

Original Article

# Association between Waist Circumference, Diabetes Mellitus, Hypertension and Dyslipidemia in a Population in Northern Angola

Carmel Helena Vita <sup>1</sup>, António Helder Francisco <sup>1</sup>, Humberto Morais <sup>1,2</sup>, João Mário Pedro <sup>3</sup>, Miguel Brito <sup>4,5</sup>, Maufer Gonçalves <sup>1,4,\*</sup>

- <sup>1</sup> Center for Advanced Studies in Medical Education and Training, Faculty of Medicine, Agostinho Neto University, Luanda, Angola.
- <sup>2</sup> Main Military Hospital/Higher Institute, Luanda, Angola.
- <sup>3</sup> Gulbenkian Institute of Science, Oeiras, Portugal.
- <sup>4</sup> Health Research Center of Angola (CISA), Angola.
- <sup>5</sup> Health and Technology Research Center (H&TRC), Lisbon School of Health Technology, Lisbon Polytechnic Institute, Portugal.

\* Correspondence: maufergoncalves@gmail.com.

**Abstract:** Obesity, particularly when it is centrally located, is an important risk factor for the development of cardiovascular diseases. This study aimed to assess the relationship between waist circumference and the presence of diabetes mellitus, hypertension, and dyslipidaemia. A community-based cross-sectional study was conducted as a sub-analysis of CardioBengo in the municipality of Dande, Bengo Province, involving 2,244 individuals aged 18–84 years. The study included a structured questionnaire and the collection of sociodemographic, anthropometric, hemodynamic and biochemical data. Analyses were carried out using correlation methods, the construction of ROC (Receiver Operating Characteristic) curves, and the determination of optimal cut-off points according to the Youden index. Waist circumference was positively associated with metabolic risk factors, particularly hypertension, in both sexes. It demonstrated moderate sensitivity and specificity (area under the curve (AUC): 0.725 in men and 0.612 in women). Waist circumference also proved to be a moderate predictor of diabetes mellitus (AUC: 0.648 in men and 0.596 in women) and hypercholesterolaemia (AUC: 0.673 in men and 0.612 in women), with cut-off points varying between 71.5 cm and 89 cm depending on gender. For hypertriglyceridaemia, however, the association was weak (AUC: 0.557 and 0.503). Waist circumference can be used as an indicator of the risk of developing metabolic factors, highlighting its usefulness in predicting hypertension in the Angolan population.

**Keywords:** Cardiovascular Risk Factors; Waist Circumference; Arterial Hypertension; Diabetes Mellitus; Dyslipidemia; Angola.

Citation: Vita CH, Francisco AH, Morais H, Pedro JM, Brito M, Gonçalves M. Association between Waist Circumference, Diabetes Mellitus, Hypertension and Dyslipidemia in a Population in Northern Angola. Brazilian Journal of Clinical Medicine and Review. 2026;Jan-Dec;04(1):bjcmr46.

<https://doi.org/10.52600/2763-583X.bjcmr.2026.4.1.bjcmr46>

Received: 7 August 2025

Accepted: 1 November 2025

Published: 8 November 2025



Copyright: This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0).

## 1. Introduction

Obesity is a chronic disease of multifactorial origin, resulting from the interaction between genetic and environmental factors that influence the balance between energy intake and expenditure, causing significant impacts on health [1,2]. It is strongly associated with chronic non-communicable diseases (NCDs), such as hypertension, dyslipidemia and diabetes mellitus (DM), and plays a central role in the high cardiovascular morbidity and mortality observed in various contexts [3]. Although there are

precise methods for assessing body fat, such as electrical bioimpedance, computerized tomography, magnetic resonance imaging, dual-energy X-ray absorptiometry, and isotopic markers, these tests are expensive and difficult to apply in clinical practice and population studies [4, 5]. Anthropometric indicators, such as body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR), are widely used because of their simplicity, low cost and usefulness in screening for cardiovascular risk.

According to estimates by the World Health Organization (WHO), more than 1 billion people worldwide are currently obese, including 650 million adults, 340 million adolescents and 39 million children. Obesity contributes significantly to the global burden of cardiovascular disease, which remains the leading cause of death. The WHO projects that, by 2025, around 167 million people, including adults and children, will suffer direct consequences of being overweight [6]. A recent global analysis, with data from 1990 to 2023, assessed the association between BMI, waist-to-height ratio (WHtR) and hypertension in adults aged 20 to 64 in eight regions of the world. A strong correlation was observed between BMI and WHtR ( $r = 0.76\text{--}0.89$ ). After adjustments, mean WHtR was highest in South Asia, Latin America and the Middle East, and lowest in Central and Eastern Europe, in women from high-income countries and men from Oceania. In all regions, there was an increase in the prevalence of hypertension with increasing BMI and WHtR, both with good predictive performance (C-statistics: 0.72–0.81), although WHtR reveals important regional differences in the distribution of adiposity [7].

In Angola, a cross-sectional study of civil servants identified WC cut-off points of 87.5 cm for men and 80.5 cm for women as the most appropriate for diagnosing metabolic syndrome. A positive association was also observed between WHR and hypertension, with areas under the ROC curve of 0.74 (men) and 0.67 (women), and WHR values of 0.86 and 0.82, respectively, being suggested as limits for identifying hypertension [8, 9]. The aim of this study was therefore to assess the association between waist circumference, diabetes mellitus, hypertension and dyslipidemia in a population in northern Angola, and to determine the best WC cut-off points to identifying these risk factors.

## 2. Methods

### 2.1 Type and location of study

This is a community-based cross-sectional study of a subset of the CardioBengo survey carried out in the catchment area Dande-HDSS, located in the Municipality of Dande, Bengo province, 60 km north of Luanda, the capital of Angola. The details of the study design have been described previously [10, 11, 12].

### 2.2 Study population

The sample size was calculated assuming a simple random sample, based on the prevalence of hypertension of 23% found for this population in a study conducted in 2011, and anticipating a response rate of 70%. Sample size estimates were generated for men and women and five age groups between 18 and 64 years, resulting in a total of 3,515 individuals with a participation rate of 35%, corresponding to 2,244 individuals. In this study, women represented the largest sample with a total of 1,481 (66%).

### 2.3 Inclusion and exclusion criteria

Individuals living the Dande-HDSS study area aged between 18 and 84 were included in the study. Participants with missing anthropometric, blood pressure and/or hemodynamic values were excluded. Pregnant women were also excluded because their biochemical, anthropometric and physiological parameters were altered.

## 2.4 Study variables

The study included anthropometric variables: age and gender; clinical variables: waist circumference (WC), body mass index (BMI) and blood pressure; and biological samples: fasting blood glucose and total blood cholesterol. BMI was categorized as normal (18.5 to 24.9 kg/m<sup>2</sup>), overweight (25.0 to 29.9 kg/m<sup>2</sup>) and obesity (> 30 kg/m<sup>2</sup>) [13]. The cut-off points used for WC were those recommended by the WHO: adequate (men < 90 and women < 85 cm) and at metabolic risk (men > 94 cm and women > 80 cm) [13]. The blood pressure will be measured using the OMRON M6 Comfort automatic sphygmomanometer (OMRON Healthcare Europe B.V., Hoofddorp, Netherlands). Each participant rested for 15 minutes before measurements: sitting on the right arm, with the appropriate cuff size and 3 readings taken at 3-minute intervals.

The measurements were taken with the participant seated, on the right arm, using the appropriate cuff size (22x32 cm or 32x42 cm), and the data were analyzed based on the average of the last two readings. The criteria of the European Society of Cardiology / European Society of Hypertension (ESC/ESH, 2018) were used for blood pressure classification. Thus, participants were classified as hypertensive if they reported using any antihypertensive medication or had mean SBP values  $\geq 140$  mmHg and/or DBP  $\geq 90$  mmHg. Pulse pressure was calculated and defined as the difference between systolic and diastolic pressure, as well as mean arterial pressure calculated by the formula:  $MAP = (PP/3) + DBP$ , where PP = pulse pressure and DBP = diastolic pressure [14].

The blood glucose was measured using an ACCU-CHEK Aviva glucometer with test strips. Participants were considered diabetic if they had a confirmed diagnosis or treatment for DM, or fasting blood glucose levels of  $\geq 126$  mg/dL (6.99 mmol/l) or postprandial blood glucose levels of  $\geq 200$  mg/dL. In subjects with triglyceride levels < 400 mg/dl (4.52 mmol/l), low-density lipoprotein cholesterol (LDL-C) was calculated according to Friedewald's formula, and very low-density lipoprotein cholesterol (VLDL-C) was calculated as previously described. Total blood cholesterol was measured using an AC-CUTREND Plus device with test strips. Participants were considered to have dyslipidemia if they had total cholesterol levels of  $\geq 240$ mg/dl and triglycerides  $\geq 150$  mg/dl (1.70 mmol/l), LDL-C  $\geq 160$  mg/dl (4.14 mmol/l), or HDL-C < 40 mg/dl (1.04 mmol/l) (men), < 50 mg/dl (1.30 mmol/l) (women), or were undergoing treatment for dyslipidemia [14].

## 2.5 Data collection

Participants were assessed by trained Dande-HDSS interviewers and health professionals able to communicate in Portuguese (the official language) and local languages. The data collection protocol was based on the WHO STEPS manual version 3.0, translated into Portuguese and pre-tested [15].

## 2.6 Statistical analysis

The analyses were carried out using the Statistical Package for Social Service (SPSS version 25.0) and MedCalc® Statistical Software version (MedCalc Software 22.014). ROC (Receiver Operating Characteristic) curves were performed to determine cut-off points. Descriptive data were reported as absolute frequencies and percentages, means and standard deviations. Contingency tables with Pearson's chi-square tests, paired correlations, area under the ROC curve, sensitivity, specificity and Youden index [(sensitivity + specificity -1)] were used to identify the power discrimination associated with hypertension, DM and dyslipidemia. Confidence intervals (95% CI) and a significance level of  $p < 0.001$  were set for all determinations.

### 3. Results

A total of 2244 individuals took part in this study, of whom 1481 (66%) were female. The first part of the table shows the distribution of the population according to gender and the anthropometric characteristics. The average age was  $37 \pm 14$  with no significant difference between men and women. Women had a lower average body weight and height than men, but a higher BMI ( $24.03 \pm 4.91$  and  $22.14 \pm 3.43$ ,  $p < 0.001$ ) respectively. The men had a lower waist circumference than women ( $p < 0.001$ ).

The blood pressure analysis shows that the sample average SBP was  $119.1 \pm 21.9$  and DBP was  $76.7 \pm 14.4$  – men had higher SBP values ( $p < 0.001$ ) unlike women who had higher DBP values ( $p < 0.001$ ). The average MAP was  $90.82 \pm 16.27$  and the heart rate was  $77.8 \pm 13.0$  – the men also had higher MAP values ( $p < 0.001$ ) unlike the women, who had higher heart rate values ( $p > 0.001$ ). Regarding biochemical data, it was observed that the average glycemia values were  $111 \pm 25$ , with no significant difference between genders, women had higher cholesterol values than men ( $186 \pm 32$  and  $171 \pm 26$ ;  $p < 0.001$ ) and triglycerides values showed no significant difference in either gender ( $128 \pm 78$  and  $131 \pm 84$ ).

**Table 1.** Distribution of the anthropometric characteristics, hemodynamic parameters and biochemical characteristics according to gender in Bengo population.

| Clinical Variables                 | Female            | Male              | All               | P         |
|------------------------------------|-------------------|-------------------|-------------------|-----------|
|                                    | Mean $\pm$ SD     | Mean $\pm$ SD     | Mean $\pm$ SD     |           |
| <b>Anthropometric parameters</b>   |                   |                   |                   |           |
| Age (years)                        | $38 \pm 14$       | $35 \pm 14$       | $37 \pm 14$       | ns        |
| Weight (kg)                        | $58.3 \pm 12.9$   | $61.6 \pm 11.1$   | $59.4 \pm 12.4$   | $< 0.001$ |
| Height (m)                         | $1.56 \pm 0.06$   | $1.67 \pm 0.07$   | $1.59 \pm 0.08$   | ns        |
| BMI (kg/m <sup>2</sup> )           | $24.03 \pm 4.91$  | $22.14 \pm 3.43$  | $23.38 \pm 4.55$  | $< 0.001$ |
| Waist circumference (cm)           | $80.9 \pm 13.1$   | $76.6 \pm 9.7$    | $79.5 \pm 12.2$   | $< 0.001$ |
| <b>Hemodynamic parameters</b>      |                   |                   |                   |           |
| SBP (mmHg)                         | $117.5 \pm 23.4$  | $122.2 \pm 18.5$  | $119.1 \pm 21.9$  | $< 0.001$ |
| DBP (mmHg)                         | $77.1 \pm 15.0$   | $75.9 \pm 13.1$   | $76.7 \pm 14.4$   | $< 0.001$ |
| MAP (mmHg)                         | $90.56 \pm 17.23$ | $91.33 \pm 14.22$ | $90.82 \pm 16.27$ | $< 0.001$ |
| HR (bpm)                           | $80.5 \pm 12.7$   | $72.8 \pm 12.2$   | $77.8 \pm 13.0$   | $< 0.001$ |
| <b>Biochemical characteristics</b> |                   |                   |                   |           |
| Glycemia (mg/dL)                   | $110 \pm 26$      | $113 \pm 25$      | $111 \pm 25$      | ns        |
| Cholesterol (mg/dL)                | $186 \pm 32$      | $171 \pm 26$      | $181 \pm 31$      | $< 0.001$ |
| Triglycerides (mg/dL)              | $128 \pm 78$      | $131 \pm 84$      | $129 \pm 80$      | $< 0.001$ |

ns - non significant.

Table 2 shows the bivariate Pearson correlation between WC, age and levels of glycemia, cholesterol, triglycerides and SBP/DBP/MAP, and despite the significance, all the values found showed a weak correlation. The Figure 1A shows the ROC curves for the association between CC and hypertension in men and women. The AUC was 0.725 ( $p < 0.001$ ) in men and 0.612 ( $p < 0.001$ ) in women, showing that CC has reasonable discriminatory power in men and weak discriminatory power in women. Regarding figure 1B,

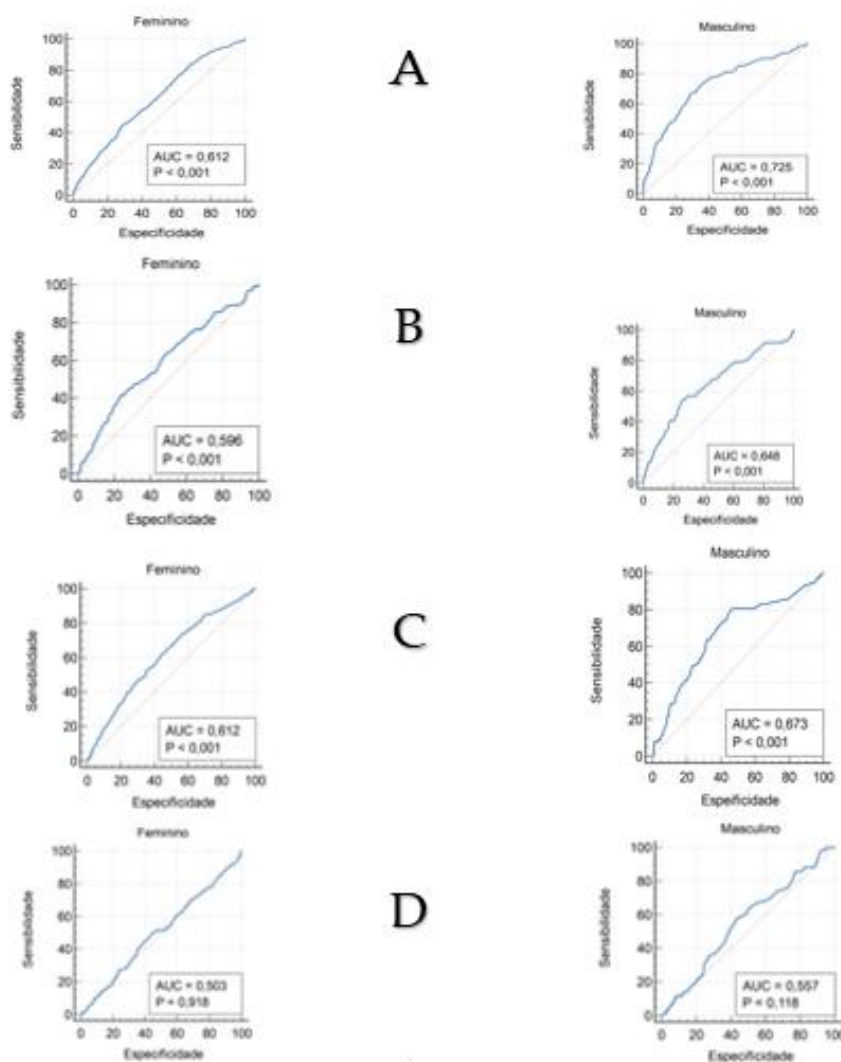
the ROC curves for the association between CC and DM in men and women had an AUC value of 0.648 and 0.596, respectively; both with  $p < 0.001$ .

**Table 2.** Pearson’s correlation between waist circumference, gender, age, glycemia, cholesterol, triglycerides and blood pressure.

| Variables                | Female    | Male      | All       | p       |
|--------------------------|-----------|-----------|-----------|---------|
|                          | Bivariate | Bivariate | Bivariate |         |
| Age (years)              | 0.196**   | 0.378**   | 0.256**   | < 0,001 |
| Blood glycemia (mg/dL)   | 0.160**   | 0.129**   | 0.141**   | < 0,001 |
| Cholesterol (mg/dL)      | 0.211**   | 0.222**   | 0.239**   | < 0,001 |
| Triglycerides (mg/dL)    | - 0.019   | 0.041     | -0.003    | > 0,001 |
| Systolic blood pressure  | 0.181**   | 0.401**   | 0.210**   | < 0,001 |
| Diastolic blood pressure | 0.236**   | 0.441**   | 0.289**   | < 0,001 |
| Mean arterial pressure   | 0.203**   | 0.432**   | 0.242**   | < 0,001 |

\*\* $p < 0.001$ .

**Figure 1.** Pearson’s correlation between waist circumference, gender, age, glycemia, cholesterol, triglycerides and blood pressure.



This showed that CC has weak discriminatory power in both sexes (with greater emphasis on women). Figures 1C and 1D show the ROC curves for the association between CC and dyslipidemia in men and women. It was subdivided into two variables: total cholesterol and triglycerides – the AUC for total cholesterol was 0.673 for men and 0.612 for women; both with  $p < 0.001$ , showing that CC has low discriminatory power in both sexes – the AUC for triglycerides was 0.557 ( $p = 0.918$ ) for men and 0.503 for women ( $p = 0.118$ ), showing that CC has very low discriminatory power in men and women.

#### 4. Discussion

In this study, despite the low discriminatory power, it was possible to identify cut-off values that best predicted the onset of cardiovascular events, due to the existence of a reasonable association between abdominal obesity and cardiovascular risk. Individuals with waist circumference above the values found have a higher risk of developing hypertension, diabetes mellitus and dyslipidemia.

##### 4.1 Association between abdominal obesity and cardiovascular risk

It was possible to observe in both sexes that, with advancing age, the waist circumference value also increases, which agrees with that found by Ford et al. [17], similarly to that found by Lahti-Koski et al. [16] in a study in Finnish adults (9,025 men and 9,950 women aged between 25 and 64 years) and again to that found by Ford et al. [17] showing that of the 32,816 men and non-pregnant women aged 20 years or older studied, the overall mean waist circumference adjusted for age increased progressively and significantly from 95.5 cm (95% CI, 94.2-96.8 cm) in 1999-2000 to 98.5 cm (95% CI, 97.5-99.4 cm) in 2011-2012: significant increases occurred in men, women, non-Hispanic whites, non-Hispanic blacks, and Mexican Americans [16,17].

There was also an association between hypertension and waist circumference, particularly in males, which is in line with the findings of Peixoto et al. [18], who showed the association in both genders. Perhaps our finding is since black males are more likely to develop hypertension, due to continuous exposure to daily stress and other risk factors [18]. However, it is possible to invest in the use of waist circumference as a valuable tool for estimating the risk of hypertension in individuals with characteristics similar to those of the study population.

Regarding dyslipidemia, it was possible to observe a low association with waist circumference, corroborating Ferreira et al. [19], even though they highlighted the waist-to-hip ratio as the best marker of fat localization compared to waist circumference, mainly due to hypertriglyceridemia [19]. In this study, waist circumference was not related to hyperglycemia, unlike that finding of Ferreira et al. [19] where it was considered a measure with better discriminatory power. It is thought that this finding was due to the possibility that the population studied had not strictly complied with the fasting period and was therefore measured using the values at the time [19].

##### 4.2 Waist circumference cut-off points

This study shows, by analyzing the ROC curve, that waist circumference can identify hypertensive, diabetic and dyslipidemic individuals. The sensitivity of waist circumference was also found to be moderate in both genders ranging from 54.65 to 79.22 in men and 41.43 to 84.09 in women, considering the variable under study. This result is probably related to the best cut-off point used, according to the value obtained by the Youden Index. A question mark arises about the credibility of these cut-off points, because for this study, the area under the ROC curve varied between 0.5-0.7 in all the conditions assessed, which showed that waist circumference has poor to reasonable discriminatory power between affected and unaffected.

Hypertension showed cut-off points for males and females of 77.0 cm and 71.5 cm, respectively, values well below those recommended by the WHO, corroborating studies by Okosun et al. [20, 21], which recommend values of 75.6 cm and 80.5 cm for men, and 71.5 cm and 81.5 cm for women of Nigerian and Cameroonian origin, respectively [20, 21]. Although the values are not taxatively like those found in our study, both remain within the same limit. So far, the WHO [15] hasn't provided sufficient evidence to recommend specific limits for sub-Saharan Africans [15]. These values may be the result of actual differences or methodological factors between populations (measurement protocol, age distribution, sample selection).

Several studies have agreed with the values recommended by the WHO for the risk of hypertension, such as Rosini, Machado and Xavier (2006), who investigated the prevalence and multiplicity of additional risk factors in 134 individuals from the Hypertensive Program in the municipality of Brusque, and showed that waist measurement reflects an important association in hypertension, giving the female group a higher prevalence of this risk factor, totaling 67% of women with WC > 88 cm and 35.4% of men with WC > 102 cm; as well as studies carried out by Peixoto et al. who found cut-off points for men > 86 cm, while for women they were > 80 cm [18, 22, 23].

For DM, the cut-off points found for men and women were 79.5 cm and 89.0 cm, respectively, disagreeing with those found by Barbosa et al. [23] in their study with a population of 1,439 adult adults, whose cut-off points: 84 cm for women and 88 cm for men, both with moderate sensitivity and specificity (68.7% and 70.0%, and 66.2% and 68.3%) respectively [23]. Despite the values obtained in our study, we question the use of this instrument in this variable to predict risk. However, the values obtained in our study also disagreed with the standardized criteria of the International Diabetes Federation for ethnic or specific values for waist circumference (Zimmet & Alberti [24]: Europe (men >94 cm and women >80 cm), South Asia (men >90 cm and women >80 cm), China (men >90 cm and women >80 cm), and Japan (men >90 cm and women >80 cm).

It is worth noting that ethnic and nutritional differences contribute as important factors to the emergence of different cut-off values [24, 25]. The use of this tool negatively influenced the appearance of these values due to the weak association with the variable under study. As this is a predominantly female population, the probability of outcome bias is estimated. For dyslipidemia, the values found for both cholesterol and triglycerides were 74.5 cm and 75.5 cm in men and 79.5 and 74.5 cm in women, respectively. These results disagreed with those found by Ferreira et al. [19], who presented 85 cm as the best cut-off point for hypertriglyceridemia in men. Women were excluded because they represented a very small proportion of the individuals studied, and they also concluded that for the study of hypercholesterolemia, the waist-to-hip ratio was better associated with waist circumference (AUC=0.5) [19].

### 4.3 Anthropometric characteristics

BMI was used to estimate the nutritional status of the population and, although women had a higher BMI compared men, the values for both were within the parameters for normal body weight (BMI:  $23.38 \pm 4.55$ ) standardized by the WHO, disagreeing with what was found by Magalhães et al. [8] who highlighted the presence of higher BMI in women, but outside the parameters for normal body weight (women:  $27.1 \pm 5.8$  and total BMI:  $25.7 \pm 5.4$ ). Perhaps because the fact that the population studied is slightly of medium to short stature would justify the presence of normal values for our study [8]. The International Diabetes Federation (IDF) considers waist circumference to be one of the necessary parameters for defining metabolic syndrome and points out that waist circumference values need to be validated in each population, due to the characteristic's peculiar to each one. In its definition of metabolic syndrome, there are already different cut-off points to be considered, depending on whether the population is of European, South Asian, Japanese or Chinese origin [24, 25]. For other origins, there is still no con-

sensus value (IDF, 2006). This demonstrates the importance of knowing the ideal cut-off point for waist circumference in each population. Most studies use an instrument similar to the one used in this study, i.e. the ROC curve. The waist circumference values found differed greatly from those recommended by the WHO. Women had a higher average WC than men ( $80.9 \pm 13.1$  and  $76.6 \pm 9.7$ ) respectively [5]. This difference in waist circumference values due to three main factors: gender, reproductive status and age.

According to the WHO [26], gender differences in body fat deposition are evident even in the fetal phase but become much more pronounced during puberty [26]. Women have substantially more total adipose tissue than men, and men have greater muscle mass [27]. Parity is an important contributor to changes in body composition and body shape in women. Pregnancy is associated with gains in postpartum visceral and central adiposity. A cross-sectional analysis of NHANES III data, by Lassek & Gaulin (2006) with a population of 16,325 women, found that women who gave birth had less body fat and greater waist circumference. After controlling for age and BMI, increased parity was associated with smaller hips and thigh circumference, and larger waist circumference. Menopause is also associated with increased fat mass and redistribution of fat to the abdominal region [28]. It is unclear whether these changes are due to hormonal changes or the aging process [13]. And with age, waist circumference tends to increase progressively [16, 17].

#### 4.4 Hemodynamic status and biochemical profile

It was observed that men had higher SBP and MAP values, unlike women who had higher DBP and heart rate values, corroborating the findings of a study carried out in Angola [8,9]. This study showed that the male population had higher SBP and MAP values, unlike the female population who only had higher heart rate values. In this study, DBP was similar, with no significant difference ( $p=0.862$ ). However, in a population-based study carried out by Rodrigues et al. [30] in Vitória-Brazil, there was disagreement. The male population had higher SBP and DBP values than the female population [30].

It was also observed that the study population had slightly elevated glycemia levels with no difference between genders, but low cholesterol and triglyceride levels. It should be noted that, despite the presence of low values, women had higher values compared to men, which agrees with Magalhães et al. [8] but disagrees with Rodrigues et al. [30] and Alvarez et al. [29] who showed higher triglyceride values in men than women ( $p<0.001$ ), despite the latter having worked with adolescents [29, 30]. The main limitations of this study relate to its cross-sectional design, with all parameters assessed at a single time-point, no longitudinal follow-up of the study population, and the absence of comparative analyses with external cohorts

#### 5. Conclusion

This research showed that there is an association between waist circumference and the variables in question, with greater emphasis on hypertension. It can therefore be concluded that waist circumference can be a predictor of the appearance of metabolic risk in the Angolan population, thus constituting an important milestone for health, and allowing professionals and competent Institutions to develop strategies for its prevention. This study has given us a new vision of long-term diagnosis and prevention, but there is a need for continued research, given that some of the predisposing factors to the onset of these cardiovascular pathologies, namely dietary habits and lifestyle, are constantly changing.

**Funding:** None.

**Research Ethics Committee Approval:** The project was approved by the Ministry of Health's Independent Ethics Committee. The participants signed an informed consent form before the data collection, following all the rules for research on human beings in accordance with the Declaration of Helsinki.

**Acknowledgments:** None.

**Conflicts of Interest:** The authors declare no conflict of interest.

**Supplementary Materials:** None.

## References

1. Haffner S, Taegtmeier H. Epidemic obesity and the metabolic syndrome. *Circulation*. 2003;108:1541-5.
2. Kopelman PG. Obesity as a medical problem. *Nature*. 2000;404:635-43.
3. Campana EM, Brandão AA. Waist circumference: an unfavorable parameter for vascular health. *Braz Soc Cardiol*. 2022;119(2):265-6.
4. Crowley VEF. Overview of human obesity and central mechanisms regulating energy homeostasis. *Ann Clin Biochem*. 2008;45:245-55.
5. Gonçalves CP. Avaliação da circunferência da cintura como variável preditora de risco coronariano em estudo de base populacional. Vitória (ES): UFES; 2008.
6. Mesquita C, Ker CE. Cardiovascular risk factors in cardiologists certified by the Brazilian Society of Cardiology: lessons to be learned. *Braz Soc Cardiol*. 2021;782. doi: 10.36660/abc.20210153.
7. NCD Risk Factor Collaboration (NCD-RisC). General and abdominal adiposity and hypertension in eight world regions: a pooled analysis of 837 population-based studies with 7.5 million participants. *Lancet*. 2024;404(10455):851-63. doi: 10.1016/S0140-6736(24)01405-3.
8. Magalhães P, Capingana DP, Mill JG. Prevalence of the metabolic syndrome and determination of optimal cut-off values of waist circumference in university employees from Angola. *Cardiovasc J Afr*. 2014;25(1):27-33. doi: 10.5830/CVJA-2013-086.
9. Gonçalves MA, Magalhães P, Silva A, Capingana D. Razão cintura/quadril como preditor de hipertensão arterial: os parâmetros normais para Angola. *Rev Cient Clin Sagrada Esperança*. 2018;10(8):20-30. doi: 10.70360/rccse.v.62.
10. Pedro JM, Rosário E, Brito M, Barros H. CardioBengo study protocol: a population-based longitudinal cardiovascular study in Bengo Province, Angola. *BMC Public Health*. 2016;16:206.
11. Pedro JM, Brito M, Barros H. Prevalence, awareness, treatment and control of hypertension, diabetes and hypercholesterolemia among adults in Dande municipality, Angola. *Cardiovasc J Afr*. 2018;29(2):73-81. doi: 10.5830/CVJA-2017-047.
12. Pedro J, Brito M, Barros H. Gender and socio-demographic distribution of body mass index: the nutrition transition in an adult Angolan community. *J Public Health Afr*. 2018;9(2):5. doi: 10.4081/jphia.2018.865.
13. World Health Organization. Waist circumference and waist-hip ratio: report of a WHO expert consultation, Geneva, 8–11 December 2008. Geneva: WHO; 2011. Available from: <https://iris.who.int/handle/10665/44583>.
14. Williams B, Mancia G, et al; ESC Scientific Document Group. 2018 ESC/ESH Guidelines for the management of arterial hypertension. *Eur Heart J*. 2018;39(33):3021-104. doi: 10.1093/eurheartj/ehy339.
15. World Health Organization. The STEPS instrument and support materials. Geneva: WHO; 2015.
16. Ford ES, Mokdad AH, Giles WH. Trends in waist circumference among US adults. *Obes Res*. 2003;11(10):1223-31.
17. Lahti-Koski M, Harald K, Mannisto S, et al. Fifteen-year changes in body mass index and waist circumference in Finnish adults. *Eur J Cardiovasc Prev Rehabil*. 2007;14(3):398-404.
18. Peixoto MRG, et al. Waist circumference and body mass index as predictors of hypertension. *Arq Bras Cardiol*. 2006;87(4):462-8.
19. Ferreira MG, et al. Accuracy of waist circumference and waist-to-hip ratio as predictors of dyslipidemia in a cross-sectional study of blood donors from Cuiabá, Mato Grosso, Brazil. *Cad Saude Publica*. 2006;22(2):307-14.
20. Okosun IS, Liao Y, Rotimi CN, et al. Predictive values of waist circumference for dyslipidemia, type 2 diabetes and hypertension in overweight White, Black and Hispanic American adults. *J Clin Epidemiol*. 2000;53(4):401-8.
21. Okosun IS, Rotimi CN, Forrester TE, et al. Predictive value of abdominal obesity cut-off points for hypertension in Blacks from island countries in West Africa and the Caribbean. *Int J Obes Relat Metab Disord*. 2000;24(2):180-6.
22. Rosini N, Machado MJ, Xavier HT. Study of prevalence and multiplicity of cardiovascular risk factors in hypertensive patients in Brusque, SC. *Arq Bras Cardiol*. 2006;86(3):.
23. Barbosa PJ, et al. Central obesity criteria in the Brazilian population: impact on metabolic syndrome. *Arq Bras Cardiol*. 2006;87:407-14.
24. International Diabetes Federation. The IDF consensus worldwide definition of the metabolic syndrome. Brussels: IDF; 2006.
25. Zimmet P, Alberti KG, Shaw J. Metabolic syndrome: a new worldwide definition. A Consensus Statement from the International Diabetes Federation. *Diabet Med*. 2006;23(5):469-80.

26. Welborn TA, Dhaliwal SS. Preferred clinical measures of central obesity to predict mortality. *Eur J Clin Nutr.* 2007;61(12):1373-9.
27. Derby CA, Zilber S, Brambilla D, et al. Body mass index, waist circumference and waist-to-hip ratio, and change in sex steroid hormones: the Massachusetts Male Aging Study. *Clin Endocrinol (Oxf).* 2006;65(1):125-31.
28. Toth MJ, Tchernof A, Sites CK, et al. Effect of menopausal status on body composition and abdominal fat distribution. *Int J Obes Relat Metab Disord.* 2000;24(2):226-31.
29. Alvarez MM, Vieira ACRE, Sichieri R, Veiga GVD. Association of anthropometric measures of central fat location with components of metabolic syndrome in adolescents from public schools. *Arq Bras Endocrinol Metabol.* 2008;52(4):649-57.
30. Rodrigues PRM, et al. Association between waist-to-height ratio and hypertension and metabolic syndrome: a population-based study. *Arq Bras Cardiol.* 2010;94(2):188.