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CLINICAL NUTRITION RESEARCH

Diet, Sleep and Metabolic Syndrome Among a Legal Amazon Population, Brazil

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Metabolic syndrome incidence is increasing worldwide then it is important to study the possible risk and protective factors. Our previous study suggested an association between coffee consumption and metabolic syndrome. The aim of this study was to address possible associations between dietary lifestyle factors with metabolic syndrome. In a case-control study we compared 74 metabolic syndrome patients with 176-matched controls attended at a public health central unit. Incident cases diagnosed according to ATP III criteria were matched with control group composed of healthy subjects performing routine examinations. Having lower educational level compared to highest levels tend to increase metabolic syndrome prevalence, which was not statistically significant. Similar pattern was observed for marital status. No difference was found regarding gender and metabolic syndrome odds. Interestingly, daily drinking two to three cups of coffee (OR = 0.0646, 95% CI, 0.0139-0.3005, p = 0.0005) or until 2 cups of milk were inversely associated with metabolic syndrome odds (OR = 0.5368, 95% CI, 0.3139-0.9181, p = 0.0231). Sleeping seven to eight hours per night was also associated with decreased odds of metabolic syndrome (OR = 0.0789, 95% CI, 0.0396-0.1570, p < 0.0001). Eating at least two portions of chocolate was also associated with decreased risk of metabolic syndrome (OR = 0.3475, 95% CI, 0.1865-0.6414, p = 0.0009). Adequate sleeping and dietary intake of some foods materially decreased the metabolic syndrome.

Key Words: Metabolic Syndrome X, Case-control studies, Chocolate, Milk, Coffee

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Introduction

Beyond its effects on cardiovascular and type 2 diabetes mellitus risk, metabolic syndrome pathogenesis involves massive release of pro-inflammatory factors (c-reactive protein, intercellular adhesion molecules, and monocyte chemoattractant protein-1), adipokines (adiponectin and resistin) and cytokines (TNF-a, IL-6) [1]. Excessive production of pro-inflammatory factors can decisively contribute to cancer initiation and promotion [2], which could explain the increased risk of hepatocellular carcinoma, and renal cell carcinoma due to obesity and metabolic syndrome [3,4].

Since prevalence of metabolic syndrome is increasing worldwide [5,6], it is urgent to study the role of nutritional interventions [7], as well as possible risk or protective factors, especially those related to the human lifestyle (diet, sleep, physical activity, fat/weight gain). In this manner, dietary intake of milk and calcium has been associated with lower prevalence and incidence of metabolic syndrome [8,9]. Similar protective effect of regular milk intake (at least one cup per day) regarding reduction of metabolic syndrome risk was observed in data from Korean NHANES III [10].

Shorter sleep duration has also been inversely associated with metabolic syndrome risk [11]. A preliminary study had reported an inverse association between coffee drinking and metabolic syndrome risk [12]. In this respect, the objective of this work was to study metabolic syndrome and its possible associated factors among a Brazilian population.

Materials and Methods

This descriptive and transversal case-control study covered 250 people, from 18 to 81 years old, attending at "Arnulfo da Cunha Coutinho" public laboratory from Barra do Garças, MT, Brazil. The adopted diagnostic criteria for metabolic syndrome case was the revised ATP III [13]. Controls were people who had none of the clinical and laboratory criteria for metabolic syndrome. We compared 74 metabolic syndrome patients with 176-matched controls attended at a public health central unit. Incident cases diagnosed according to ATP III guidelines were matched with control group composed of healthy subjects performing routine examinations. Following the revised National Cholesterol Education Program (NCEP) ATP III guidelines, subjects with three or more of the following criteria were defined as having metabolic syndrome: abdominal obesity (waist circumference > 88 cm in women and > 102 cm in men); hypertriglyceridemia (triglycerides > 150 mg/dL; for conversion to millimoles per liter, multiply by 0.0113); low high-density lipoprotein cholesterol fraction (< 40 mg/dL in men and < 50 mg/dL in women; for conversion to millimoles per liter, multiply by 0.0259); high blood pressure (130/85 mmHg); high fasting glucose levels (100 mg/dL; for conversion to millimoles per liter, multiply by 0.0555) [13].

Blood samples were collected to determinate fasting glycemia, total cholesterol, LDL-cholesterol, HDL, urea, and triglycerides. Body weight and waist circumference were measured using a digital body scale TBF-551 model (Tanita®, Japan) and an anthropometric tape (Sanny, Brazil).

In 2013, the Brazilian minimum salary was R$678.00 which is equivalent to US$297.00 according to the Ministry of Work and Employment (http://portal.mte.gov.br/sal_min/). Before engaging into the research people received an explanation regarding the procedures and they signed a written informed consent. The study was approved by the Ethics Committee on Research of the Julio Müller University Hospital (HUJM), from Federal University of Mato Grosso (UFMT) (protocol. no.668/CEP-HUJM/09).

The estimation of odds ratio and data analysis were performed using the programs epicalc® and epitools®. Considering that the distribution of sample population is approximately normal, a two-tailed 2-sample z test was used to compare sample proportions, considering at least a 5% significance level ($p < 0.05$).

Results

In the current study, prevalence of metabolic syndrome was higher (29.6%). Other socioeconomic and epidemiological characteristics of studied the population are presented in Table 1.

As expected hyperglycemia and having 40 years old or more had been associated with increased prevalence (or odds) of metabolic syndrome (Table 2). Having lower educational level compared to highest levels trend to increase metabolic syndrome prevalence, which was not statistical significant. Similar pattern was observed for marital status. No difference was found regarding gender and metabolic syndrome odds.

Interestingly, daily drinking two to three cups of coffee ($p = 0.0005$) or until 2 cups of milk ($p = 0.0231$) were inversely associated with metabolic syndrome odds. Sleeping seven to eight hours per night was also associated with decreased odds of metabolic syndrome ($p = 0.0001$) (Table 2).

Discussion

The first national survey regarding metabolic syndrome in Brazil reported a 14.2% of prevalence [14]. However, the prevalence of metabolic syndrome in Central Brazil reached 32% [15]. In the current study which was performed in a Central-Western Brazilian city, the prevalence of metabolic syndrome was similar to previous studies in Brazil [14] and Korea [10].

In a previous study, with a sample of adults from the same city, there was no association between education and metabolic syndrome, whereas lowest family income was correlated with increased odds of that disease [16]. In the present study, regular milk intake was associated with decreased odds of metabolic syndrome. This is in accordance with previous study

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Table 1. Socioeconomic and epidemiological characteristics of the population

Variable	n	%
Education		
Illiterate	7	2.80
Incomplete elementary	96	38.40
Elementary	71	28.40
Incomplete high-school	15	6.00
High-school	41	16.40
College	20	8.00
Ethnicity		
White	169	67.60
Black	15	6.00
Others	63	25.20
Indigenous	3	1.20
Gender		
Female	147	57.20
Male	103	42.80
Marital status		
Single	69	27.60
Married	126	50.40
Separated/divorced	15	6.00
Widowed	28	11.20
Alcohol drinking		
No	198	79.20
Some days	52	20.80
Smoking		
No	166	66.40
Yes	84	33.60
Diabetes mellitus		
No	107	42.80
Yes	23	9.20
Don't know	120	48.00
High blood cholesterol		
No	90	36.00
Yes	73	29.20
Don't know	87	34.80
Hypertension		
No	38	15.20
Yes	190	76.00
Don't know	22	8.80
Metabolic syndrome		
No	176	70.40
Yes	74	29.60
Metabolic syndrome by gender		
Female	47	32.87
Male	27	25.23

in France, Korea, and UK [8-10]. A meta-analysis also reported that regular dietary intake of high-fat dairy foods was also inversely associated with obesity [17].

According to the systematic review performed by Cappuccio et al. [18], there is no literature consensus regarding short sleep duration. Some authors consider short sleep as being 5 hours, 6 hours, and 7 hours per night [18]. Anyway, sleep 7 hours or less is very harmful. Many studies have been reported inverse associations between short sleep duration and metabolic syndrome risk [11,19]. In the current study, exposition to seven to eight hours of sleep was associated with decreased risk of metabolic syndrome. This result is in accordance with a previous report [20]. It has been suggested that sleeping 5 hours induced β-cell dysfunction and hyperglycemia as well as it provoked insulin resistance, contributing to obesity pathogenesis [21,22]. Sleeping 5 hours or sleep restriction (some consecutive days of shorter sleep, e.g., 5 hours per night) has also been associated inflammation, impairment of growth hormone secretion, delay on muscle glucose regulation and insulin sensitivity, oxidative stress, and endothelium dysfunction both biological mechanisms involved in cardiometabolic disorders [21,23].

Previous studies have been suggested a protective effect of coffee on metabolic syndrome risk [11,16,24]. The current study also observed an inverse association between coffee drinking and metabolic syndrome. Experimental studies with rats demonstrated that caffeine intake improved glucose tolerance, insulin sensitivity, and decreased liver steatosis, body fat, and systolic blood pressure [25].

In an obesity rat model regular coffee drinking improved both blood glucose values and decreased expression of eight inflammatory genes [26]. Into the same approach, regular intake of coffee up-regulated mitochondrial citric acid cycle and urea cycle [27]. Both studies suggested important plausible biological anti-metabolic syndrome mechanisms.

Table 2. Odds risk values and significance level of variables in metabolic syndrome

Variable	Odds ratio	95% confidence interval	Significance level
Age			
18-19	0.0002	0.0000 - 0.0116	$p < 0.0001$
20-39	1.2486	0.7132 - 2.1860	$p = 0.4371$
40 and +	2.6919	1.5597 - 4.6457	$p = 0.0004$
Education*			
Elementary x high school/college	1.6889	0.9550 - 2.9853	$p = 0.0714$
Family income			
(≤ 1 salary† x > 1salary)	1.8065	1.0004 - 3.2619	$p = 0.0498$
Gender‡			
Women x men	0.9700	0.5876 - 1.6200	$p = 0.9200$
Marital status§			
Married x single	1.6789	0.9114 - 3.0929	$p = 0.0964$
Divorced/separated x widow	0.7917	0.2410 - 2.6000	$p = 0.7002$
Hyperglicemia			
Hyperglycemia x normoglycemia	2.1957	1.2521 - 3.8500	$p = 0.0061$
Chocolate‖			
Don't eat x eat (2 to 5 portions per day)	0.3475	0.1865 - 0.6474	$p = 0.0009$
Coffee¶			
Don't drink x 2-3 cups/day	0.0646	0.0139 - 0.3005	$p = 0.0005$
Milk**			
Don't drink x ≤ 2 cups per day	0.5368	0.3139 - 0.9181	$p = 0.0231$
Sleep††			
< 7 hours x 7-8 hours	0.0789	0.0396 - 0.1570	$p < 0.0001$

*Elementary education compared to those with high school and/or college degree; †The official value of minimum salary was US$297.00; ‡Women compared to the men; §Married compared to the single. Divorced or separated compared to the widow; ‖Do not eat compared to eat 2 to 5 portions/day; ¶Do not drink compared to drink 2 or 3 cups/day; **Do not drink compared to drink 1 or 2 cups per day; ††Sleep < 7 hours per night compared to those who sleep 7 to 8 hours/night.

Comparing people who did not eat chocolate with those who ate at least two portions of chocolate per day a decreased prevalence of metabolic syndrome was found. A systematic review and meta-analyses study suggested that chocolate consumption was associated with reduced risk of cardiometabolic diseases [28]. However, the NHLBI Family Health Study, a transversal epidemiological design, found no association between chocolate intake and metabolic syndrome prevalence [29].

Among obese mice feeding a high-fat diet supplemented with high polyphenolic cocoa it was reported a decrease on body weight gain, insulin resistance, inflammation, and liver steatosis with concomitant increase on fecal lipid excretion [30]. In this regard, daily intake of chocolate had been associated with decreased risk of overall cardiovascular disease (19%), coronary artery disease (23%), incident type 2 diabetes mellitus (28%), and cerebrovascular disease (32%) in humans [31]. The present study with a small sample confirmed the data from previous studies with larger populations [8-12,19,29]. Notwithstanding, the sample size, the use of a food frequency questionnaire, and use a non-probabilistic sampling, were the limitations of the present work.

Conclusion

Normal sleep duration (7-8 hours), milk and chocolate intake, and coffee drinking were inversely associated with metabolic syndrome prevalence. But more epidemiological and experimental studies are needed.

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Conflict of Interests

No conflict interests were declared by any of the authors.

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