SciForschen
Open HUB for Scientific Research

Nutrition and Food Technology: Open Access

ISSN 2470-6086 | Open Access

RESEARCH ARTICLE

Volume 4 - Issue 1 | DOI: http://dx.doi.org/10.16966/2470-6086.150

Comparison Study of Calcium Intake, Obesity and Metabolic Syndrome in Brazilian Women

Lilian Cardia[1,2*], Carlos Alberto Malheiros[1], Elias Jirjoss Ilias[1] and Roberto de Cleva[2]

[1]*Santa Casa of São Paulo Medical School, São Paulo, Brazil*
[2]*University of São Paulo Medical School, São Paulo, Brazil*

[*]**Corresponding author:** Lilian Cardia, Santa Casa of São Paulo Medical School, São Paulo, Brazil, Tel: +55 11 9 8358.2322; **E-mail:** liliancardia@gmail.com

Received: 28 Feb, 2018 | **Accepted:** 02 Apr, 2018 | **Published:** 06 Apr, 2018

Citation: Cardia L, Malheiros CA, Ilias EJ, de Cleva R (2018) Comparison Study of Calcium Intake, Obesity and Metabolic Syndrome in Brazilian Women. Nutr Food Technol Open Access 4(1): dx.doi.org/10.16966/2470-6086.150

Abstract

A high prevalence of obese women cannot achieve the recommended daily intake of calcium. The aim of the study is to compare intake of dietary sources of calcium in Brazilian obese and no obese women and relationship between their consumption and metabolic syndrome occurrence. 84 Brazilian women was an assessment by food frequency intake of calcium source stratified into levels and compared to Food Guide for the Brazilian Population. Metabolic syndrome was defined as the presence of ≥ 3 criteria on National Cholesterol Education Program-Adult Treatment Panel III. Anthropometric data were obtained through measurement body weight, height and waist circumference. The subjects were divided into Obese and Eutrophic Group, were matched by age 41 ± 10 and 39 ± 7 years. Were evaluated 44 obese and 40 eutrophics (52.4% obese), weight 112.3 ± 14.8 kg and 63.6 kg ± 8.3, body mass index between 36.6-63.2 kg/m^2 and mean 24.3 kg/m^2. The association between the presence of metabolic syndrome and obesity was present in 41.7% (P<0.001) of the total sample and an expressive way in obese (71%). When evaluated intake frequency of calcium food sources between groups, were observed the statistical difference in consumption of conventional yoghurt (P=0.021) and sardines (P=0.018). The data revealed very low daily consumption of high bioavailability calcium sources (milk and dairy products); especially in reference to rarely ingest milk and dairy products. No significant difference was found when the presence of criteria of metabolic syndrome was evaluated with consumption of calcium source. Metabolic syndrome was prevalent in obese but it was not possible to infer the relationship between consumption of calcium food sources and metabolic syndrome. Calcium intake was below recommendations in both groups. It becomes an evident need for nutritional education to stimulate consumption of calcium food sources part of an adequate diet to protect for obesity and metabolic syndrome.

Keywords: Calcium; Dairy product; Metabolic syndrome; Obesity

Introduction

Obesity is a chronic disease of multifactorial origin, has been widely studied in recent years due to risks to the development of co morbidities and significant reduction life expectancy it imposes on patients [1]. In Brazil, obesity affects 18.1% of the male and 19.6% female population, according to the Surveillance Research on Risk Factors and Protection for Chronic Diseases by Telephone Inquiry [2].

Responsible for a high morbimortality is considered a determinant factor for the development diseases such as hypertension, dyslipidemias and also increases the risk for colon and postmenopausal breast cancer, in addition to insulin resistance and type 2 diabetes [3].

Studies have shown that among the numerous nutritional causes for the development of obesity, low calcium intake could contribute to its physiopathology not being limited to the known health benefits of bone, but it has also been associated with protection against diseases such as hypertension, some types of cancer, renal lithiasis, insulin resistance, diabetes, prevention and control of obesity by inducing increased parathyroid hormone and calcitriol for influx of intracellular calcium into adipose tissue would stimulate expression of enzyme fatty acid synthetase, by inhibiting lipolysis, promoting lipogenesis and reducing fat oxidation [4-7].

However, some studies have reported conflicting results on the association between dairy intake, the most important

calcium food sources and obesity. Prospective studies have investigated the role of dairy consumption in weight change and risk of overweight or obesity and whether these associations depend on initial body weight [8].

Recent studies suggest that consumption of dairy products and associated nutrients components may have a protective effect against some components of the Metabolic Syndrome (MetS). The population study The Development of Coronary Artery Risk in Young Adults (CARDIA) [9] identified lower frequency of dairy consumption in overweight than in eutrophic individuals and observed inverse associations between frequency of dairy intake for development of obesity, abnormal homeostasis glucose, blood pressure elevation, and dyslipidemiaia in both sex, Black, White and overweight [10].

The consumption of dairy products in the country and the world has decreased fundamentally due to the substitution of sweet beverages, a situation of particular concern when milk and its derivatives are replaced by soft drinks. This tendency has a negative effect on bone health due to the inadequate availability of mineral or substances contained in soda that prevents calcium fixation in bone matrix [9,6,11,12].

There is a high prevalence of adults who cannot reach the recommended of calcium intake, between 1,000 and 1,200 mg/day for men and women [13,14]. The dairy foods intake has also been inversely associated with the occurrence of one or more components of MetS. Set of metabolic disorders, is characterized by the presence of hypertriglyceridemia and low HDL-c, hypertension, visceral obesity and glucose intolerance. Insulin resistance is the nucleus of this phenomenon and its occurrence is associated with an increased risk for cardiovascular disease [15,16].

From these data, we hypothesize that if adequate dietary calcium intake seems to have a protective character for diseases such as obesity and MetS, and are recognized as important risk factors for the development of cardiovascular diseases adequacy of diet may be a factor of relative simplicity to be adjusted.

As the current state of knowledge about the association between dairy consumption, obesity, and MetS in women remains contradictory and inconclusive. The purpose of this study was to compare intake of dietary sources of calcium in Brazilian obese and non obese women and relationship between their consumption and MetS occurrence.

Methods

Design and group description

A cross-sectional study was carried out at Outpatient Clinic of Severe Obesity of Santa Casa Medical School in 2011, 44 women with BMI ≥ 35 kg/m^2, aged between 25-65 years, with an indication for surgical treatment of obesity (Obese Group) were evaluated. For the Eutrophic Group (EG), 40 women with a similar age to OG and BMI between 18.5 kg/m^2-24.9 kg/m^2 were considered. Socio-demographic characteristics were analyzed such as ethnicity, schooling, marital and professional status.

Clinical experiments

Food frequency assessment: The food frequency assessment was based on semi quantitative questions of calcium foods source intake such as milk and dairy products (whole milk, any flavors and fat contents conventional yoghurt, white cheese, cottage cheese and Brazilian creamy cheese), fresh and canned fish (sardines), dark green leafy vegetables (kale, broccoli), adapted from Food Frequency Questionnaire (FFQ) [17].

As this identifies stratified frequency in levels (≥ 2 times/day, once/day, 5-6 times/week, 2-4 times/week, once/week, 1-3 times/month, rarely and never), it was necessary grouping to allow application of statistical tests: frequency of daily consumption (≥ 2 times/day and once/day) for frequent consumption and other frequencies for low consumption which was compared to recommendations of Food Guide for Brazilian Population (2009) [18].

The formets definition was used criteria established by defined according to the National Cholesterol Education Program Expert Panel III [19].

The anthropometric data were obtained by measuring body weight (without shoes and use light clothing) Welmy® digital scale, model R104 (kg). For height stadiometer was used. Waist circumference was measured by a non-elastic tape measure at height of umbilical scar. Height and weight were used to calculate BMI.

For systemic arterial hypertension diagnosis data from the clinical record were used aneroid sphygmomanometer UNITEC model AD2 mechanical [19].

Laboratory parameters: Fasting glycemia (enzymatic method), triglycerides (enzymatic assay method) and HDL-c (homogeneous enzymatic assay method) were measured at the Central Laboratory of Santa Casa Medical School, São Paulo [19].

Data analysis

In statistical analysis, Statistical Package for Social Sciences (SPSS), version 13.0 was used. For qualitative variables, absolute (n) and relative (%) frequencies were presented. For quantitative, summary measures were presented (mean, median and standard deviation). Student-t or Mann-Whitney, Chi-square (association) or Fisher Exact tests were used and a significance level of 5% (p<0.05) was adopted.

Ethics

This research was approved by Scientific Committee of Department of Surgery, Scientific Committee of Department of Nutrition and by the Ethics Committee in Human Research of the Irmandade da Santa Casa de Misericórdia de São Paulo (048/10).

Results and Discussion

In this present study, 84 women, 52.4% OG (n=44) and 47.6% EG (n=40) were evaluated, with a mean age of 41.4 years

between OG and 39.7 years between EG. The mean BMI in OG 47.7 kg/m^{2}e EG 24.3 kg/m^2 (Table 1). Among obese, 61.4% were white and 36.6% other races (Afro-American). Eutrophic 67.5% was white and 32.5% other races (Afro-American). 25% of the obese had basic schooling and while among eutrophic 25% higher education.

The MetS association among of obesity presence (Table 2) was an expressive form in OG (70%). The data found in this group reiterate studies demonstrating a high prevalence of MetS in obese individual [10,19,20].

A cohort study of more than 10,000 American women demonstrated a significantly lower prevalence of MetS among those with the highest consumption of dairy products and calcium supplements; however in this study no association was found between the consumption of the recommended portions of dairy products with the presence of the syndrome also for each of its components [21].

Calcium can be acquired through daily intake of food sources, among which are dairy products which have high bioavailability due to Vitamin D content and presence of lactose, which increases its absorption [20]. However, data on the frequency of dietary intake revealed a very low daily intake of dietary sources of calcium of great bioavailability (from milk and dairy products) in groups, with emphasis on both "rarely" consuming milk and milk products (Table 3).

In order to observe consumption of calcium source foods, FFQ was used, which was adapted only to food sources of calcium and habitual Brazilian consumption. As FFQ identifies the stratified frequency in 8 levels, it was necessary to group frequency of consumption as the daily frequency for "frequent", the weekly frequency for "moderate" and monthly or rare frequency for "rare", so that it allows application statistical tests. Thus, a statistically significant difference was observed in yoghurt consumption (P=0.02) and sardines (P=0.01) (Table 4).

When stratification is reduced to frequent and moderate intake, it is not possible to find the statistical difference.

Studies have shown that frequent consumption of sardine would have cardiovascular protective effect in postmenopausal women possibly not only due to high calcium content, as other nutrients including protein and taurine could play a role in their insulin sensitive effects, as some studies have demonstrated in models with diabetes and metabolic syndrome [22-24].

In general, the consumption of foods rich in calcium is lower than the recommendation of the Food Guide for the Brazilian Population [18].

This change in dietary pattern may play an important role in the development of cardiovascular diseases. When analyzing consumption of dairy products according to recommendations of Food Guide for the Brazilian Population, no significant difference between groups was identified. However, although there was no percentage difference, the consumption found was 50% below the recommendation in a number of servings and corroborates with the BRAZOS (Brazilian Osteoporosis Study) [13] study that indicates the low consumption of dairy products in Brazil (Table 5).

Many dairy components can contribute to the beneficial effects on body weight and fat. Milk and particularly whey appear to be insulin tropic when given in a single meal. Medium chain fatty acids improve insulin sensitivity, whey proteins, amino acids, medium chain fatty acids, and especially calcium [15].

Table 1: Anthropometric characteristics of groups

Characteristics	Obese Group% md (sd)	Europhic Group% md (sd)	*p* value
Age (y)	41.4 ± 9.7	39.7 ± 7.3	0.377
Height (m)	1.60 ± 0.1	1.62 ± 0.1	0.290
Weight (Kg)	122.3 ± 14.8	63.6 ± 8.3	**<0.001**
BMI (Kg/m^2)	47.7 ± 5.5	24.3 ± 3.0	**<0.001**

Chi squared test (*p*-value<0.001)

Table 2: Association between metabolic syndrome and obesity

Groups	Presence of MetS NO (%) n	Presence of MetS YES (%) n	*p* value
Obese	29.0 (13)	71.0 (31)	**<0.001**
Eutrophic	90.9 (36)	9.1 (4)	
TOTAL	58.3 (49)	41.7 (35)	

Chi squared test (*p* value<0.001)

Table 3: Frequency of intake calcium foods source between groups

Foods	Intake pattern	obese (n=44) % (n)	eutrophic (n=40) % (n)	*p* value
Milk	Frequent	70.4 (31)	70.0 (28)	*
	Moderate	11.4 (5)	2.5 (1)	
	Rare	18.2 (8)	27.5 (11)	
Conventional Yoghurt	Frequent	31.8 (14)	**42.5 (17)**	**0.021**
	Moderate	**45.5 (20)**	17.5 (7)	
	Rare	22.7 (10)	**40.0 (16)**	
Brazilian Creamy cheese	Frequent	15.9 (7)	25.0 (10)	0.398
	Moderate	59.1 (26)	45.0 (18)	
	Rare	25.0 (11)	30.0 (12)	
White Cheese	Frequent	11.4 (5)	10.0 (4)	*
	Moderate	50.0 (22)	32.5 (13)	
	Rare	38.6 (17)	57.5 (23)	
Sardines	Frequent	-	-	**0.008**
	Moderate	34.1 (15)	10,0 (4)	
	Rare	65.9 (29)	**90.0 (36)**	
Dark green leafy vegetables	Frequent	40.9 (18)	35.5 (14)	0.728
	Moderate	37.5 (17)	37.5 (15)	
	Rare	20.5 (9)	27.5 (11)	

Chi squared test (*p* value<0.001)

Table 4: Frequency of dairy products intake between obese and control group, according to recommendations of Food Guide for the Brazilian Population

Foods	Intakepattern	Metabolic syndrome obese eutrophic %(n)		*p* value
Dairy products	3 portions/day	47.7 (21)	47.5 (19)	0.983
	<3 portions/day	52.3 (23)	52.5 (21)	

Chi squaredtest (*p* value<0.001)

Table 5: Presence of metabolic syndrome and frequency of dairy products intake according to recommendations of Food Guide for the Brazilian Population

Foods	Intakepattern	Metabolic syndrome obese eutrophic %(n)		*p* value
Dairy products	3 portions/day	46.0 (23)	50.0 (17)	0.719
	<3 portions/day	54.0 (27)	46.0 (23)	

Chi squared test (*p* value<0.001)

The recent study of 18438 eutrophic women investigated how dairy intake was associated with a change in weight and risk of overweight or obesity during an average follow-up of 11 years. In this period, 8238 women became obese and overweight. There was a lower risk of becoming obese or overweight of high-fat dairy products intake. A higher intake of total dairy products may be of importance in preventing weight gain in middle-aged women who are initially of normal weight [8].

On the other hand, results of a recent meta-analysis reflect that the consumption of dairy products was not positively related to changes in body weight where no significant association could be observed for the risk of weight gain. The only yoghurt showed some evidence for a beneficial effect, where greater intake was inversely associated with reduced risk of obesity, changes in body weight or waist circumference and association were positive for each increase in cheese consumption [25].

The National Health and Nutrition Examination Survey examined the association between calcium intake and hypertension among 14,408 obese adults. Calcium intake was significantly lower for the hypertensive group compared to the normotensive group especially among obese women (20-44 years) and among non-diabetic obese adults. A significant inverse relationship was detected where calcium intake and the likelihood of hypertension was stronger among women compared to total sample, including all obese adults [26].

The biological mechanisms associate calcium and hypertension is not yet clear, but may involve calcium-mediated effects on circulating calcemic hormones that influence vascular changes. Dairy products intake was associated with the lower blood pressure due presence of calcium and Vitamin D as well as milk peptides, may exert a beneficial effect on blood pressure by inhibiting angiotensin I converting enzyme, modulating endothelial function or affecting body weight. On the other hand, was analyzed low calcium in the diet as a possible mechanism for raising blood pressure [5].

In a similar study, 77 obese (76.6% of women) with a mean age of 44 years have submitted an evaluation of nutritional status and food consumption only 26.0% had adequate calcium intake. The most common comorbidities were hypertension (72.4%); type 2 DM (32.9%) and dyslipidemia (18.4%) [27].

The cross-sectional MABAT study, based on a sample of 3246 individuals aged 25-64 years (1411 were females), divided by BMI confirmed an inverse relationship between dietary calcium intake and obesity among females. The group of women with a waist circumference below 88 cm had significantly higher calcium intakes than those with the higher circumference. This association was related only to milk intake and not to other dairy products [28].

The recommendation of calcium intake varies according to age groups and life cycles, being especially increased in adolescence when there is bone growth and mineral deposit grow and in periods when intestinal absorption of nutrient is decreased when the rate of bone resorption is raised as in postmenopause [5,25]. Although skeleton functions as a mineral reserve for maintenance of extracellular fluid concentrations, deficiency in cellular and tissue levels are rarely found. Whatever reduction of this reserve, there may be impairment of bone resistance. It should be considered that in addition to the loss of bone mass expected in adulthood, changes that occur during menopause, such as decreased calcium intake and reduced physical activity, may increase the risk of fractures [13].

According to the Food Guide for the Brazilian Population [17] (Table 6), intake of three glasses of milk per day is sufficient to meet calcium intake needs of adult women. However, consumption of calcium in Brazil is extremely low. According to data obtained by BRAZOS [13], when evaluating calcium intake among 2,420 individuals over 40 years, 90% of interviewees consumed slightly more than 30% of recommendations of Dietary Reference Intake for Calcium and Vitamin D [29] and only 6% did make use of supplements.

It is important to emphasize determination of the Codex Alimentarius [30] for definition of a rich food source. The food must have at least twice the value of the "source" as 240 mg of Ca/100 g, 120 mg of Ca/100 mL, 80 mg of Ca/100 kcal or, still, 240 mg of Ca/portion. Even low-fat and low-fat milk are rich in calcium. Dairy products, such as yoghurt and white cheese, have a same nutritional profile as milk. Regular consumption of dairy at any stage in course of life should be encouraged in order to ensure adequate intake of calcium.

Table 6: Frequency of dairy products intake according to recommendation of Food Guide for the Brazilian Population according to the presence of MetS and individual components

Components of MS	Yes % (n)	No % (n)	*p* value
Waist circumference>88 cm			
3 portions/day	60.0 (15)	42.4 (25)	0.139
<3 portions/day	40.0 (10)	57.6 (34)	
Systemic arterial hypertension ≥ 130/85 mmHg			
3 portions/day	46.0 (23)	50.0 (17)	0.719
<3 portions/day	54.0 (27)	50.0 (17)	
Triglycerides ≥ 150 mg/dL			
3 portions/day	45.3 (29)	55.0 (11)	0.449
<3 portions/day	54.7 (35)	45.0 (9)	
Fasting glycemia ≥ 110 mg/dL			
3 portions/day	47.8 (32)	47.1 (8)	0.959
<3 portions/day	52.2 (35)	52.9 (9)	
HDL-c<50 mg/dL			
3 portions/day	48.0 (24)	47.1 (16)	0.932
<3 portions/day	52.0 (26)	52.9 (18)	

Conclusions

This study revealed a relevant, low intake of these foods in both groups. The positive association between metabolic syndrome and obesity in women was observed. However, no association was found between dairy consumption and the presence of the MetS in each individual component of the syndrome. It was verified that there was no positive association between deficient consumption of dietary sources of calcium and obesity. There was a significant difference in the consumption of yoghurt and canned fish between groups.

These findings justify a more in-depth analysis of low consumption and the prevalence of MetS criteria.

It becomes an evident need for guidance in nutritional education to stimulate consumption of calcium sources of higher bioavailability as part of an adequate diet.

Competing Interests

The authors have declared that no competing interests exist.

References

1. Peeters A, Barendregt JJ, Willekens F, Mackenbach JP, Al Mamun A, et al. (2003) Obesity in Adulthood and Its Consequences for Life Expectancy: A Life-Table Analysis. Ann Intern Med 138: 24-32.
2. Ministério da Saúde (2016) Vigitel Brasil Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico. Brasília 51.
3. Carraro LM, Geloneze B, Geloneze S, Guedes EP (2007) Condições Clínicas Associadas à Obesidade. In: Associação Brasileira para o estudo da obesidade e da Síndrome Metabólica. Diretrizes Brasileiras de Obesidade. Abeso, Brazil 25.
4. Dicker D, Belnic Y, Goldsmith R, Kaluski DN (2008) Relationship between dietary calcium intake, body mass index, and waist circumference in MABAT-The Israeli national Health and nutrition study. Isr Med Assoc J 10: 512-515.
5. Martini LA, Wood RJ (2009) Milk intake and the risk of type 2 diabetes mellitus, hypertension and prostate cancer. Arq Bras Endocrinol Metabol 53: 688-694.
6. Pereira GAP, Genaro PS, Pinheiro MM, Szejnfeld VL, Martini LA (2009) Cálcio dietético-estratégias para otimizar o consumo. Rev Bras Reumatol 49.
7. Schrager S (2005) Dietary calcium intake and obesity. J Am Board Fam Pract 18: 205-210.
8. Rautiainen S, Wang L, Lee IM, Manson JE, Buring JE, et al. (2016) Dairy consumption in association with weight change and risk of becoming overweight or obese in middle-aged and older women: a prospective cohort study. Am J Clin Nutr 103: 979-988.
9. Pereira MA, Jacobs DR Jr, Van Horn L, Slattery ML, Kartashov AI, et al. (2002) Dairy consumption, obesity and the insulin resistance syndrome in Young adults: the CARDIA Study. JAMA 287: 2081-2089.
10. Saltevo J, Niskanen L, Kautiainen H, Teittinen J, Oksa H, et al. (2011) Serum calcium level is associated with metabolic syndrome in the general population: FIN-D2D study. Eur J Endocrinol 165: 429-434.
11. Beydoun MA, Gary TL, Caballero BH, Lawrence RS, Cheskin LJ, et al. (2008) Ethnic differences in dairy and related nutrient consumption among US adults and their association with obesity, central obesity and the metabolic syndrome. Am J Clin Nutr 87: 1914-1925.
12. Bueno AL, Czepielewski MA (2008) The importance for the growth of dietary intake of calcium and Vitamin D. J Pediatr (Rio J) 84: 386-394.
13. Pinheiro MM, Schuch NJ, Genaro PS, Ciconelli RM, Ferraz MB, et al. (2009) Nutrient intakes related to osteoporotic fractures in men and women-The Brazilian Osteoporosis Study (BRAZOS). Nutr J 8: 6.
14. Ortega Anta RM, Jiménez Ortega AI, López-Sobaler AM (2015) Calcium and health. Nutr Hosp 31: 10-17.
15. Pfeuffer M, Schrezenmeir J (2007) Milk and the metabolic syndrome. Obes Rev 8: 109-118.
16. Phillips LK, Prins JB (2008) The link between abdominal obesity and the metabolic syndrome. Curr Hypertens Rep 10: 156-164.
17. Fisberg RM, Martini LA, Slater B, Araújo L (2005) Métodos de inquéritos alimentares. In: Fisberg RM, Slater B, Slater B, Martini LA (eds) Inquéritos alimentares: métodos e bases científicos. Manole, Brazil 1-16.
18. Ministério da Saúde (2005) Guia alimentar para a população brasileira: promovendo a alimentação saudável. Ministério da Saúde, Secretaria de Atenção à Saúde, Coordenação-Geral da Política de Alimentação e Nutrição, Brasília 236.
19. Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (2001) Executive summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). JAMA 285: 2486-2497.
20. Buzinaro EF, Almeida RN, Mazeto GM (2006) Bioavailability of dietary calcium. Arq Bras Endocrinol Metabol 50: 852-861.
21. Liu S, Song Y, Ford ES, Manson JE, Buring JE, et al. (2005) Dietary Calcium, Vitamin D, and the Prevalence of Metabolic Syndrome in Middle-Aged and Older U.S. Women. Diabetes Care 28: 2926-2932.
22. Kondo K, Morino K, Nishio Y, Kondo M, Nakao K, et al. (2014) A fish-based diet intervention improves endothelial function in postmenopausal women with type 2 diabetes mellitus: a randomized crossover trial. Metabolism 63: 930-940.
23. Dunstan DW, Mori TA, Puddey IB, Beilin LJ, Burke V, et al. (1997) The independent and combined effects of aerobic exercise and dietary fish intake on serum lipids and glycemic control in NIDDM. A randomized controlled study. Diabetes Care 20: 913-921.
24. Balfegó M, Canivell S, Hanzu FA, Sala-Vila A, Martínez-Medina M, et al. (2016) Effects of sardine-enriched diet on metabolic control, inflammation and gut microbiota in drug-naïve patients with type 2 diabetes: a pilot randomized trial. Lipids Health Dis 15: 78.

25. Schwingshackl L, Hoffmann G, Schwedhelm C, Kalle-Uhlmann T, Missbach B, et al. (2016) Consumption of Dairy Products in Relation to Changes in Anthropometric Variables in Adult Populations: A Systematic Review and Meta-Analysis of Cohort Studies. PLoS One 11: e0157461.

26. Chen Y, Strasser S, Cao Y, Wang KS, Zheng S (2015) Calcium intake and hypertension among obese adults in United States: associations and implications explored. J Hum Hypertens 29: 541-547.

27. Correia Horvath JD, Dias de Castro ML, Kops N, Kruger Malinoski N, Friedman R (2014) Obesity coexists with malnutrition? Adequacy of food consumption by severely obese patients to dietary reference intake recommendations. Nutr Hosp 29: 292-299.

28. Dicker D, Belnic Y, Goldsmith R, Kaluski DN (2008) Relationship between dietary calcium intake, body mass index, and waist circumference in MABAT-The Israeli National Health and Nutrition Study. Isr Med Assoc J 10: 512-515.

29. Ross AC, Taylor CL, Yaktine AL, Del Valle HB (2011) Dietary reference intakes for calcium and Vitamin D. Institute of Medicine, National Academies Press, USA.

30. Codex Alimentarius Commission (1997) Guidelines for Use of Nutrition Claim-CAC/GL 23-1997.