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Artigo Original

The Prevalence of Metabolic Syndrome and its Components in Bragança District, North-Eastern Portugal: A Retrospective Observational Cross-Sectional Study

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A B S T R A C T

Introduction: Metabolic syndrome (MetS) is an independent determinant to increase the risk of metabolic and cardiovascular diseases. MetS prevalence in Portugal is high, however an update is needed since the latest Portuguese epidemiological report is from 2017. Thus, this study aims to examine MetS prevalence and its components in the adult and older Portuguese sub-population (Bragança district).

Methods: A retrospective observational cross-sectional was conducted with a community sample collected from two Portuguese primary health care centres between January 2019 and December 2020. A total of 6570 individuals aged 18–102 years were included for analysis, among which 3865 women (57.37 ± 18.67 years) and 2705 men (59.97 ± 16.76 years). MetS was defined according to HARM2009 statement and binary logistic regression was performed to analyse the prevalence across sex and age.

Results: MetS prevalence in Bragança district was 54.51%. MetS prevalence was higher in men (61.63%) than women (49.52%). Men are 1.53 (95% OR: 1.37–1.72, $p < 0.001$) times more likely of having MetS compared to women. MetS risk increases with age (OR: 2.68–42.57, $p < 0.001$) with a decline from the eighties onwards (OR: 27.84, 95% CI: 19.19–40.38, $p < 0.001$). Men presented higher prevalence of overweight (48.50%) and obesity (28.06%) and women have higher prevalence of abdominal obesity (62.07%).

Conclusion: This study reported high prevalence of MetS in the Portuguese sub-population (Bragança district). A quasi-linear increase across age was verified in the MetS prevalence for both sexes with a decline from the eighties onwards.

Palavras-chave:
Portugal;
Prevalência;
Síndrome Metabólica.

A Prevalência da Síndrome Metabólica e dos seus Componentes no Distrito de Bragança, Nordeste de Portugal: Um Estudo Observacional, Retrospetivo e Transversal

R E S U M O

Introdução: A síndrome metabólica (SM) assume-se como um determinante independente para o aumento do risco de doenças metabólicas e cardiovasculares. A prevalência de SM em Portugal é elevada, contudo o último relatório epidemiológico realizado na população portuguesa reporta-se a 2017 e carece de atualização. Por conseguinte, este estudo pretende examinar a prevalência da SM e dos seus componentes numa subpopulação portuguesa de adultos e idosos do distrito de Bragança.

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Métodos: O estudo observacional, retrospetivo e transversal foi realizado com uma amostra comunitário proveniente de dois centros de saúde primários portugueses entre janeiro de 2019 e dezembro de 2020. A análise inclui um total de 6570 indivíduos, com idades compreendidas entre os 18 e os 102 anos, sendo 3865 mulheres (57,37 ± 18,67 anos) e 2705 homens (59,97 ± 16,76 anos). A SM foi definida de acordo com critérios HARM2009, tendo-se realizada uma regressão logística binária para analisar a sua prevalência por sexo e idade.
Resultados: A prevalência de SM no distrito de Bragança foi de 54,51%. A prevalência de SM foi mais elevada nos homens (61,63%) do que nas mulheres (49,52%). Os homens têm 1,53 (95% OR: 1,37–1,72; p < 0,001) vezes maior probabilidade de SM em comparação com as mulheres. O risco de SM aumenta com a idade (OR: 2,68–42,57; p < 0,001), observando-se um declínio a partir dos oitenta anos (OR: 27,84, 95% IC: 19,19–40,38; p < 0,001). Os homens apresentaram maior prevalência de excesso de peso (48,50%) e obesidade (28,06%), enquanto que as mulheres apresentam maior prevalência de obesidade abdominal (62,07%).
Conclusão: O presente estudo observou uma elevada prevalência de SM numa subpopulação portuguesa do distrito de Bragança, apresentando um aumento quase linear ao longo da idade para ambos os sexos com um declínio a partir dos oitenta anos.

Introduction

Metabolic syndrome (MetS) is a common metabolic disorder characterized by a cluster of factors such as central obesity, dysglycemia, dyslipidaemia and hypertension.[1,2] The combination of these factors increases the risk of metabolic and cardiovascular diseases.[3–6] The risk of developing type 2 diabetes mellitus (T2DM) are 5-fold higher with MetS.[7–9] Also, MetS is a good predictor of coronary heart disease and stroke and has been associated with a 1.5-fold increase in cardiovascular mortality, as well as a 2-fold increase in overall mortality.[4,5] The main causes for the MetS condition seems to be the result of sedentary lifestyle, physical inactivity and hypercaloric diet.[10,11] Nevertheless, genetic factors, functional ageing-related changes and mood disorders should not be underestimated in the MetS diagnosis.[6,12–14]

Over the last few decades, several MetS definitions and clinical guidelines have been developed,[1,15] in particular the definitions of the World Health Organization (WHO),[16] European Group for the Study of Insulin Resistance (EGIR),[17,18] National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III),[19] International Diabetes Federation (IDF)[7] and American Heart Association/National Heart, Lung and Blood Institute (AHA/NHLBI).[20] Presently, a joint interim statement for MetS criteria was published as HARM2009 to harmonize the previous definitions.[1] On the basis of that definition, MetS'criteria for clinical diagnosis are elevated waist circumference (WC), low high-density lipoprotein cholesterol (HDL-c), elevated triglyceride levels (TG), impaired fasting glucose (IFG), elevated systolic (SBP) and/or diastolic blood pressure (DBP). MetS diagnosis is confirmed when three of these five MetS components are present.[1,15]

More recently, epidemiological studies have reported a worldwide increase in MetS prevalence.[21,22] According to Scuteri *et al*,[2] Southern Europe showed higher MetS prevalence comparing to other European countries (i.e., Italy, Spain, and Portugal, 31.4%, 18.4%, and 17.1%, respectively). Indeed, Raposo *et al*[14] reported high MetS prevalence in Portugal (36.5%, 49.6%, and 43.1% reporting NCEP-ATP III, IDF and HARM2009 definitions, respectively). These findings corroborate with previous population-based cohort studies carried out in the Portuguese population, where it was reported higher MetS prevalence in Portuguese middle-aged and older adults.[5,23,24] Moreover, other studies have also reported a highly prevalence of T2DM, obesity, hypertension and dyslipidaemia in the Portuguese population.[8,9,25,26] However, the latest Portuguese epidemiological reports to 2017. Thus, an update is crucial to assess the current epidemiological state of MetS in the Portuguese population. Therefore, the aim of this descriptive and cross-sectional study was to examine the prevalence of MetS and its components in an adult and older Portuguese sub-population (Bragança district).

Methods

Study design and population

The present study is a retrospective observational cross-sectional study as part of an intervention project that intends to implement physical activity and exercise in the prevention and treatment of the metabolic diseases (Project GreenHeath).[27] A sample of adults was selected from two primary health care centres of Bragança district. A total of 18 890 participants were analysed, using the information collected between January 2019 and December 2020. From those, 12 320 participants were excluded from the data analysis considering the following exclusion criteria: (i) participants with age <18 years; (ii) missing information about MetS clinical criteria's, height, weight, BMI and demographic considerations. After this selection process, the final analysis included 6570 individuals aged 18–102 years, among which 3865 (58.83%) were women (mean age of 57.37 ± 18.67 years) and 2705 (41.17%) were men (mean age of 59.97 ± 16.76 years).

Data Collection

1. Anthropometric measures

Anthropometric measures were collected during clinical practice considering the standard procedures.[28] For this research, weight (kg), height (cm) and WC (cm) were analysed retrospectively from patients' clinical records.[29] Body mass index (BMI) was calculated by dividing weight (kg) by the square of height (m). European BMI cut offs were used to define overweight (25.0 to 29.9 kg/m^2) and obesity (≥30 kg/m^2).[30]

2. Laboratory analysis and blood pressure

Blood samples were collected from a collaborative laboratory at the primary health centre after 9/12 hours of overnight fasting. All subjects had at least one record of blood tests in their clinical process, valid for at least 6 months. Blood samples were collected in the morning following standard laboratory procedures and routine enzyme methods, in order to collect 10 mL venous blood.3[1] Thus, HDL-c, TG and fasting blood glucose were directly measured. Dyslipidaemia reports the serum lipid profile based on HDL-c and TG levels.[32] Blood pressure was analysed in retrospective from patients' clinical records.[30,31] High blood pressure was characterized according to elevated SBP and/or DBP (i.e., ≥130 mmHg) and elevated DBP (i.e., ≥85 mmHg). T2DM was diagnosed based on values for venous plasma with the following parameters in the general population: (a) fasting blood glucose ≥ 126 mg/dL (or ≥ 7.0 mmol/L); or (b) classic symptoms plus occasional blood glucose ≥ 200 mg/dL (or ≥ 11.1 mmol/L); or c) blood glucose ≥ 200 mg/dL (or ≥ 11.1 mmol/L) at 2 hours on the oral glucose tolerance test (OGTT) with 75 g glucose; or (d) glycated hemoglobin A1c (HbA1c) ≥ 6.5%.[33,34]

3. Age groups

Subjects were splited into seven age-groups and stratified by sex to dataset comparision. Fig. 1 presents the age distribution across sampled population according to women and men. The most representative age group is 60-69 years with 802 (55.59%) women and 646 (44.61%) men followed by: 70-79 years age group with 675 (53.83%) women and 579 (46.17%) men; 50-59 years age group with 657 women (59.89%) and 440 (40.11%) men; 30-39 years age group with 407 women (64.09%) and 228 (35.91%) men; over 80 years with 438 (59.03%) women and 304 (40.97%) men. Less representative age group were 18-29 years with 328 (69.64%) women and 143 (30.36%) men.

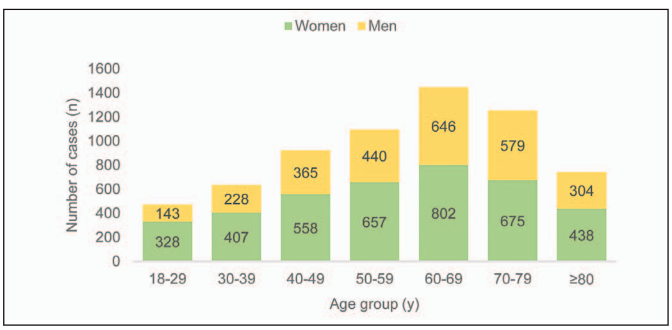

Figure 1. Number of observations among age groups according to sex.

4. MetS definition

MetS was defined in this study using the harmonize definition.[1,15] According to HARM2009, MetS diagnosis is confirmed when three of these five components are present: elevated WC (i.e., population- and country-specific delimitations), elevated TG (i.e., ≥150 mg/dL or 1.7 mmol/L), reduced HDL-c (i.e., <40 mg/dL or 1.0 mmol/L in men; <50 mg/dL or 1.3 mmol/L in women), elevated SBP (i.e., ≥130 mmHg) or elevated DBP (i.e., ≥85 mmHg) and IFG (i.e., ≥100 mg/dL or 5.6 mmol/L). European cut-off points were considered for the WC measurements, specifically: WC ≥88 cm in women and WC ≥102 cm in men. Additionally, drug treatment for each MetS component was considered to an alternative indicator.[1]

5. Statistical analysis

Descriptive statistics, the Kolmogorov–Smirnov and Levene's test were used to assess the normality and homogeneity. Data are presented as the mean ± one standard deviation (SD), or as percentage (%) and their respective 95% confidences intervals (CI). Categorical variables were expressed using counts and proportions. Chi-squared test or fisher exact test were applied whenever appropriate. To compare continuous variables independent sample t-test or Mann-Whitney U test were used. Statistical significance was set at $p < 0.05$.35,36 The prevalence of MetS and its components was analysed using a binary logistic regression (log-binary model), with an age and sex adjustments to calculate odds ratio (OR) and their 95% CI. Adjusted OR were performed to express different risk factors for likelihood of getting MetS.[37,38] All statistical analyses were conducted using SPSS for Windows Version 26.0 (SPSS Inc., Chicago, IL, USA).

Results

Table 1 presents the descriptive statistics for MetS components according to sex. Significant differences among men and women were found for all MetS components ($p < 0.001$). MetS was present in 3581 (54.51%) individuals, where 1914 (49,52%) were women and 1667 (61.63%) men. The prevalence of the various MetS components varied between 41. For overall population, 13%–66.71%. Above-normality values on the following MetS components were found for TG (49.44%), IFG (41.13%), SBP (66.71%) and DBP (51.57%). Below-normality values were found for HDL-c (52.91%). Men presented higher prevalence in all MetS components except for WC, specifically: reduced HDL-c (68.61%), elevated TG (52.94%), elevated IFG (52.42%), elevated SBP (74.23%), and elevated DBP (56.08%). Women showed a higher prevalence of elevated WC (62.07%). The prevalence of abdominal obesity, T2DM, hypertension and dyslipidaemia in overall population was 52.85%, 17.38%, 43.20%, and 41.43%, respectively. Men showed a higher prevalence of T2DM (22.18%), hypertension (46.69%) and dyslipidaemia (43.84%). Additionally, men presented higher prevalence of overweight (47.36%) and obesity (28.06%) and women showed higher prevalence of abdominal obesity assessed by WC (62.07%). Considering both sexes, 2667 (40.59%) were overweight, 1777 (27.05%) were obese and 3472 (52.85%) had abdominal obesity.

Table 1. Prevalence of metabolic syndrome and its components according to sex.

Variables	Men (n=2705)	Women (n=3865)	Total (n=6570)	p-value
Age (y) [Mean, SD]	59.97 ± 16.76	57.37 ± 18.67	58.44 ± 17.59	< 0.001
Height (cm) [Mean, SD]	170.97 ± 7.20	158.67 ± 6.66	163.33 ± 8.86	< 0.001
Weight (kg) [Mean, SD]	80.54 ± 13.44	68.69 ± 13.85	73.57 ± 14.87	< 0.001
BMI (kg/m²) [Mean, SD]	27.84 ± 4.14	27.30 ± 16.76	27.52 ± 4.88	< 0.001
Normal [n (%)]	665 (24.58)	1461 (37.80)	2126 (32.26)	
Overweight [n (%)]	1281 (47.36)	1386 (35.86)	2,667 (40.59)	
Obesity [n (%)]	759 (28.06)	1018 (26.34)	1777 (27.05)	
Elevated WC (cm) [n (%)]	1073 (39.67)	2399 (62.07)	3472 (52.85)	< 0.001
Reduced HDL-c (mg/dL) [n (%)]	1856 (68.61)	1620 (41.91)	3476 (52.91)	< 0.001
Elevated TG (mg/dL) [n (%)]	1432 (52.94)	1816 (46.99)	3248 (49.44)	< 0.001
IFG (mg/dL) [n (%)]	1418 (52.42)	1284 (33.22)	2702 (41.13)	< 0.001
Elevated SBP (mmHg) [n (%)]	2008 (74.23)	2375 (61.45)	4383 (66.71)	< 0.001
Elevated DBP (mmHg) [n (%)]	1517 (56.08)	1871 (48.41)	3388 (51.57)	< 0.001
MetS [n (%)]	1667 (61.63)	1914 (49.52)	3581 (54.51)	< 0.001
T2DM [n (%)]	600 (22.18)	542 (14.02)	1142 (17.38)	< 0.001
Hypertension [n (%)]	1263 (46.69)	1575 (40.75)	2838 (43.20)	< 0.001
Dyslipidaemia [n (%)]	1186 (43.84)	1536 (39.74)	2722 (41.43)	< 0.001

BMI – body mass index; DSP – diastolic blood pressure; HDL-c – low high-density lipoprotein cholesterol; IFG – impaired fasting glucose; n – number; SBP – systolic blood pressure; TG – triglycerides; WC – waist circumference; y – years.

Table 2 presented the MetS prevalence for overall sample according to sex, age and MetS components. Significant differences among normal and MetS groups were found for all variables ($p < 0.001$). Participants with MetS were more likely to present reduced HDL-c (83.30%), elevated TG (80.51%), IFG (63.78%), elevated SBP (87.74%), elevated DBP (71.40%) and elevated WC (70.96%). Additionally, MetS individuals showed prevalence of the following conditions: T2DM (29.27%), hypertension (63.00%) and dyslipidaemia (70.23%). The age groups with the highest prevalence of MetS were the 60-69 age-group (27.81%) and 70-79 age-group (27.67%), followed by the age groups of 50-59 years (16.78%) and older than 80 years (14.66%). Overwight and obesity were more likely to be present in MetS individuals than normative individuals. Of those, 1797 (50.18%) and 1493 (41.69%) were overweight and obese, respectively. Also among the population without MetS, the prevalence of T2DM, hipertension and dyslipidaemia were present in 94 (3.14%), 582 (19.47%) and 207 (6.93%) individuals, respectively.

Between the normative population, with less than 3 MetS components, also presents abnormal values in some of those components, namely a 41.52% prevalence of elevated SBP, a 31.15% prevalence of elevated WC, a 27.80% prevalence of elevated DBP, a 16.49% prevalence of reduced HDL-c, a 13.98% prevalence of elevated IFG and a 12.21% prevalence of elevated TG. The age group with the lowest percentage of MetS cases was 18 to 29 years old (1.03%) and the highest was 60 to 69 years old (27.81%).

Table 2. Prevalence of the metabolic syndrome according to sex, age, BMI, HDL-c, TG, IFG, SBP, DBP, WC, T2DM, hypertension and dyslipidaemia.

Variables	Normal (n=2989)	MetS (n=3581)	Total (n=6570)	*p*-value
Age (y) [n (%)]				< 0.001
18-29*	434 (14.52)	37 (1.03)	471 (7.17)	
30-39	515 (17.23)	120 (3.35)	635 (9.67)	
40-49	612 (20.48)	311 (8.68)	923 (14.05)	
50-59	496 (16.59)	601 (16.78)	1097 (16.70)	
60-69	452 (15.12)	996 (27.81)	1448 (22.04)	
70-79	263 (8.80)	991 (27.67)	1254 (19.09)	
>80	217 (7.26)	525 (14.66)	742 (11.29)	
BMI [n (%)]				< 0.001
Normal*	1439 (48.14)	687 (19.18)	2126 (32.36)	
Overweight	870 (29.11)	1797 (50.18)	2667 (40.59)	
Obesity	284 (9.50)	1493 (41.69)	1777 (27.05)	
Reduced HDL-c (mg/dL) [n (%)]	493 (16.49)	2983 (83.30)	3476 (52.91)	< 0.001
Elevated TG (mg/dL) [n (%)]	365 (12.21)	2883 (80.51)	3248 (49.44)	< 0.001
IFG (mg/dL) [n (%)]	418 (13.98)	2284 (63.78)	2702 (41.13)	< 0.001
Elevated SBP (mmHg) [n (%)]	1241 (41.52)	3142 (87.74)	4383 (66.71)	< 0.001
Elevated DBP (mmHg) [n (%)]	831 (27.80)	2557 (71.40)	3388 (51.57)	< 0.001
Elevated WC (cm) [n (%)]	931 (31.15)	2541 (70.96)	3472 (52.85)	< 0.001
T2DM [n (%)]	94 (3.14)	1048 (29.27)	1142 (17.38)	< 0.001
Hypertension [n (%)]	582 (19.47)	2256 (63.00)	2838 (43.20)	< 0.001
Dyslipidaemia [n (%)]	207 (6.93)	2515 (70.23)	2722 (41.43)	< 0.001

BMI – body mass index; DSP – diastolic blood pressure; HDL-c – low high-density lipoprotein cholesterol; IFG – impaired fasting glucose; SBP – systolic blood pressure; TG – triglycerides; WC – waist circumference; y – years.

Fig. 2 shows the prevalence of having one, two, three, four, and five of the MetS components for each age group in women (a), men (b) and overall population (c). Individuals with 18 to 49 years old were more likely to have none, one or two MetS components. On the other hand, three, four or five of the MetS components were more frequent according to age increase, specifically to 60-69- and 70-79-years range.

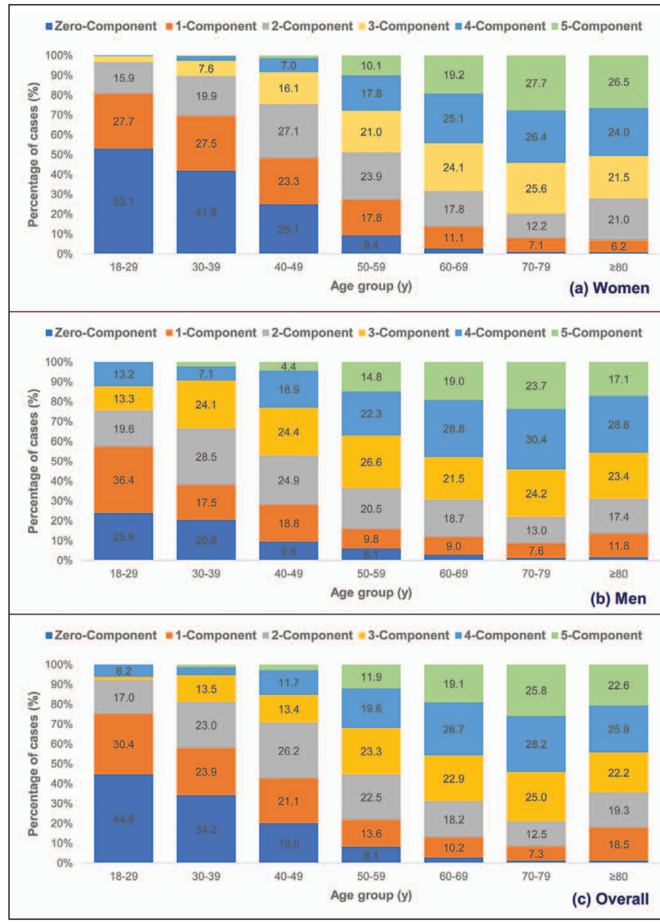

Figure 2. Percentage of MetS cases with one, two, three, four, or five MetS components for each age group, for women (a), men (b) and overall population (c).

Table 3 presents the adjusted OR for MetS according to sex and age. Men are 1.53 (95% CI: 1.37–1.72, $p < 0.001$) times more likely of having MetS compared to women. The risk for MetS increases with age (OR: 2.68–42.57, $p < 0.001$), and the individuals with the higer risk are those between 70-79 years old, with 42.57 (95% CI: 29.62–61.19, $p < 0.001$) times more likely to develop MetS. However, adjusted OR seems to decrease from the eighties onwards (OR: 27.84, 95% CI: 19.19–40.38, $p < 0.001$).

Table 3. Adjusted odds ratio for metabolic syndrome according to sex and age.

Variables		Adjusted OR	OR (95% CI)	*p*-value
Sex	**Women***	-	-	-
	Men	1.53	1.37 – 1.72	< 0.001
Age group	18-29*	-	-	-
	30-39	2.68	1.81 – 3.96	< 0.001
	40-49	5.78	4.03 – 8.32	< 0.001
	50-59	13.89	9.73 – 19.86	< 0.001
	60-69	24.95	17.50 – 35.55	< 0.001
	70-79	42.57	29.62 – 61.19	< 0.001
	>80	27.84	19.19 – 40.38	< 0.001

* Reference group; CI – confidence interval; OR – odds ratio.

Fig. 3 presents the evolution of the adjusted OR and percentage of the MetS prevalence across age groups. The probability of developing MetS increases with age, except in individuals aged over 80 years old.

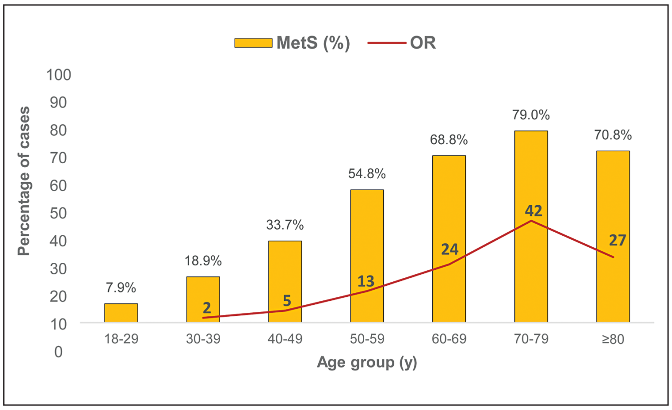

Figure 3. Adjusted odds ratio and percentage of MetS cases across age-groups.

Discussion

The prevalence of MetS has been increasing worldwide over the last few years.[21,22] As above-mentioned, high prevalence of MetS in Portugal and the outdated epidemiological reports justifies this update about the phenomenon.[2,5,14,23] Thus, this study provides an overview of the MetS prevalence in adult and older Portuguese sub-population (Bragança district). Current research reported an overall MetS prevalence of 54.51% (Table 1). Compared to previous epidemiological reports, it appears that the current MetS prevalence is substantially higher comparing with the results of Raposo *et al*[14] and Santos & Barros,[23] that reported a MetS prevalence substantially lower (31.7% and 37.2%, respectively). Raposo *et al*[14] reported a prevalence of 35.9% in Bragança district after ajustement for sex and age. The higher prevalence of MetS observed at the present study should be analyzed considering the sampling technique used. It is a cross sectional retrospective analysis from regular patients' appointment between 2019 and 2020, comparing to the sample selection from the PORMETS study[14] that used a list of enrollees in the Health Care Centers. This may constitute a selection bias of our study, if we admit that those who attend the consultation the most are, in principle, those who will have more morbidities. However, current results were similar to MetS prevalence reported by Timóteo *et al*[5] (55.3%). All these studies reported the prevalence of MetS based on the HARM2009 definition.[5,14,23] MetS prevalence described in the present study was also higher than values stated in the Metabolic Syndrome and Arteries Research (MARE) Consortium.[2] Additionally, we found a slightly higher MetS prevalence in men (61.63%) than women (49.52%). In fact, men are 1.53 times more likely of having MetS compared to women (Table 3). Moreover, the observed sex disparity was also not congruent with PORMETS study, which described a higher MetS prevalence in female population (49.41% *vs* 39.0%).[14] Other population-based cohort studies have also pointed out a higher prevalence of MetS in women.[39–42] However, higher prevalence of MetS in men has been reported in some specific populations.[43,44] This may suggest a wide variation in the prevalence of MetS across different populations, ethnicities and nationalities.[15,45]

According to HARM2009 criteria, MetS diagnosis is confirmed in the presence of, at least three of five MetS components as described previously.[1,15] The most frequent MetS component founded in the present analysis was elevated WC (62.07%) in women and elevated SBP in men (74.23%). Considering men and women together, abnormal values for MetS components ranged 33.With most of them been more prevalent in men, 13%–68.61%, except for WC (Table 1). These results were in line with the findings described by Mendoza-Caamal *et al*[42] that reported that central obesity was most frequent in women (61%). PORMETS study has not described the combinations of MetS components that were present in the subjects. However, elevated TG levels showed the highest values.[14]

Several studies have addressed an overview about the distribution of the number of MetS components across age.[42,43,46] When stratified by age group, significant gender differences were observed for MetS prevalence and its distribution according to different components. In this study, 3-, 4- and 5-MetS components were more frequent as age increased, specifically in 60-69 and 70-79-years range (Fig. 2). Furthermore, individuals in the age group of 70-79 years seemed to are 42.57 (OR: 29.62–61.19) times more chance to develop MetS and the risk increases with age (OR: 2.68–42.57) (Table 3). Effectively, MetS appears to present an age-related association, both for men and women, as it can be found in literature.[14,41,42,46] This points out that adjusted OR and MetS prevalence have presented a quasi-linear increase across age in both sexes, however a decline seems to be observed from the eighties onwards. The possible explanation for this decline in the MetS prevalence could be attributed to a possible higher proportion of mortality at earlier age groups in subjects with MetS, especially in the 60-69 years and 70-79 years.[47] Moreover, this decrease in MetS prevalence has not been reported in previous studies, since no age group cut-offs were included above 80 years old.[14,39,46] Other explanation could be that some individuals normalize some MetS components from the eighties onwards, however it will be unlikely due to its association with aging.48 We consider that older age range cut-offs are justified in futures epidemiological reports about the MetS.[49] That was justified by the increased average life expectancy around the world. In Portugal, average life expectancy is currently 80.8 years old.[50,51]

It has been suggested that overweight and obesity may be primarily involved in the pathophysiological mechanisms of hypertension, dyslipidaemia and insulin resistance.[15] Central adiposity also plays an important role because of its greater implication in these pathophysiological processes, compared to general obesity.[52–54] Consequently, these clustering factors are associated with an increased risk of cardiovascular disease and metabolic disorders.[3–6,15] The high prevalence of obesity has made it a global pandemic.[54,55] In Portugal, the combined prevalence of overweight and obesity were reported as 66.6% and 57.9% in adult's men and women, respectively.[56] Additionally, these findings have been increasing over the past decades.[25,57] Hypertension and high-risk lipid profile have been also documented in previous Portuguese epidemiological reports.[26,58,59] On the other hand, the association between MetS and T2DM has also been widely reported.[7–9] The present study results seem to be in accordance with the literature, which showed that the prevalence of abdominal obesity, T2DM, hypertension and dyslipidaemia in overall population was 52.85%, 17.38%, 43.20% and 41.43%, respectively (Table 1). Additionally, men presented higher prevalence of overweight (47.36%) and obesity (28.06%), however women showed a higher prevalence of abdominal obesity (62.07%). When analysed the prevalence of aforementioned metabolic disorders in individuals with MetS, it was noted that abdominal obesity, T2DM, hypertension and dyslipidaemia were present in 70.96%, 29.27%, 63.00% and 70.23%, respectively (Table 2).

This study presented some limitations, and the results should be interpreted with caution. First, results cannot be generalised due to the fact that only a sub-population/community sample (Bragança district) was evaluated. That is, the sample is not representative of the overall population of Portugal. However, the percentage of older population resident in Bragança (25%) is similar to metropolitan areas, such as Porto (21%) and Lisboa (22%).[51,60] Moreover, despite the normal sample distribution, a greater number of women were included (Fig. 1). Second, comparisons with other populations should be interpreted with a broader overview of the actual body of knowledge. Indeed, as far as we know, there are only two previous Portuguese epidemiological reports about MetS prevalence preceded this study.[2,14] Third, current study did not report about demographic and behavioural variables. These variables should be considered in future reports as the influence of socio-demographic factors, dietary and nutrition habits, modifiable risk factors (e.g., drinking and smoking), physical activity and lifestyle. These variables have been addressed in previous investigations.[10,11,39,41] Furthermore, future researches should include more focused approach in the evolution of the T2DM and its association with the MetS components.

Conclusion

This study reported a high prevalence of MetS in an adult and older Portuguese sub-population (Bragança district). Men are more likely to develop MetS, overweight and general obesity, whereas women showed a higher prevalence of abdominal obesity. Furthermore, adjusted OR and MetS prevalence have presented a quasi-linear increase across age in both sexes, however a decline seems to be observed from the eighties onwards. Thus, implementing intervention programmes is crucial to control the rising MetS prevalence and reduce the associated cardiovascular events.

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I declare that all authors had a substantial contribution for this manuscript.

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