Prevalence of Metabolic Syndrome in Elderly and Agreement among Four Diagnostic Criteria

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Abstract

Background: Metabolic syndrome (MS) is an aggregation of risk factors that increase the incidence of cardiovascular events and diabetes mellitus (DM). Population aging is accompanied by higher prevalence of MS, which varies depending on the population studied and the diagnostic criteria used.

Objective: To determine prevalence of MS in the elderly using four diagnostic criteria and agreement between them.

Methods: Cross-sectional study on 243 patients older than 60 years (180 women) in Niterói, RJ. They were evaluated by clinical examination, fasting glucose, fasting insulin, lipid profile and anthropometric measurements - weight, height, waist circumference and waist/hip ratio. Prevalence of MS was estimated by World Health Organization (WHO) modified, National Cholesterol Education Program - Adult Treatment Panel III (NCEP-ATP III), International Diabetes Federation (IDF) and Joint Interim Statement (JIS) criteria.

Results: Prevalence was high with the four criteria WHO (51.9%), NCEP-ATPIII (45.2%), IDF (64.1%) and JIS (69.1%), and agreement between criteria by kappa was moderate in almost all comparisons WHO vs. IDF (k = 0.47;95% confidence interval (CI), 0.35 to 0.58); WHO vs. NCEP-ATPIII (k = 0.51; 95% CI, 0.40 to 0.61); WHO vs. JIS (k = 0.45; 95% CI, 0.33 to 0.56); IDF vs. NCEP-ATPIII (k = 0.55; 95% CI, 0.45 to 0.65) and NCEP-ATPIII vs. JIS (k = 0.53; 95% CI, 0.43-0.64), except between IDF vs. JIS (K = 0.89;95% CI, 0.83 to 0.95), which was considered good.

Conclusion: Prevalence of MS was high with the four diagnostic criteria, mainly by JIS. There was good agreement between JIS and IDF criteria and moderate among the others. (Arq Bras Cardiol. 2014; 102(3):263-269)

Keywords: Metabolic Syndrome; Prevalence; Aged; Obesity; Abdominal Circumference; Risk Factors.

Introduction

The combination of central obesity, dysglycemia, dyslipidemia and arterial hypertension characterize the so-called Metabolic Syndrome (MS). Several studies[1-3] have shown that MS prevalence increases with age, making its diagnosis necessary due to the 2.5-fold increased risk of cardiovascular disease and five-fold increase for the development of diabetes mellitus (DM)[4].

In 1988, Reaven[5] described a close association between metabolic abnormalities and insulin resistance, calling it "Syndrome X". The World Health Organization (WHO), in 1998[6], established the first diagnostic criterion, of which hyperglycemia was the important and indispensable component. In 2001, the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATPIII) proposed a new criterion, in which glycemia was no longer considered an indispensable factor, becoming just one of the components. In this criterion, the presence of at least three of the five components of MS - increased Waist Circumference (WC) increased fasting glucose, low HDL cholesterol, hypertriglyceridemia and high blood pressure comprise the diagnosis of MS[7]. The I Brazilian Guideline for the Diagnosis and Treatment of MS, developed in 2005, used this criterion as the basis for MS diagnosis[8].

The prevalence of obesity has increased in recent decades in all age groups, concomitantly with the population aging. Considering the evidence of the association between obesity and cardiovascular risk, the International Diabetes Federation (IDF) in 2005 proposed a new definition of MS taking into account abdominal obesity through the WC, making it essential for the diagnosis[9].

In 2009 Alberti et al[10] presented a consensus criterion for the diagnosis of MS –the Joint Interim Statement (JIS) – that was endorsed by several societies, which chose the non-mandatory presence of any of the components, but the presence of at least three altered components in five and the WC measurement according to different ethnicities.

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Considering that the MS represents a higher risk for cardiovascular disease, DM, mobility alterations[11], cognitive deficits[12] and depression[13] in the elderly, together with the scarcity of data in Brazil, this study aims at determining the prevalence of MS by four different diagnostic criteria and the agreement between them in a population older than 60 years old.

Methods

The present is a cross-sectional study including 243 patients, 180 of which females, over 60 years old, volunteers in a convenience sample, all treated at the Outpatient Clinic of Geriatrics and Internal Medicine of Fundação Municipal de Saúde de Niterói (RJ). Patients included the study had different diagnosis and reasons for the treatment received. The project was approved by the Ethics Committee of Faculdade de Medicina, Universidade Federal Fluminense, number 0183.0.258.258.10 and all participants signed a free and informed consent form.

Morbidly obese patients, patients with liver failure and end-stage renal disease, individuals on corticosteroids, immunosuppressants and cognitive disabilities were excluded.

Anamnesis was performed, with collection of social data and information on medication use. Clinical evaluation consisted of blood pressure measurement with an OMRON HEM 742INT automatic sphygmomanometer (Bannockburn, Illinois 60015 USA) in the left arm, with the patient in the sitting position, after at least five minutes of rest, using the average of the last two measurements with a difference < 4 mmHg between them[14]. Anthropometric measures included weight in kilograms (kg) and height in centimeters (cm) using a Filizola anthropometric scale (São Paulo, SP, Brazil) calibrated by INMETRO. The Body Mass Index (BMI) was calculated by dividing weight in kilograms by the square of height in meters.

The waist circumference (WC) was measured using a SANNY inelastic measuring tape (São Bernardo do Campo, SP, Brazil), at the midpoint between the iliac crest and the last rib, with the patient standing at the end of exhalation[15].

Blood samples were obtained after a 12-fast and subsequently analyzed at Laboratório Central de Saúde Pública. Serum fasting glucose, total cholesterol, HDL - cholesterol and TG were measured using Labtest commercial kits (Lagoa Santa, Belo Horizonte, Brazil). LDL - cholesterol was calculated by the Friedewald equation. The samples were analyzed by an enzymatic method in automated Labmax 240 equipment (Belo Horizonte, Brazil).

Insulin measurements were performed on an ELECSYS equipment (Roche, Japan) by the method of electrochemiluminescence. The Homa1-IR was calculated by multiplying fasting glucose (mmol / L) by fasting insulin (μIU / mL) and dividing by 22.5 and a Homa1-IR > 2.7 was considered positive for insulin resistance[16]. The diagnosis of MS was established according to the modified WHO, NCEP-ATPIII, IDF and JIS criteria as described in Table 1. The cutoff used for WC in IDF and JIS criteria was that of European ethnicity.

Statistical Analysis

Student's *t* test and one-way ANOVA were used to analyze numerical data. Statistical analysis evaluated the concordance in the diagnosis of MS among the criteria used in the survey, WHO, NCEP-ATPIII, IDF and JIS using the Kappa index. Significance level was set at 0.05. S-Plus 8.0 software program was used for these analyses.

Results

A total of 243 elderly individuals participated in study, of which 180 were women (74%). Mean age was 71 ± 7 years when assessing the entire study population and 71 ± 7 years in females and 70 ± 7 in males ($p > 0.05$). Table 2 shows the mean MS components evaluated by gender.

In women, BMI ($p > 0.05$), total cholesterol ($p < 0.01$) HDL-c and LDL-c ($p < 0.05$) values were higher than in males, whereas the WC ($p < 0.05$), fasting glucose ($p > 0.05$) and triglycerides ($p > 0.05$) values were higher in men (Table 2).

A total of 51.9%, 45.2%, 64.1% and 69.1% of participants were classified as having MS according to WHO criteria, NCEP-ATPIII, IDF and JIS, respectively (Chart 1). The prevalence of MS according to gender was 49.4%, 45.6%, 65.6% and 68.9% by WHO, NCEP-ATPIII, IDF and JIS criteria, respectively, in females. In males, the prevalence of MS was 58.7%, 44.4%, 60.3% and 69.8% according to the WHO, NCEP-ATPIII, IDF and JIS criteria, respectively.

Chart 2 shows the prevalence of MS according to the four diagnostic criteria used, according to age groups (60-69, 70-79 and ≥ 80 years) in both genders.

The JIS criterion was the one that diagnosed the most MS cases when evaluating all participants (69.1%), in females (68.9%) and in males (69.8%). On the other hand, the NCEP-ATPIII MS criterion diagnosed the least, both in the general population studied (45.2%) and in females (45.6%) and males (44.4%).

The agreement between the criteria used for the definition of MS was analyzed by determining the kappa index, considered moderate between WHO criteria vs. IDF ($k = 0.47$, 95% CI, 0.35-0.58); WHO vs. NCEP-ATPIII ($k = 0.51$, 95% CI, 0.40-0.61); WHO vs. JIS ($k = 0.45$, 95% CI, 0.33-0.56); IDF vs. NCEP-ATPIII ($k = 0.55$, 95%CI, 0.45-0.65) and NCEP-ATPIII vs. JIS ($k = 0.53$, 95% CI, 0.43-0.64). The agreement was considered very good between IDF vs. JIS ($k = 0.89$, 95% CI, 0.83 to 0.95).

Discussion

The population projection study carried out by the Brazilian Institute of Geography and Statistics (IBGE)[17] shows that the elderly will have a higher intensity of growth from 2020 on, going from 28.3 million to 52 million elderly individuals in 2040, representing a quarter of the Brazilian population. As for the MS, its prevalence is also on the rise worldwide, which is probably related to the increase in obesity, sedentary lifestyle, changes in dietary habits and the important process of aging. The result of a higher prevalence of MS is the recognized increase in cardiovascular morbimortality[18,19].

Table 1 – Definitions and diagnostic criteria for metabolic syndrome

	WHO (modified)*	NCEP-ATPIII †	IDF ‡	JIS §
Blood pressure	≥ 140/90 mmHg or SAH treatment(∥)	≥ 130/85 mmHg	≥ 130/85 mmHg or SAH treatment	≥ 130/85 mmHg or SAH treatment
Anthropometrics	WHR (¶) ♂ > 0.9 and ♀ > 0.85and/or BMI (#) > 30 kg/m²	WC(§§) ≥ 102 ♂ ≥ 88 ♀	WC ≥ 94 ♂ ≥ 80 ♀	WC ≥ 94 ♂ ≥ 80 ♀
Glucose	DM.IGT (**) or Homa-1 IR (††) > 2.7	≥ 110	≥ 100	≥ 100
TG	≥ 150 (‡‡)	≥ 150	≥ 150	≥ 150
HDL-col	♂ < 35 ♀ < 39	♂ < 40 ♀ < 50	♂ < 40 ♀ < 50	♂ < 40 ♀ < 50
MS Criterion	DM, IGT or Homa-1 IR > 2.7 +2 other components	3 or more components	WC plus 2 components	3 or more components

(*)WHO: World Health Organization; (†)NCEP-ATPIII-Third Report of the National Cholesterol Education Program; (‡)IDF-International Diabetes Federation; (§) JIS: Joint Interim Statement. (∥) SAH: Systemic Arterial Hypertension; (¶)WHR: waist/hip ratio;(#)BMI: Body Mass Index;(**) IGT: Impaired glucose tolerance; (††) Homa1-IR: Homeostatic model assessment; (‡‡)Bothaltered TG orlow HDL-c constitute only one factorbyWHO; (§§)WC: waist circumference.

Table 2 – Metabolic Syndrome componentsaccording togender

	Male (n = 63)	Female (n = 180)	p
	Mean ± SD	Mean ± SD	
BMI* (kg/m²)	28.1 ± 4.4	29.2 ± 5.7	> 0.05
Waist circumference (cm)	99.9 ± 10.1	96 ± 12.7	< 0.05
Fasting glycemia (mg/dL)	114 ± 39	106 ± 27	> 0.05
Total cholesterol (mg/dL)	182 ± 38	206 ± 43	< 0.01
Triglycerides (mg/dL)	145 ± 74	139 ± 74	> 0.05
HDL - cholesterol (mg/dL)	47 ± 12	57 ± 14	< 0.05
LDL - cholesterol (mg/dL)	106 ± 34	120 ± 40	< 0.05

**BMI: Body Mass Index.*

The literature shows great variability in the prevalence of MS among the elderly, which depends greatly on the criteria used for the diagnosis and also the ethnic and regional characteristics of the study population.

The present study assessed the prevalence and agreement between diagnostic criteria of MS, according to the latest criteria, JIS, compared with the WHO, NCEP-ATP III and IDF criteria in an elderly population treated at the Outpatient Clinic of Internal Medicine and Geriatrics. The prevalence of MS was higher using the JIS criterion (69.1%) followed by the IDF (64.1%), WHO (51.9%) and NCEP-ATPIII (45.2%) criteria. This higher prevalence by JIS and IDF criteria was probably due to the lower cutoff of WC and fasting glycemia established by them[20]. Alkerwi et al[20] found a prevalence of MS of 88% in women and 74% men, aged between 60 and 69 years, using the JIS criterion, with a WC cutoff of 94 cm for men and 80 cm for women.

In a study by Ford et al[21], carried out in the United States and using the JIS criterion, with a cutoff of 102 cm for men and 88 cm for women, the prevalence of MS was 59.3% in men and 55.4% in women. According to these authors, their findings differ from those found in Europeans, with a lower prevalence of MS, probably due to the higher cutoff used. With aging, there is an increase in WC due to the accumulation of abdominal fat, as seen in the present study both in men and women, which should be taken into account because of its association between this increase and the risk of mortality from all causes[22].

In a study carried out in the city of Novo Hamburgo, state of Rio Grande do Sul, Brazil, among 378 elderly individuals evaluated, aged > 60 years, the prevalence of MS was 50.3% and 56.9% by the NCEP-ATPIII and IDF criteria, respectively, with a higher prevalence in women by the two criteria[23]. In the present study, the prevalence by NCEP-ATPIII and IDF was also higher in women than in men, 45.6% vs. 44.4% by NCEP-ATPIII and 65.6% vs. 60.3% by the IDF. However, when using the WHO and JIS criteria, the result was different, with a higher prevalence in males, 69.8% vs. 68.9% using JIS and 58.7% vs. 49.4% using WHO criteria. A study carried out in Macapa, state of Amapa, Brazil, showed a prevalence of 18.8% according to NCEP-ATP III criterion and 38.9% by the IDF criterion among elderly African-descendants and 34% and 43% among elderly non-African descendants, with a higher prevalence among women[24].

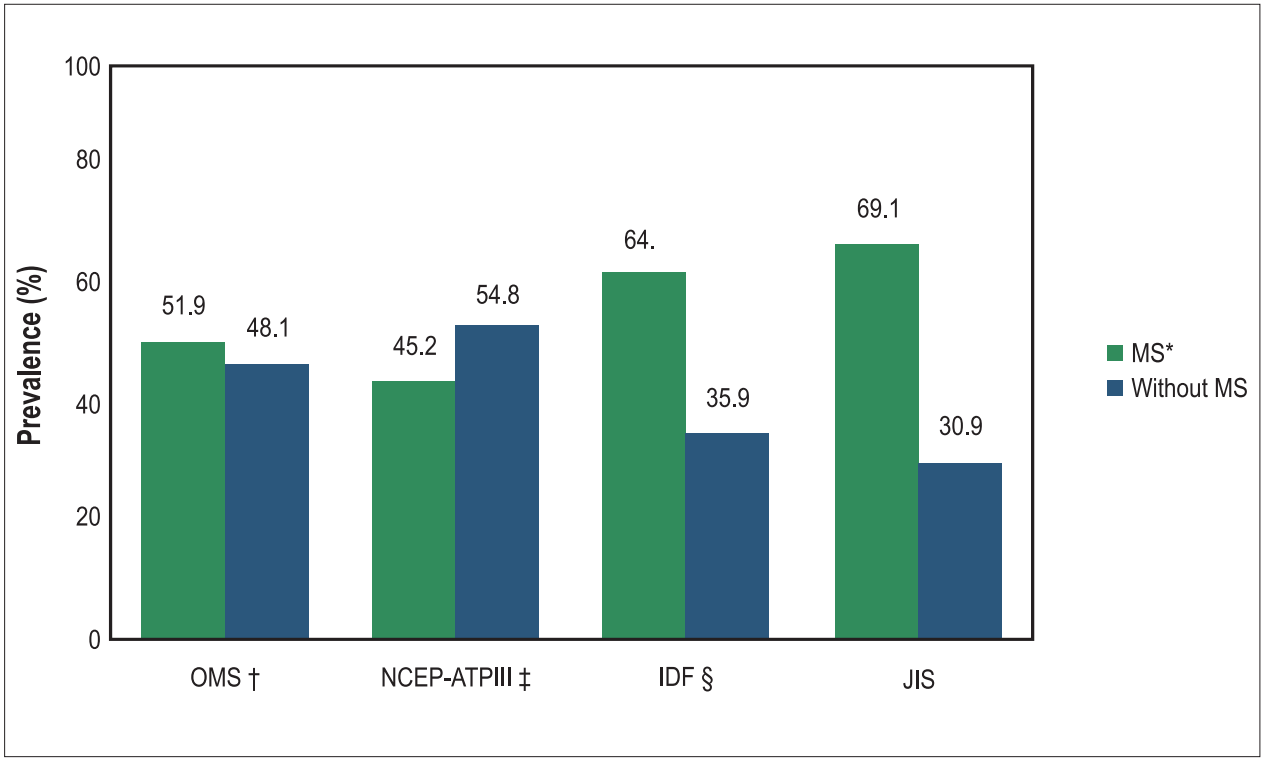

Chart 1 – *Prevalence of metabolic syndrome in the study population according to the four criteria.*
**MS: Metabolic Syndrome; †WHO: World Health Organization; ‡NCEP- ATP III: Third Report of the National Cholesterol Education Program; § IDF: International Diabetes Federation;⁄⁄JIS-Joint Interim Statement.*

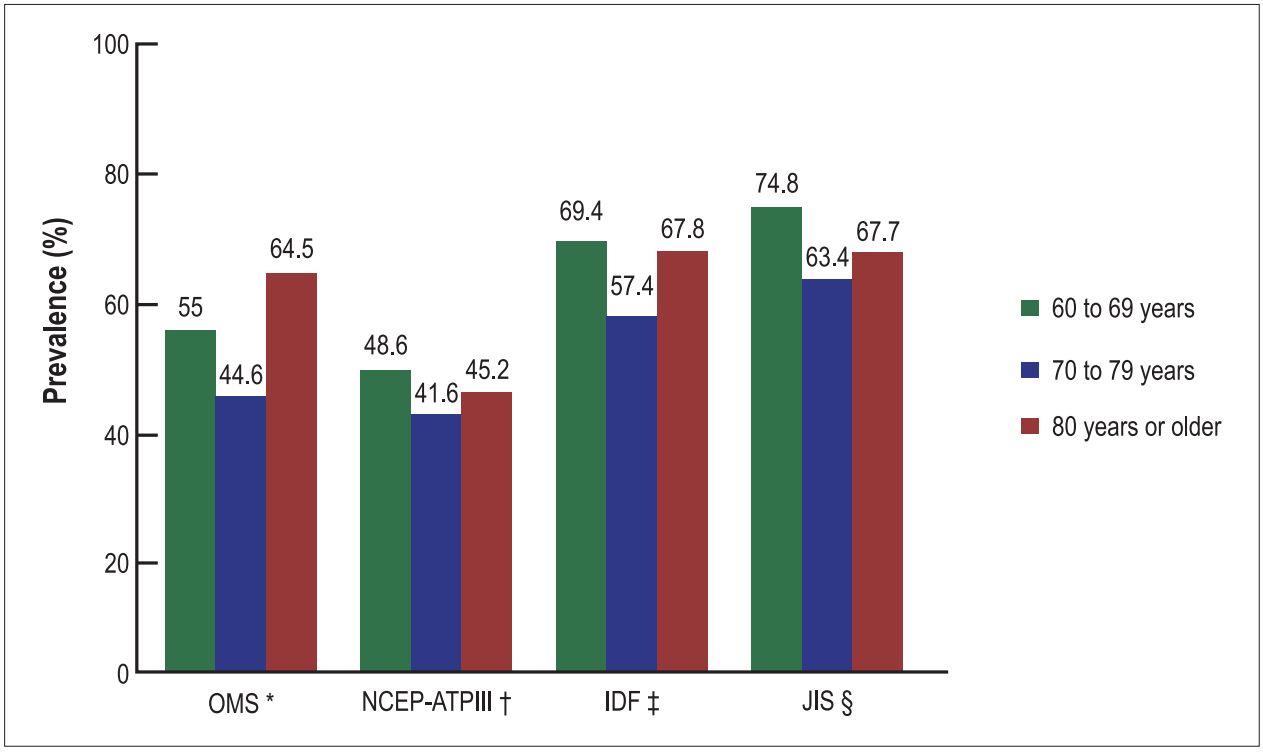

Chart 2 – *Prevalence of metabolic syndrome by age range according to the four criteria.*
**WHO: World Health Organization; †NCEP - ATP III: Third Report of the National Cholesterol Education Program; ‡IDF: International Diabetes Federation; §JIS: Joint Interim Statement.*

In Italy[2], a study in individuals older than 65 years found a prevalence of MS of 20% in women and 33% in men, using the of NCEP-ATP III criterion. In another study carried out in a Geriatrics service in Turkey[25], the prevalence of MS in individuals older than 65 years was 24%, also by the NCEP-ATPIII.

When compared with the results of the present study, considering only the NCEP-ATPIII criterion, there was a higher prevalence of MS in the population by this criterion: 45.6% for women and 44.4% for men, similar to the results of the study in Novo Hamburgo (RS), although not so high. This difference probably reflects the ethnic and regional characteristics that predominate in the population of each region. This becomes clearer when considering a French study in which the prevalence of MS was 11.3% in women and 12.5% in men older than 70 years, using the NCEP-ATPIII criterion[26]. In Finland[27], the prevalence of MS in elderly women by the IDF criterion was higher than by the NCEP-ATPIII, similar to what was observed in a Brazilian study carried out in the state of Minas Gerais[28].

In China[29], where there is a growing change in society's lifestyle, with the incorporation of Western habits and, thus, an increase in metabolic diseases, a study in a population older than 60 years showed a high prevalence of MS, of 54% in women and 35% in men, according to the IDF criterion. When the NCEP-ATPIII criterion was applied to the same population, the prevalence decreased to 39% and 18%, respectively. In Australia[30], the prevalence of MS according to the IDF criterion was 46% in women and 36% in men older than 70 years.

The comparison between studies in the elderly population from other countries[31,32] and even in other regions of Brazil demonstrates the importance of regional studies, as the different prevalence values for MS found in these studies indicate the need tostrongly consider the population ethnic aspects and regional habits. The findings demonstrate the difficulty in having a diagnostic criterion that is accurate, sensitive and specific and that can be useful for assessing the general population, overcoming the limitations of regional specificities.

The diagnosis of MS itself identifies an increased cardiovascular risk[8], but it is unclear which diagnostic criterion for MS would be the best predictor of cardiovascular events. Assmann et al[33] compared the diagnostic criteria of IDF and NCEP-ATPIII in adults between 18 and 65 years as predictors of cardiovascular events during ten years of follow-up. Although most cases of MS have been diagnosed by IDF, the NCEP-ATPIII criterion had higher predictive value for cardiovascular risk. A cohort study in a Chinese population older than 50 years showed a prevalence of MS of 28% in men and 48.4% in women diagnosed by the JIS criterion, and it was associated with increased risk of cardiovascular mortality when three or more components of MS were present[34].

A study by Athyros et al[35] showed that the prevalence of cardiovascular disease increased in the presence of MS, regardless of the definition used, but it was more evident when using the NCEP-ATPIII criterion, when compared with the IDF. According to a report by He et al[29] in elderly Chinese diagnosed with MS by IDF, but not by the NCEP-ATPIII, it increased the chance of coronary heart disease and cerebral vascular accident.

In the present study, the correlation between the diagnostic criteria for MS was moderate between WHO vs. IDF (k = 0.47), WHO vs. NCEP-ATP III (k = 0.51), WHO vs. JIS (k = 0.45), IDF vs. NCEP-ATPIII (k = 0.55), NCEP-ATPIII vs. JIS (k = 0.53) and very good between IDF vs. JIS (k = 0.89). In Luxembourg[20], the agreement between the NCEP-ATPIII, IDF and JIS criteria was excellent (k = 0.89), particularly between IDF vs. JIS (k = 0.93). In the United States[36] the agreement was k = 0.92 between the NCEP-ATPIII and IDF criteria in postmenopausal women. A study in Africa[37] in individuals between 25 and 64 years found an agreement between WHO vs. IDF of k = 0.61, between WHO vs. NCEP-ATPIII of k = 0.59 and NCEP-ATPIII vs. IDF of k = 0.82.

The difference in concordance between the MS diagnostic criteria in different populations is probably due to ethnic characteristics, dietary habits and lifestyle, thus making it difficult to use a single diagnostic criterion for all populations.

Limitations of this study include the sample size and the likely regional specificity, which somehow prevent the extrapolation of these data to the entire elderly population of Brazil and worldwide.

Conclusion

We observed that the prevalence of MS in the elderly population was high using the four diagnostic criteria, particularly by JIS, and the agreement between the diagnostic criteria was considered very good between JIS and IDF, but only moderate among the others. Due to population characteristics of each region, it is clear the need for further regional studies to better assess the prevalence of MS in the elderly and, therefore, to improve disease diagnosis and treatment with cardiovascular risk reduction.

Author contributions

Conception and design of the research: Saad MAN, Cardoso GP, Cruz Filho, RA; Acquisition of data: Saad MAN; Analysis and interpretation of the data: Saad MAN, Cardoso GP, Martins WA, Velarde LGC, Cruz Filho, RA; Statistical analysis: Velarde LGC; Writing of the manuscript: Saad MAN, Cardoso GP, Martins WA, Cruz Filho, RA; Critical revision of the manuscript for intellectual content: Cardoso GP, Martins WA, Cruz Filho, RA.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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