Metabolic syndrome in middle-aged and older women: A cross-sectional study

Mayle Andrade Moreira[1] (iD), Saionara Maria Aires da Câmara[2] (iD),
Sabrina Gabrielle Gomes Fernandes[2] (iD),
Ingrid Guerra Azevedo[3] (iD) and Álvaro Campos Cavalcanti Maciel[2]

Abstract

Objective: This study aims to compare the prevalence of metabolic syndrome between different age groups of middle-aged and older women and to assess whether these differences are independent of potential covariates.

Methods: Study conducted with 510 women divided into three age groups: 45–54, 55–64 and 65–74 years. Socioeconomic, reproductive and lifestyle variables were self-reported. We defined metabolic syndrome using the National Cholesterol Education Program Adult Treatment Panel III criteria (abdominal obesity, diabetes, reduced high-density lipoprotein, elevated triglycerides, and hypertension). Logistic regression assessed the association between age groups, and metabolic syndrome was adjusted for covariates (socioeconomic variables, age at menarche and at first childbirth, parity, menopausal status, physical activity variables and smoking).

Results: Women aged 55–64 years presented higher prevalence of all metabolic syndrome criteria than the other groups, except for abdominal obesity, which was higher in the oldest group. In the fully adjusted analysis, the 55–64 years age group continues to exhibit significantly higher odds of presenting metabolic syndrome when compared to the youngest group (45–54 years) (OR = 2.257; 95% CI = 1.20:4.24). There was no statistical difference in the odds of presenting metabolic syndrome when comparing the oldest and the youngest groups (OR = 1.500; 95% CI = 0.85:2.65).

Conclusion: The higher prevalence of metabolic syndrome among those aged 55–64 years may indicate that middle-aged women become unhealthy earlier in the life course and that many of them may die prematurely. This result highlights the importance of screening metabolic syndrome earlier in the midlife and the need for public health policies aimed at reducing adverse effects in later years.

Keywords

aging, epidemiology, metabolic syndrome, public health, women's health

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Introduction

Metabolic syndrome (MetS) refers to a cluster of metabolic abnormalities mostly linked to abdominal obesity and insulin resistance,[1] which simultaneously act to increase the risk of developing cardiovascular diseases (CVD), type 2 diabetes mellitus (DM) and death.[2] In Brazil, the prevalence of MetS varied according to the characteristics of the population studied, reaching an average of 29.6%.[3]

MetS is a challenging condition for public health,[4] and it is associated with higher incidence of CVD and DM,[5] poorer physical performance[6,7] and greater risk of developing functional deficiencies.[8]

It is already clear that several socioeconomic factors influence the prevalence of MetS.[9] Among women, MetS risk increases after menopause,[10] reaching a prevalence that varies between 31% and 55%.[11] Menopause appears to affect almost all components of MetS,[10] since changes in

[1]Physical Therapy Department, Faculty of Medicine, Federal University of Ceará, Fortaleza, Brazil
[2]Physiotherapy Department, Federal University of Rio Grande do Norte, Natal, Brazil
[3]Permanent Academic of Kinesiology, Department of Therapeutic Processes, Universidad Católica de Temuco, Temuco, Chile

Corresponding author:
Ingrid Guerra Azevedo, Permanent Academic of Kinesiology, Department of Therapeutic Processes, Universidad Católica de Temuco, Temuco 4813302, La Araucania, Chile.
Email: iguerra@uct.cl

the levels of the sex hormone estradiol during this stage of life are associated with metabolic changes and fat gain; therefore, menopausal status can be an additional and possibly independent determinant of MetS.[10]

In addition to gender-related factors, different studies have shown that MetS is associated with socioeconomic inequalities in the low- and middle-income regions,[3] and that low-income women are more likely to be involved in behavioral risk factors, having more children and presenting a younger age at natural menopause,[12] which can increase the risk of MetS.

There are still few studies carried out in Brazil[13] on the prevalence of MetS, mainly in the northeastern region,[14] where social inequality is considered to affect access to quality health care, which can increase MetS risks. Understanding how the prevalence of MetS varies among middle-aged and older women of these characteristics is important because this population group is more vulnerable to MetS during the transition period from menopause and aging. Thus, the main objective was to compare the prevalence of MetS between different age groups of middle-aged and older women and to assess whether these differences are independent of potential covariates, such as socioeconomic factors, reproductive history and lifestyle habits.

Materials and methods

Setting and population

This cross-sectional study was conducted in Natal and Parnamirim, two cities in the Northeast of Brazil. Natal is the capital of the Rio Grande do Norte state (RN), and Parnamirim is located within its metropolitan region. The sample consisted of middle-aged and older women aged 45–74 years. We defined this age range to recruit only adults classified as young-older adults,[15] thus reducing the impact of advanced aging on the proposed analysis. This study included women who did not have severe cognitive disorders. For women above 60 years of age, the orientation scale of the Leganes Cognitive Test (LCT) was applied, considering four or more errors to be exclusion criteria since it indicates inability to complete the study protocols.[16] Details can be found in the flowchart (Figure 1).

The sample in Natal was recruited on the basis of a list of people included in the Family Health Care Program, and the data collection was performed at home. In Parnamirim, the sample was recruited after disclosing the project at primary health care units in all neighborhoods and community centers around the city. In Brazil, primary health care is universally funded by the federal government through the Family Health Care Program and 80% of women in this age group are registered in this program. The minimum sample size required for the study was established using the following parameters:
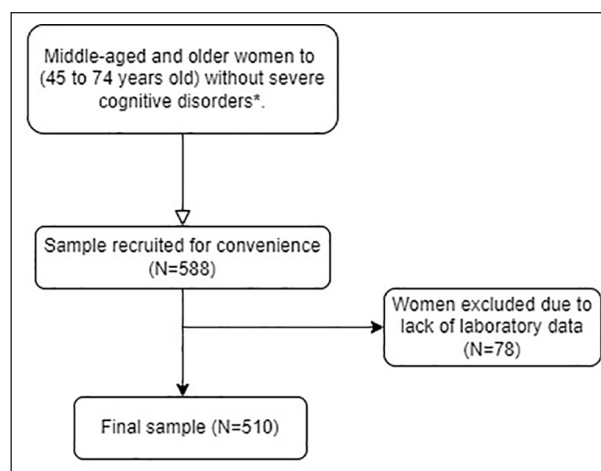

Figure 1. Inclusion and exclusion criteria flowchart.
*For women > 60 years of age, the orientation scale (LCT) was applied.

50% for the proportion of the outcome in the population,[3] a 0.05 margin of error (d) and a 95% confidence interval, calculated in 415 subjects. However, to compensate for any losses, 25% was added to this value, resulting in a proposed sample of 518 women. Considering a recruitment of 588 and the exclusion of 78 women, the final study sample consisted of 510 women. The entire sample was recruited by convenience (n = 588). Laboratory data needed for the assessment of MetS were not available for 78 women who were excluded from this study, leading to a final sample of 510 women. Data were collected between 2012 and 2014.

MetS evaluation

MetS was defined according to the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) criteria[17] (NCEP, 2002). The presence of at least three criteria of the following was indicative of MetS: abdominal obesity (waist circumference > 88 cm for women), insulin resistance (fasting glucose ≥ 110 mg/dL) or diagnosed diabetes, reduced high-density lipoprotein (HDL) cholesterol (< 50 mg/dL), elevated triglycerides (≥ 150 mg/dL) and hypertension (blood pressure ≥ 130/85 mmHg) or diagnosed hypertension (NCEP-ATP III, 2002).[17]

We used a Fiber Glass® metric tape to quantify the waist circumference by measuring the waist midway between the lowest rib and the iliac crests, with the subject standing and at the end of normal expiration.[18] The participants were positioned with their feet together, arms crossed over their chests and were instructed to relax. We provided standard training for measurements to reduce intra- and inter-rater variability.

Blood pressure was measured using a validated and calibrated Omron® digital sphygmomanometer in accordance with the Association for the Advancement of Medical

Instrumentation (AAMI)[19] and British Hypertension Society (BHS)[20] guidelines. We performed three measurements with a 5-min interval between each. The mean of the three measures was considered to classify hypertension. Laboratory items (fasting glucose, HDL cholesterol and triglyceride levels) were analyzed through the enzymatic colorimetric method, in a commercial, specialized and certified laboratory, by specialized laboratory professionals. We collected the participants' blood after 12 h of fasting through pre-scheduled day appointments.

Demographic and socioeconomic variables

Age was measured in years and then categorized into three groups (45–54, 55–64, and 65–74 years). The education level was self-reported and we created three categories: "less than basic education" (up to 7 years of age), "between basic and secondary" (8–10 years of age), and "secondary or more" ($\geq$ 11 years of age).

Family income was categorized according to the Brazilian minimum wage (MW), which is the lowest remuneration that employers should pay workers. Family income was divided into "less than 3 MW" and "3 MW or more."[21]

Menopausal status and reproductive history

We defined menopausal status according to the Stages of Reproductive Aging Workshop classification (STRAW).[22] Those reporting regular menses were classified as "premenopausal." "Perimenopausal" was defined when the women reported irregular menses, with differences in cycle length over 7 days or amenorrhea up to 1 year. Women were classified as "postmenopausal" when reporting absence of menses for over 1 year.

We created three groups for the "age at menarche" variable since more than one-fourth of women reported their menarche at the age of 13 years. The groups created were "menarche before 13 years of age," "at 13 years of age," and "after 13 years of age." The "parity" variable was divided into "less than three births" and "three births or more," and the "age at first childbirth" variable was categorized into "before 18 years of age" and "at 18 years of age or after 18 years of age."[21]

Physical activity variables

Women were asked to report the time they remain seated during a regular day to register sedentary behaviors. This variable was divided into "4 h/day or less," and "more than 4 h/day."[21] Women also reported how many days per week, and for how long each day they had walked for more than 10 min without stopping during the last week. A walking indicator was created to distinguish women walking "less than 90 min/week" or "more than 90 min/week."[21]

Smoking

We asked participants about their habits in relation to smoking with three response options: current smoker, previous smoker or never a smoker. This variable was divided into two groups: current smokers versus former smokers/never a smoker.

Statistics

Analyses were conducted using Statistical Package for Social Sciences (SPSS) version 20.0. First, descriptive statistics were conducted according to age group, using the chi-square test to compare proportions of categorical variables and analysis of variance (ANOVA), followed by Tukey post hoc tests to compare continuous variables. Then, the presence of MetS and the proportion of each MetS criteria were compared among the three age groups using the chi-square test. Following this, we compared the groups considering the classification of MetS in relation to all independent variables, using the chi-square test for categorical variables and the Student's *t*-test for continuous variables. Finally, we conducted logistic regression models to assess the association between age group and MetS adjusted for covariates. We created four models to include the different groups of covariates, thus allowing us to assess how each block of variables influences the results and the potential for some of the variables to be on the causal pathway. The first model was unadjusted. In the second model, we adjusted for age, education and income. In the third model, we added the reproductive variables (age at menarche, age at first childbirth, parity and menopausal status). In the fourth model, we included physical activity, sitting time per day and smoking. A 5% significance level and 95% CI were adopted for all analyses.

Results

Table 1 shows the distribution of MetS according to the independent variables of the total sample. Considering the women with MetS, 67.7% are between 45 and 64 years of age, and only 32.3% are above 65 years of age. Women with MetS have a poorer educational level, lower family income, higher parity and a higher proportion of women reporting that they do not practice any physical activity. There was no significant difference in relation to age at menarche, menopausal status, age at first childbirth, sitting time per day and smoking.

Table 2 presents the results for each of the MetS components according to the age groups. This shows that women in the second age group (55–64 years) have a significantly higher prevalence of three MetS components: elevated glucose (36.4% and p=0.001), low HDL levels (39.0% and p < 0.001) and high blood pressure (85.7% and p < 0.001), and a marginally higher prevalence of elevated triglycerides. A significantly higher prevalence of

Table 1. Distribution of MetS according to independent variables (N = 510).

Variables		MetS		p-value
		No	Yes	
		M (SD) or n (%)		
Age (years)	45–54	129 (61.4)	149 (49.7)	
	55–64	23 (11.0)	54 (18.0)	0.017
	65–74	58 (27.6)	97 (32.3)	
Education (years of schooling)		7.54 (± 4.46)	6.43 (4.38)	0.006
Education	Less than basic education	107 (51.0)	185 (61.9)	0.048
	Between basic and secondary	38 (18.1)	44 (14.7)	
	Secondary or more	65 (31.0)	70 (23.4)	
Family income (MW)	0–1	140 (66.7)	234 (78.0)	0.017
	1–3	60 (28.6)	58 (18.7)	
	>3	10 (4.8)	10 (3.3)	
Age at menarche (years)	<13	62 (29.5)	111 (37.4)	0.129
	13	53 (25.2)	75 (25.3)	
	>13	95 (45.2)	111 (37.4)	
Parity (children)	<3	94 (44.8)	107 (35.9)	0.044
	≥3	116 (55.2)	191 (64.1)	
Age at first childbirth	No child	18 (8.6)	12 (4.0)	0.074
	Before 18 years of age	34 (16.2)	59 (19.8)	
	18 years of age or above	158 (75.2)	227 (76.2)	
Menopausal status	Premenopausal	23 (11.0)	22 (7.5)	0.194
	Perimenopausal	53 (24.4)	64 (21.8)	
	Postmenopausal	133 (63.6)	208 (70.7)	
Physical activity	No	141 (67.1)	226 (75.6)	0.037
	Yes	69 (32.9)	73 (24.4)	
Sitting time per day	4h or less	101 (48.1)	147 (49.2)	0.812
	More than 4h	109 (51.9)	152 (50.8)	
Smoking	No/never	132 (62.9)	170 (56.9)	0.175
	Former smoker	78 (37.1)	129 (43.1)	

SD: standard deviation; MW: minimum wage.

Table 2. Distribution of MetS components by age group (N = 510).

Variables (n = 510)		Age 45–54 years		Age 55–64 years		Age 65–74 years		Total		p-value
		n (%)								
Glucose (mg/dL)	<110	233	83.8	49	63.6	102	65.8	384 (75.3)		0.001[a]
	≥110	45	16.2	28	36.4	53	34.2	126 (24.7)		
Triglycerides (mg/dL)	<150	170	61.2	36	46.8	92	59.4	298 (58.4)		0.073
	≥150	108	38.8	41	53.2	63	40.6	212 (41.6)		
HDL (mg/dL)	≥50	109	39.2	30	39.0	99	63.9	238 (46.7)		<0.001[a]
	<50	169	60.8	47	61.0	56	36.1	272 (53.3)		
Abdominal obesity (cm)	≤88	76	27.3	19	24.7	20	12.9	115 (22.5)		0.002[a]
	>88	202	72.7	58	75.3	135	87.1	395 (77.5)		
Blood pressure (mmHg)	<130/85	98	35.3	11	14.3	23	14.8	132 (25.9)		<0.001[a]
	≥130/85	180	64.7	66	85.7	132	85.2	348 (74.1)		

HDL: high-density lipoprotein cholesterol; mg/dL: milligrams per deciliters; cm: centimeter; mmHg: millimeters of mercury.
[a]Chi-squared test (p < 0.05).

abdominal obesity was found in the older group (87.1% and p = 0.002).

Table 3 shows the results of the logistic regression for MetS. Women in the second age group exhibited significantly higher odds of presenting MetS (odds ratio (OR) = 2.033 and CI = 1.19:3.49) vis-à-vis younger women (45–54 years of age). The OR was even higher when more covariates were added to the models, showing that this

Table 3. Logistic regression model for MetS by age group adjusted for covariates (N = 510).

	Age group (years)		
	45–54	55–64	65–74
	OR (95% CI)		
Model 1	Ref	2.033 (1.19: 3.49)	1.448 (0.97:2.16)
Model 2	Ref	2.012 (1.16: 3.48)	1.270 (0.82:1.98)
Model 3	Ref	2.118 (1.14: 3.94)	1.384 (0.79:2.39)
Model 4	Ref	2.257 (1.20:4.24)	1.500 (0.85:2.65)

OR: odds ratio; CI: confidence interval; Model 1: unadjusted. Model 2: adjusted for age, education and income; Model 3: Model 1 + age at menarche, age at first childbirth, parity and menopausal status; Model 4: Model 3 + physical activity, sitting time per day, smoking.

group is around twice more likely to have MetS (OR = 2.257 and CI = 1.20:4.24) compared to the younger group. The OR of MetS for the older groups was not significant in relation to the younger group.

Discussion

This study evaluated the prevalence of MetS in women from three different age groups. It was observed that women aged 55–64 years presented a higher prevalence of MetS than the oldest and youngest groups. They also presented a significantly higher prevalence of three MetS components (high glucose, low HDL levels and high blood pressure) and a marginally higher prevalence of elevated triglyceride levels. In our study, these women were twice more likely to present MetS compared to the youngest group (45–54 years of age), even after the adjustment for covariates. The oldest and the youngest groups presented similar prevalences of MetS and its components. Furthermore, a higher prevalence of MetS was associated with lower socioeconomic status, higher parity and a deficient level of physical activity.

Although the literature reports that the presence of MetS increases with aging,[2,5] previous research has already reported that people aged 65 years are less likely to have MetS than those aged 60–64 years.[5,23]

Some hypotheses can be considered to explain the lower prevalence of MetS among the oldest women compared to the middle-aged group in our study. Women in the oldest group were born around the 1940s, when the life expectancy in Northeastern Brazil was approximately 36.5 years. Having already reached around twice the expected age, it is possible that this group of older women is composed of survivors who were able to adapt to their life course adversities.[23]

In turn, because low-income women might have faced more adversities during their lives, they may tend to become unhealthy earlier in midlife,[13] which would explain the higher prevalence of MetS in the second age group. Many of these women may die prematurely and not

reach more advanced ages, which complements the justification of higher prevalence of MetS among them compared to the oldest group.

Nutritional changes may also contribute to these results. It has been reported that younger generations in low-income populations tend to eat less traditional food and consume more sugary drinks and ultra-processed food.[24] This dietary profile may have contributed to the higher prevalence of MetS and its components among the middle-aged groups vis-à-vis the oldest groups.

Finally, it is well known that women around 50 years of age are more likely to have a greater accumulation of fat in the abdominal region[25] in addition to other symptoms related to menopause, such as anxiety, poor quality of sleep, stress and lower quality of life, which can contribute to adverse metabolic outcomes.[26] Thus, because the second age group includes women in their first postmenopausal years, these factors may contribute to the higher prevalence of MetS among them.

MetS was also associated with other socioeconomic variables, with higher prevalence among women who have lower education and lower income levels. Previous studies showed that a lower income and a lower educational level may be related to the presence of MetS due to the adoption of an unhealthy lifestyle, such as low consumption of nutritious foods, high intake of salt and fat, in addition to low adherence to physical exercise practices.[27]

A higher prevalence of MetS was also associated with higher parity, which is consistent with previous research, involving Hispanic and Latino women.[28] Since the gestational process is associated with higher rates of insulin resistance, dyslipidemia, fat accumulation and weight gain,[29] it is possible that they can persist and even increase after successive pregnancies.

Strengths and limitations

Our research has some limitations. The participants were middle-aged and older women from Northeast Brazil; therefore, caution should be used in inferring the results to other populations. Because we used a convenience sample strategy, our participants may have been healthier than the average target population, and thus the possibility of healthy volunteer bias cannot be ruled out. Nevertheless, the similarity in the sociodemographic characteristics of the sample in this study with the last census data of the general local population supports the representativeness of this sample. There is also a possibility of information bias due to some self-reported measures; however, since there is no reason to think that this bias is related to MetS, the misclassifications are probably non-differential. Furthermore, as we previously described, the results of this study may have been influenced by survivor bias, with the oldest group being composed of resilient healthier women. Changes in life habits and conditions across the generations

of women in Northeast Brazil may also have an important impact on their health status, and these findings may not be applicable even to the next generation of women. The cross-sectional nature of this research does not allow us to definitively confirm or discard these hypotheses, and a longitudinal study might be more suitable to understand how MetS varies over the life course.

This study also has some strengths. By investigating MetS among lower income middle-aged and older women, this study provides valuable information about a high risk and understudied group. This study used objective and valid measurements to identify MetS is also one of its strengths. Finally, by comparing three different age groups regarding the prevalence of MetS, this study raised important hypotheses regarding how socioeconomic and life course change over the years may influence the prevalence of this condition in different phases of women's lives.

Conclusion

In this study, women aged 55–64 years presented a higher prevalence of MetS when compared to the youngest (45–54 years) or oldest (65–74 years) groups. The oldest group has similar odds of presenting MetS than the youngest group. Survivor bias, changes in socioeconomic conditions and life habits across generations may explain these results, and longitudinal studies may help to understand the impact of age itself on the occurrence of MetS.

The elevated prevalence of MetS among the middle-aged group in this study highlights the importance of screening MetS components and associated factors earlier in midlife. In addition, these findings show the need to implement public health policies for middle-aged women aimed at reducing the adverse effects of MetS in later years.

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Author contribution(s)

Mayle Andrade, Moreira: Conceptualization; Formal analysis; Investigation; Methodology; Project administration; Writing – original draft; Writing – review & editing.
Saionara Camara: Investigation; Methodology; Project administration; Writing – original draft.
Sabrina Gabrielle Gomes, Fernandes: Formal analysis; Methodology; Writing – review & editing.
Ingrid Guerra, Azevedo: Methodology; Writing – original draft; Writing – review & editing.
Alvaro Campos, Cavalcanti Maciel: Conceptualization; Formal analysis; Investigation; Writing – review & editing.

Declaration of conflicting interests

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All participants were informed of the objectives and procedures of the research study at the time of first contact and signed an informed consent form. The study protocol received approval from the Ethics and Research Committee of the Federal University of Rio Grande do Norte (No. 387.737).

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ORCID iDs

Mayle Andrade Moreira https://orcid.org/0000-0002-6032-6542
Saionara Maria Aires da Câmara https://orcid.org/0000-0002-3054-7213
Sabrina Gabrielle Gomes Fernandes https://orcid.org/0000-0001-5876-655X
Ingrid Guerra Azevedo https://orcid.org/0000-0001-7305-7583

References

1. Lanktree MB and Hegele RA. Chapter 4—metabolic syndrome. In: Ginsburg G and Willard H (eds) *Genomic and precision medicine: cardiovascular disease*. 3rd ed. Amsterdam: Elsevier, 2018, pp.47–63.
2. Raposo L, Severo M, Barros H, et al. The prevalence of the metabolic syndrome in Portugal: the PORMETS study. *BMC Public Health* 2017; 17(1): 555.
3. De Carvalho Vidigal F, Bressan J, Babio N, et al. Prevalence of metabolic syndrome in Brazilian adults: a systematic review. *BMC Public Health* 2013; 13(1): 1198.
4. Alberti KGMM, Eckel RH, Grundy SM, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation* 2009; 120(16): 1640–1645.
5. De Oliveira Costa AC, de Oliveira Duarte YA and de Andrade FB. Metabolic syndrome: physical inactivity and socioeconomic inequalities among non-institutionalized Brazilian elderly. *Rev Bras Epidemiol* 2020; 23: e200046.
6. Beavers KM, Hsu FC, Houston DK, et al. The role of metabolic syndrome, adiposity, and inflammation in physical performance in the health ABC study. *J Gerontol Ser A Biol Sci Med Sci* 2013; 68(5): 617–623.
7. Blaum CS, West NA and Haan MN. Is the metabolic syndrome, with or without diabetes, associated with progressive disability in older Mexican Americans? *J Gerontol Ser A Biol Sci Med Sci* 2007; 62(7): 766–773.
8. Ogawa EF, Leritz E, McGlinchey R, et al. Metabolic syndrome and physical performance: the moderating role

of cognition among middle-to-older-aged adults. *J Int Neuropsychol Soc* 2021; 27(2): 172–180.

9. Rochlani Y, Pothineni NV and Mehta JL. Metabolic syndrome: does it differ between women and men? *Cardiovasc Drugs Ther* 2015; 29(4): 329–338.

10. Pu D, Tan R, Yu Q, et al. Metabolic syndrome in menopause and associated factors: a meta-analysis. *Climacteric* 2017; 20(6): 583–591.

11. Pucci G, Alcidi R, Tap L, et al. Sex- and gender-related prevalence, cardiovascular risk and therapeutic approach in metabolic syndrome: a review of the literature. *Pharmacol Res* 2017; 120: 34–42.

12. Montez JK, Bromberger JT, Harlow SD, et al. Life-course socioeconomic status and metabolic syndrome among midlife women. *J Gerontol Ser B Psychol Sci Soc Sci* 2016; 71(6): 1097–1107.

13. Ramires EKNM, de Menezes RCE, Longo-Silva G, et al. Prevalence and factors associated with metabolic syndrome among Brazilian adult population: national health survey – 2013. *Arq Bras Cardiol* 2018; 110(5): 455–466.

14. Moreira MA, Vafaei A, da Câmara SMA, et al. Metabolic syndrome (MetS) and associated factors in middle-aged women: a cross-sectional study in Northeast Brazil. *Women Health* 2020; 60(6): 601–617.

15. Alterovitz SSR and Mendelsohn GA. Relationship goals of middle-aged, young-old, and old-old internet daters: an analysis of online personal ads. *J Aging Stud* 2013; 27(2): 159–165.

16. De Yébenes MJ, Otero A, Zunzunegui MV, et al. Validation of a short cognitive tool for the screening of dementia in elderly people with low educational level. *Int J Geriatr Psychiatry* 2003; 18(10): 925–936.

17. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). 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) final report. *Circulation* 2002; 106(25): 3143–3421.

18. Lean MEJ, Han TS and Morrison CE. Waist circumference as a measure for indicating need for weight management. *BMJ* 1995; 311(6998): 158–161.

19. White WB, Berson AS, Robbins C, et al. National standard for measurement of resting and ambulatory blood pressures with automated sphygmomanometers. *Hypertension* 1993; 21(4): 504–509.

20. O'brien E, Petrie J, Little W, et al. Short report: An outline of the revised British Hypertension Society Protocol for the evaluation of blood pressure measuring devices. *J Hypertens* 1993; 11(6): 677–679.

21. Da Câmara SMA, Zunzunegui MV, Pirkle C, et al. Menopausal status and physical performance in middle aged women: a cross-sectional community-based study in Northeast Brazil. *PLoS ONE* 2015; 10(3): e0119480.

22. Harlow SD, Gass M, Hall JE, et al. Executive summary of the Stages of Reproductive Aging Workshop + 10: addressing the unfinished agenda of staging reproductive aging. *Fertil Steril* 2012; 97(4): 843–851.

23. Khosravi-Boroujeni H, Sarrafzadegan N, Sadeghi M, et al. Secular Trend of metabolic syndrome and its components in a cohort of Iranian adults from 2001 to 2013. *Metab Syndr Relat Disord* 2017; 15(3): 137–144.

24. Monteiro CA, Levy RB, Claro RM, et al. A new classification of foods based on the extent and purpose of their processing. *Cad Saude Publica* 2010; 26(11): 2039–2049.

25. Hunter GR, Gower BA and Kane BL. Age related shift in visceral fat. *Int J Body Compos Res* 2010; 8(3): 103–108.

26. Ali AM, Ahmed AH and Smail L. Psychological climacteric symptoms and attitudes toward menopause among Emirati women. *Int J Environ Res Public Health* 2020; 17(14): 5028.

27. Gupta R, Deedwania PC, Sharma K, et al. Association of educational, occupational and socioeconomic status with cardiovascular risk factors in Asian Indians: a cross-sectional study. *PLoS ONE* 2012; 7(8): e44098.

28. Vladutiu CJ, Siega-Riz AM, Sotres-Alvarez D, et al. Parity and components of the metabolic syndrome among US Hispanic/Latina women: results from the Hispanic community health study/study of Latinos. *Circ Cardiovasc Qual Outcomes* 2016; 9(2 Suppl. 1): S62–S69.

29. Gunderson EP, Murtaugh MA, Lewis CE, et al. Excess gains in weight and waist circumference associated with childbearing: The Coronary Artery Risk Development in Young Adults Study (CARDIA). *Int J Obes Rel Metab Disord* 2004; 28: 525–535.