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Original Article

Prevalence of metabolic syndrome and associated factors in adults living in Fernando de Noronha, Brazil



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ABSTRACT

Metabolic Syndrome (MetS) is multivariate disease, clustered with socioeconomic and behavioral risk factors. Investigations about epidemiology estimative could be a prevention strategy.

Aim: to investigate the prevalence of metabolic syndrome and its associated factors in adult population in Fernando de Noronha Archipelago (PE-Brazil).

Methods: A cross-sectional study was performed on a representative sample (N = 375) of adult residents of the region, aged 24–59 years, were harmonized according to the International Diabetes Federation (IDF) criteria.

Results: The prevalence of metabolic syndrome was 45 (12%) and, the age was associated with MetS, which increases the chances to MetS development around 3% respectively (OR: 1.03; CI 95%: 1.002–1.070 P 0.0384). Waist circumference was elevated in female population 266 (70.74%), however, levels of fasting blood glucose (304 [80.85%]), blood pressure (375 [100%]), TG (302 [80.32%]), and low HDLc (297 [78.99]) presented normal biochemical values. There is no significant difference for male and female gender and, the social and behavior factors did not present significant association.

Conclusion: The Fernando de Noronha presents lower prevalence of MetS thus, shows associations for elderly people. The waist circumference was elevated on female population. The results of this study provide further evidence and underscore the need for public health strategies that include education about MetS, promotion of cardiometabolic health, and prevention of undesirable outcomes such as diabetes and cardiovascular disease.

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1. Introduction

Metabolic Syndrome (MetS) is a multidimensional, progressive, and complex disorder which contains at least two risk factors among five associated with waist circumference (WC), including hyperglycemia, hypertriglyceremia, lower levels of high-density lipoprotein cholesterol (HDL), and high blood pressure [1]. The

main MetS-associated conditions are insulin resistance and abdominal adiposity since are trigger of biological changes, such as lipid and cardiac disturbances [2].

Currently MetS is considered a relevant public health once the prevalence is growing up around the world. Data from National Health and Nutrition Examination Survey (NHANES) for 1988 through 2012 showed that among US adults aged 18 years or older, the prevalence of metabolic syndrome rose by more than 35% from 1988 to 1994 to 2007–2012, increasing from 25.3% to 34.2% [3]. In this way, Brazil, a non-Hispanic middle income country has growing estimates of overweight and obesity until the 2030 year [4], which may increase the risks of MetS development [5]. Beyond

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obesity, characteristics such as age, inadequate diet, gender, physical inactivity, geographic location and socioeconomic condition are all factors that influence the prevalence of MetS [3,6,7].

Fernando de Noronha Archipelago, Northeastern Brazil, is an important tourist region for the Brazilian economy. It is a group of islands formed by 21 islands and islets at 756 m below sea level and situated from the Median Dorsal of the Atlantic Ocean, 545 km from Recife city. The main island has an area of 17 km² with 10 km of length and 3.5 km of width [8]. However, the literature regarding the health conditions of Fernando de Noronha's adult population is scarce [8] as well as, its correlation with social and behavioral factors considering as for non- and chronic diseases events. Based on this information, the present study aimed to investigate the prevalence of metabolic syndrome (MetS) and its associated factors in adult population of the Fernando de Noronha Archipelago (PE-Brazil).

2. Methods

2.1. Study design

Cross-sectional study carried out in 2014 (from April to November) with the adult population from Fernando de Noronha (PE) Brazil Archipelago, a district of Pernambuco State. The sample size was estimated based on the adult population, composed of 1683 adults according to the IBGE Census (2010) [9]. It was used a casual simple randomized method (individual sample) conform to the standards of the CONSORT statement, which in this study considered casual participation (50% a favor and 50% against), with a level of 95% of confidence and 10% of error estimations [10]. Therefore, it was defined the minimum number of 313 participants.

Human selection criteria were used for both genders in the age group between 24 and 59 years old, permanent resident of the archipelago (born on the local or has more than ten years as a resident) who had the Fernando de Noronha Registration Number (CIR/FN) by the District Administration. All individuals involved in the study were previously informed about the purpose of the study and the Free and Informed Consent Term were obtained from each participant.

All the data collection were performed by health professionals (doctors, nurses and nursing technicians, nutritionists, laboratory technicians, biochemistries and community agents) previously trained. A protocol was elaborated by the researchers to collect the information regarding age, gender (male or female), alcohol consumption and smoking status, education, per capita income, desalinated water and fruits and vegetables intake, and physical activity practice estimative. Socio-demographic, behavioral, nutritional and health status were included in this study as independent variables. The physical activity criteria was defined as a frequency with more than three times a week, with 30 min and persistent exercise performances for at least 3 months [11]. Additionally, types of exercise and leisure activities were not included in the questionnaire.

The MetS as a dependent variable was considered according to the International Diabetes Federation (IDF) guidelines [1] when the WC cut point was ≥ 94 cm for men and ≥ 80 cm for women associated with at least two health characteristics: fasting glucose ≥ 100 mg/dL; blood pressure $\geq 130/85$ mmHg; triglycerides (TG) ≥ 150 mg/dL; HDL-cholesterol <40 mg/dL in men and <50 mg/dL in women.

The Institutional Review Board for this research project was approved in October 4th, 2013 in accordance with the indication of the National Health Council/Ministry of Health, Brazil Platform, CAEE: 13543313.7.0000.5191, according to resolution 466/12 that guides the research involving humans.

2.2. Anthropometric and biochemical measurements

Participants were evaluated with light clothing and barefoot. The body weight was measured in portable digital scale weighing up to 200 kg. Height was performed by a vertical millimeter stadiometer with extension of 2.2 m and a scale of 0.1 cm. Waist circumference (WC) was measured in the midpoint between the lower limit of the rib cage and the iliac crest with inelastic metric tape with scale of 0.1 cm. Based on these results, it was calculated the body mass index (BMI: kg/m²) for nutritional status classification.

The historical of hypertension (HAS) was verified and then, systolic and diastolic blood pressure were measured twice with 5 min as regular interval using a calibrated Hartman HG160 brand sphygmomanometer (Heidenheim, Alemanha).

Blood collection was performed at the Family Health Unit in Fernando de Noronha Archipelago. After 12 h of fasting, 10 mL of blood sample was collected and submitted to centrifugation for 10 min at 3600 RPM using Eppendorf 5430/5430 centrifuge. Serum was collected and stored at -80°C for assays. Glucose, creatinine, triglycerides (TG), high-density lipoprotein cholesterol (HDL) and fractions (VLDL, LDL), total protein were performed as specified by colorimetric assay (Bioclin, Belo Horizonte, Brasil) using an automatic biochemical analyzer Mindray BS-200 (Shenzhen, China).

2.3. Statistical analysis

To estimate the overall contribution of independent variables diagnostic for metabolic syndrome (variable outcome), a bivariate analysis was performed and its association was assessed by Pearson's correlation or Fisher's Exact test. The variable age was submitted to *t*-Student test. A multivariate study was carried out by logistic regression which model was considered if significance level at P value < 0.05 . Additionally, the stepwise forward method was used as a method of selecting and, the age variable was used in the final model. Statistical Analysis System (SAS/STAT 9.3.)[®] software for Windows was used for statistical tests and significance level was considered when P value < 0.05 .

3. Results

Data collection was performed in 375 individuals (257 female and 118 male). The overall MetS prevalence among adults evaluated were 12% (45/375), which presented elevated waist circumference associated with at least two risk factors defined for this study (Fig. 1).

Anthropometric and biochemical characteristics are showed on Table 1. Waist circumference (WC) was elevated in 266 [70.74%]

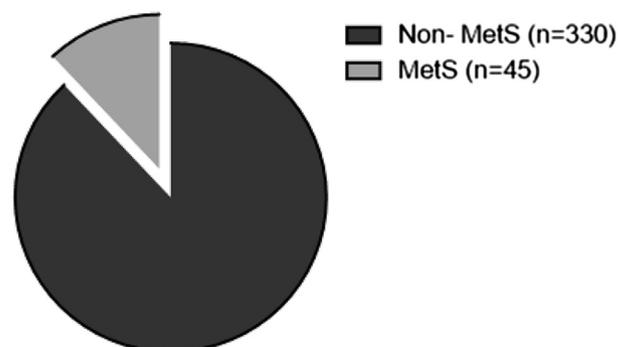


Fig. 1. Prevalence of MetS in adult population of Fernando de Noronha according to IDF criteria.

Table 1
Anthropometric and biochemistry components in Fernando de Noronha's population.

Variable	Mean \pm SD	Normal n (%)	Altered n (%)
Waist circumference (WC)	93.19 \pm 13.64	110 (29.26%)	265 (70.74%)
Blood glucose	95.59 \pm 36.4	304 (80.85%)	71 (19.15%)
Systolic Blood pressure	12.37 \pm 1.95	375 (100.0%)	0 (0%)
Diastolic Blood pressure	8.32 \pm 1.25	375 (100.0%)	0 (0%)
Triglycerides (TG)	112.55 \pm 76.71	302 (80.32%)	73 (19.68%)
Low HDLc	55.60 \pm 11.20	297 (78.99%)	78 (21.01%)

participants. Otherwise, fasting blood glucose (304 [80.85%]), blood pressure (375 [100%]), TG (302 [80.32%]), and low HDLc (297 [78.99%]) presented normal values for the most part of individuals.

Table 2 shows the sociodemographic and behavior variables in adults of Fernando de Noronha Archipelago. Regarding these parameters, only the age showed statistical significance ($p = 0.0052$) between individuals with and without MetS. More than this, it is important to emphasize that the participants exhibited 1.03 more chances to develop MetS (OR: 1.03; CI 95%: 1.002–1.070) $p < .0384^{a,b}$ analyzed from Fisher's Exact test for age variable chances, estimates by stepwise forward method, which was used as selection technique for bivariate model. The other variables: gender, residents and native islands, education, per capita income, smoking, physical activity level, alcohol, desalinated water and, fruits and vegetables consumption did not present statistical difference.

4. Discussion

The aim of this study was to investigate the prevalence of metabolic syndrome (MetS) and associated factors in adult population of the Fernando de Noronha Archipelago (PE-Brazil). Metabolic Syndrome is a cluster of the most dangerous heart attack risk factors: diabetes and raised fasting plasma glucose, abdominal

obesity, high cholesterol and high blood pressure and considered a global epidemic [12]. So, to identify people in this condition is important to reduce future aggressive therapies and also to promote preventive strategy on public health [13].

Studies about residents or native islands are scarce on literature. Cuschierri et al. (2017) studied Maltese population in a Mediterranean Island with around 28.1% of prevalence of MetS, with male predominance. Differently from our study, there was no significance for gender on MetS prevalence and it was correlated with elderly, corroborating with our data. On the other hand, Tyrovolas et al. (2011) shows 55% of prevalence in the elders living in mountainous areas in 13 Mediterranean Islands, which was associated with the difficult access to health services due to unfavorable geographic localization [14].

Regarding our results, the general MetS prevalence in adults from Fernando de Noronha Archipelago was 12% (45 participants). This number is low compared to another Brazilian geographic location: Dutra et al. (2012) found in their study 32% of prevalence in Sao Paulo city [15] and around 34.5% in six Brazilian cities in the study of Briskiewicz et al. (2017) [16]. This can be associated to the adequate consumption of fruit and vegetables as showed by Table 2: at least 72% of whom do not present MetS consumes at least 3 portions of fruits and vegetables [17,18]. Fruits and vegetables are important components of the diet and have been reported to have many potential health benefits, since they are rich in fibre, minerals, vitamins and phytochemicals. Moreover, antioxidants and anti-inflammatory components from fruits and vegetables are hypothesized to play an important role in MetS [17].

The International Diabetes Federation (IDF) guidelines establishes abdominal adiposity for diagnosis of MetS in association with at least two risk factors, as explained previously. In the present study, around 70% of participants showed abdominal obesity. Abdominal obesity is the most prevalent manifestation of metabolic syndrome and considered a marker of dysfunctional adipose tissue [19]. Several epidemiological and physiological studies have

Table 2
Prevalence of sociodemographics and behavior variables and MetS among adults in Fernando de Noronha Archipelago.

Variable	Category	Prevalence (Mean, (n %)) (n = 375)		
		Non-MetS (n = 330 (88.03%))	MetS (n = 45 (11.97%))	P value
Age		43.81 (9.2%)	48.20 (8.2%)	.0052 ^{a,c}
Gender	Male	105 (27.93%)	14 (3.72%)	.541 ^a
	Female	226 (60.11%)	31 (8.24%)	
Island Residents	No	21 (5.59%)	2 (0.53%)	.061 ^a
	Yes	310 (82.45%)	43 (11.44%)	
Island Native	No	260 (68.15%)	32 (8.51%)	.261 ^a
	Yes	71 (18.88%)	13 (3.46%)	
Alcohol consumptiong	No	210 (56.00%)	30 (8.00%)	.311 ^b
	Yes	40 (10.67%)	8 (2.13%)	
Smoking	No	290 (77.33%)	35 (9.33%)	.619 ^b
	Yes	29 (7.73%)	8 (2.13%)	
Desalinated Water consumptiong	No	147 (39.20%)	18 (4.80%)	.727 ^b
	Yes	148 (39.47%)	23 (6.13%)	
Physical Activity Level	Active	89 (23.73%)	13 (3.47%)	.696 ^b
	Insufficiently active	59 (15.73%)	5 (1.33%)	
	Inactive	181 (48.27%)	27 (7.20%)	
Fruits/Vegetables consumption (portions)	<3.0	58 (15.51%)	12 (3.21%)	.1722 ^b
	3.0–5.0	150 (40.11%)	22 (2.88%)	
	≥ 5.0	121 (32.35%)	11 (2.94%)	
Education (years)	0–8	158 (42.02%)	22 (5.85%)	.5170 ^b
	9–11	132 (35.11%)	20 (5.32%)	
	≥ 12	41 (10.90%)	3 (0.80%)	
Per Capita Income (minimal wages)	<0.5	30 (8.11%)	7 (1.89%)	.2824 ^b
	0.5–1.0	5 (1.35%)	0 (0.00%)	
	>1.0	291 (78.65%)	37 (10.00%)	

^a Fisher's Exact test.

^b Bivariate (Pearson) correlation.

^c Statistical significance for Student's *t*-test to $p < 0.05$.

demonstrated a strong association between excess of abdominal adipose tissue and the presence of metabolic risk factors for coronary heart disease (CHD), including insulin resistance, impaired glucose tolerance, type 2 diabetes, dyslipidemia, and increased circulating inflammatory proteins [20,21]. The adipose tissue is recognized as complex endocrine and paracrine organ with a multiple functions as hormonal response through the production of adipocytokines, proinflammatory mediators such as interleukin-6, tumor necrosis factor- α , all which can contribute to the mechanisms involved in oxidative stress and inflammatory processes triggering diseases developments [2].

In our data, age was associated with an increased odds for MetS could be a relevant information for health improvements for this kind of population [22]. Metabolic disorders are closely related with aging process and the first manifestation is central obesity. Decline in lean body mass and increase in body fat, particularly visceral adiposity that often accompanies aging may contribute to the development of insulin resistance. As for the mechanism of Type 2 DM, it is known that aging induces decrease of insulin sensitivity and alteration or insufficient compensation of beta-cell functional mass in the face of increasing insulin resistance. Other metabolic diseases are also frequently related with aging, such as coronary arterial disease, malignancies, cognitive disorders, and vitamin D deficiency [23]. More than this, among them with MetS, the most part was women. Some explanations about these results are involved with sex differences in lean muscle mass, visceral, adiposity, differential impact of aging, influence of the menopausal transition, and altered susceptibility to free fatty acid-induced peripheral insulin resistance [24].

Although in our study socioeconomic status, education levels and per capita income were not associated with MetS, these variable could be used to estimate preventive strategies for MetS development [25]. Higher education is associated with lower risk of development of these diseases complex; however, people with lower economic status trends to increasing morbidity and mortality variables [25,26].

5. Conclusions

In summary, Fernando de Noronha's Archipelago presented prevalence of 12% of MetS and elderly people showed association for MetS development. Additionally, to stimulate the reduction of waist circumference in female population could be effective to prevent MetS in Fernando de Noronha's population perspectives. The results of this study provide further evidence and underscore the need for public health strategies that include education about MetS, promotion of cardiometabolic health, and prevention of undesirable outcomes such as diabetes and cardiovascular disease.

CRediT authorship contribution statement

Letícia M. Mulatinho: Conceptualization, Data curation, Investigation. **Ana Paula C.R. Ferraz:** Formal analysis, Methodology. **Fabiane V. Francisqueti:** Formal analysis, Writing - original draft, Writing - review & editing. **Jéssica L. Garcia:** Formal analysis, Methodology. **Claudinalle F.Q. de Souza:** Formal analysis, Methodology. **Mirian D. Cardoso:** Formal analysis, Methodology. **Kelly C.T. Lemes:** Formal analysis, Methodology. **Milca V.C.O. Mesquita:** Formal analysis, Methodology. **José Eduardo Corrente:** Formal analysis, Software, Validation. **Klinsmann C. dos Santos:** Formal analysis, Visualization, Writing - original draft. **Camila R. Corrêa:** Conceptualization, Supervision, Funding acquisition, Validation.

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List of abbreviations

MetS	Metabolic Syndrome
IDF	International Diabetes Federation
WC	Waist circumference
HDL	High-density lipoprotein cholesterol
NHANES	National Health and Nutrition Examination Survey
IBGE	Instituto Brasileiro de Geografia e Estatística
TG	triglycerides
HAS	hypertension

Declarations

Ethics approval

This research project was approved in October 4th, 2013 in accordance with the indication of the National Health Council/Ministry of Health, Brazil Platform, CAAE: 13543313.7.0000.5191, according to resolution 466/12 that guides the research involving humans.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no conflict of interest.

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