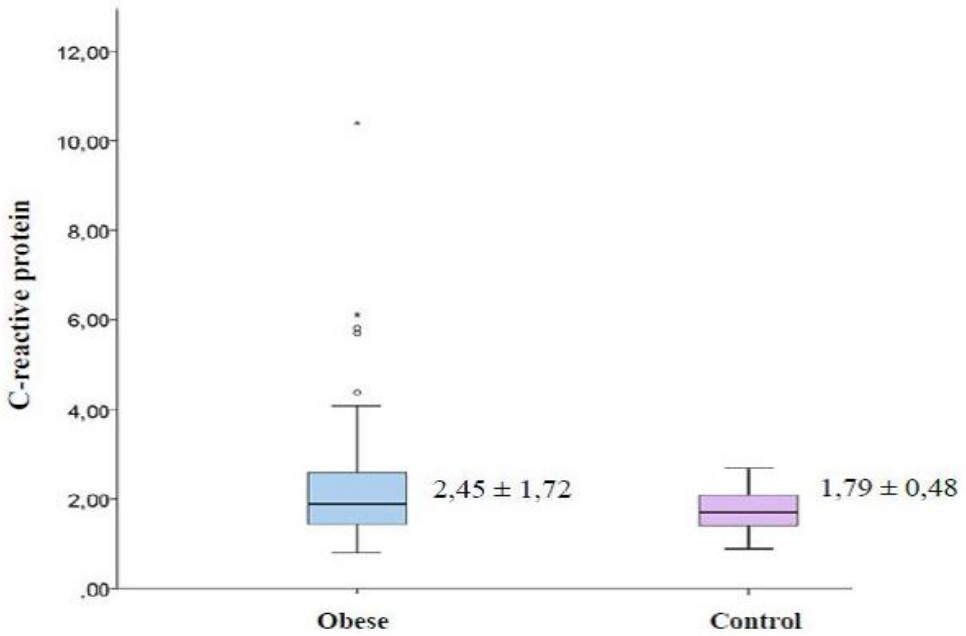

Figure 2 - Activity of the C- reactive protein in obese women and control group.
Legenda: Statistical analysis conducted to verify the existence of a correlation between vitamin D intake and serum concentrations of C-reactive protein did not show significant results (Table 4).

Table 4 - Analysis of simple linear correlation between vitamin D intake and serum concentrations of C-reactive protein in obese and the control group.

Parameters	C-reactive protein			
	Obese		Control	
	r	p	r	p
Vitamin D [a]	-0,091	0,555	-0,199	0,196

Legenda: Simple linear correlation of Spearman[a] (p>0,05).

DISCUSSION

In this study, the intake of vitamin D and serum concentrations of C-reactive protein were estimated the existence of a correlation between these variables in obese women was also explored.

Data obtained regarding the intake of vitamin D by obese women revealed quantities lower than the reference values and those of the control group, with significant statistical difference.

Ratifying this result, the present study also showed that 65% of these women consumed lower vitamin D quantities than the EAR values. Moreover, it was observed that diets consumed by obese women had a reduced amount of food sources of vitamin D, such as tuna, salmon, fish liver oil and egg yolk (Jungert e colaboradores,2014; Vizuete e colaboradores, 2013).

Similar results were found in the study by Ruiz e colaboradores (2014), which showed reduced dietary intake of this nutrient in obese subjects.

It should be noted that reduced consumption of vitamin D by obese women is a negative aspect, since it contributes to its deficiency in the body and the manifestation of relevant metabolic disorders, such as oxidative stress, insulin resistance, and low-grade chronic inflammation (Santos e colaboradores

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2017; Ruiz e colaboradores 2014; Zhang e colaboradores, 2014).

In addition, the present study identified an association between the presence of obesity and the reduced amount of this nutrient in the diet, which may be a relevant factor in inducing the onset of these metabolic disorders.

The serum concentrations of C-reactive protein had adequate values in both groups evaluated, without a significant difference.

The study by Oliveira e colaboradores, 2015) also demonstrated serum concentrations of this inflammatory marker within the normal range. It should be emphasized that the results obtained in this research can be explained by the various factors that interfere with the analysis of this parameter, such as its lability and the effectiveness of the technique used. In addition, C-reactive protein is a biomarker whose synthesis is stimulated by cytokines and that is strongly associated with the presence of an acute inflammatory process, though not specific enough to identify chronic low-grade inflammation that is characteristic of obesity.

Thus, to better understand the results of this study, a correlation analysis was conducted between dietary intake of vitamin D and serum C-reactive protein levels.

However, in this study, no correlation was found between these parameters, which may be due to vitamin D homeostasis in the body, since this nutrient can be acquired by sun exposure, even when there are variations in dietary intake.

Some factors may have influenced the results, such as the lack of vitamin D evaluation through biochemical parameters (plasma, erythrocytes, and urine), limiting the possibility of obtaining a correlation between these nutrients and the inflammatory parameters.

Furthermore, the use of C-reactive protein as the only marker of low-grade chronic inflammation does not allow for a wholesome discussion about the inflammatory process involved in obesity, as well as about the effective participation of vitamin D in this metabolic disorder.

Thus, in view of the complexity of the effects of vitamin D on the inflammatory process, the need to carry out new studies on the subject to better understand the metabolic behavior of this nutrient in clinical complications involved with obesity, particularly low-grade chronic inflammation, is evident.

CONCLUSIONS

Obese women participating in this study consumed less than the recommended amount of dietary vitamin D.

The results of this study did not show the influence of the ingestion of this vitamin on the serum concentrations of the marker of inflammation analyzed.

However, considering the important anti-inflammatory function of vitamin D, it is necessary to deepen knowledge about the impact of this vitamin on obesity.

Conflict of Interest

The authors declare that they have no conflict of interests.

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