



Contents lists available at ScienceDirect

## Diabetes &amp; Metabolic Syndrome: Clinical Research &amp; Reviews

journal homepage: [www.elsevier.com/locate/dsx](http://www.elsevier.com/locate/dsx)

## Original Article

## Optimal waist circumference cutoff values for predicting metabolic syndrome among older adults in Ecuador

Carlos H. Orces<sup>a, \*</sup>, Martha Montalvan<sup>b</sup>, Daniel Tettamanti<sup>c</sup><sup>a</sup> Laredo Medical Center, Department of Medicine, 1700 East Saunders, Laredo, TX, 78041, United States<sup>b</sup> Universidad de Guayaquil, Universidad Católica de Santiago de Guayaquil, Ecuador<sup>c</sup> Universidad Católica de Santiago de Guayaquil, Universidad de Especialidades Espíritu Santo, Ecuador

## ARTICLE INFO

## Article history:

Received 23 December 2018

Accepted 17 January 2019

## Keywords:

Waist circumference  
Metabolic syndrome  
Older adults  
Ecuador

## ABSTRACT

**Aims:** To determine optimal waist circumference cutoff values for predicting metabolic syndrome (MetS) among adults aged 60 years and older in Ecuador.**Material and methods:** The National Survey of Health, Wellbeing, and Aging survey was used to describe the prevalence of MetS according to standard definitions. Receiver operating characteristics (ROC) curve analyses and the Youden index *J* (YI) were performed to examine optimal waist circumference cutoff values for predicting MetS. Moreover, the prevalence of MetS according to country-specific waist circumference cutoff values was compared with those using standard definitions.**Results:** Among 2306 participants with a mean age of 70.6 years, the optimal waist circumference cutoff value for predicting MetS was 90.7 cm in women with a sensitivity of 66.1%, specificity of 65.6% and YI of 0.31. In men, a waist circumference of 91.2 cm with a sensitivity of 73.2%, specificity of 62.8%, and YI of 0.36 was the optimal cutoff point for predicting MetS. In general, applying country-specific cutoff values decreased the prevalence of MetS among older Ecuadorian women. In men, except with the ATP III definition, similar MetS prevalence rates were seen whether the country-specific or standard waist circumference cutoff values were applied.**Conclusions:** The optimal waist circumference cutoff values for predicting metabolic syndrome among older Ecuadorians adults were 90.7 cm for women and 91.2 cm for men. Moreover, current standard definitions of abdominal obesity may overestimate the prevalence of MetS, particularly in Latin American women.

© 2019 Diabetes India. Published by Elsevier Ltd. All rights reserved.

## 1. Introduction

The Metabolic syndrome (MetS) is a cluster of cardio metabolic risk factors characterized by abdominal obesity, elevated blood pressure, dyslipidemia, and elevated fasting glucose, associated with higher risk of cardiovascular disease, type 2 diabetes mellitus, and mortality [1,2]. In Ecuador, previous studies have described that the prevalence of MetS among older women varies from 66% to 81% [3–5]. Moreover, abdominal obesity was the most frequently reported MetS components among older Ecuadorians with a prevalence of 60.8% and 87.5% of older men and women, respectively [3]. Although the International Diabetes Federation (IDF)

consensus makes the presence of abdominal obesity necessary for the diagnosis of MetS, this adipose component is specified by nationality or ethnicity according to the best available population estimates. In general, the MetS definition of abdominal obesity applied to Latin American populations has been based on waist circumference (WC) cutoff values from South Asians who have different cultural and genetic backgrounds [1,6,7].

Of relevance, a previous study conducted by Aschner et al. in five Latin American countries demonstrated that the optimal WC cutoff value was 94 cm in men and between 90 and 92 cm in women, using as the reference test for abdominal obesity an area of visceral adipose tissue  $\geq 100 \text{ cm}^2$  measured by computed tomography scan (CT) [8]. Similarly, a large cross-sectional study among Latin American patients seen in primary care clinics reported a mean WC of 96.4 cm for men and 89.7 cm for women, which was markedly larger than those described among South and East Asians. Moreover, the authors concluded that a WC cutoff value of 80 cm may

\* Corresponding author.

E-mail addresses: [corces07@yahoo.com](mailto:corces07@yahoo.com) (C.H. Orces), [mmontalvanmd@yahoo.com.ar](mailto:mmontalvanmd@yahoo.com.ar) (M. Montalvan).

overestimate the prevalence of abdominal obesity in Latin American and Caribbean women [9]. Therefore, the present study aimed to determine optimal WC cutoff values for predicting MetS among older adults in Ecuador. A secondary objective was to compare the prevalence of MetS according to country-specific WC values with those using standard definitions.

## 2. Methods

The present study was based on data from participants in the National Survey of Health, Wellbeing, and Aging (Encuesta Nacional de Salud, Bienestar, y Envejecimiento, SABE). Briefly, this survey is a probability sample of households with a least one person aged 60 years or older residing in the Andes Mountains and coastal regions of Ecuador. The methodology of the sampling design has been previously described [3]. Between April and August 2010, participants underwent biochemical evaluation to determine their metabolic risk profile. Laboratory data were processed at NetLab laboratory (Quito, Ecuador). Survey data, including operation manuals are publicly available [10].

### 2.1. Characteristics of participants

Age and sex were self-reported. Literacy was defined by answering affirmatively to the question “Can you write and read a message?” Smoking status was classified as current, former, and never. The average use of alcohol per week during the previous three months was classified as none, one day, or two or more days per week. Vigorous physical activity was evaluated by the question, “Have you exercised such as jogging, dance, or performed rigorous physical activity for the past year”. Participants’ physical activity status was classified as inactive, < 150 min, or  $\geq 150$  min per week based on the reported average the number of days and minutes of vigorous physical activity. Subjects were defined as having diabetes if they had been previously diagnosed by a physician with this condition or a fasting plasma glucose was  $\geq 126$  mg/dl [11]. Waist circumference was measured at the midpoint between the lower ribs and the iliac crest and the mean of two measures was used in the present analysis.

### 2.2. MetS definitions

The 2009 Harmonizing Joint Scientific Statement defines MetS if subjects meet 3 of the following risk factors: 1) WC cut-points > 90 cm in men and >80 cm in women; 2) systolic blood pressure 130 mmHg or diastolic blood pressure 85 mmHg; 3) HDL cholesterol 40 mg/dl for men, 50 mg/dl for women; 4) triglycerides 150 mg/dl; 5) fasting glucose 100 mg/dl [1].

The IDF consensus requires subjects to have central obesity defined by ethnic and sex specific WC cut-points (men > 90 cm, women > 80 cm), plus two of the four other components: 1) elevated triglycerides (>150 mg/dL), 2) elevated blood pressure (systolic BP  $\geq 130$  or diastolic BP  $\geq 85$  mm Hg), 3) elevated fasting blood glucose ( $\geq 100$  mg/dL); 4) low HDL cholesterol (<40 mg/dL for men or < 1.30 mmol/L or < 50 mg/dL for females) [6].

The Adult Treatment Panel III 2001 (ATP III) definition requires the presence of three or more of the following criteria: 1) elevated WC (>102 cm for men and >88 cm for women); 2) elevated triglycerides ( $\geq 150$  mg/dL); 3) low HDL cholesterol (<40 mg/dL for men and <50 mg/dL for females); 4) elevated blood pressure (systolic BP  $\geq 130$  or diastolic BP  $\geq 85$  mm Hg); 5) elevated fasting glucose ( $\geq 110$  mg/dL) [12].

## 3. Statistical analysis

The demographic characteristics and cardiometabolic risks of participants by gender were compared with the chi-squared and *t*-test for categorical and continuous variables, respectively. Receiver operating characteristic (ROC) curve analysis by gender was performed to determine optimal WC cutoff values for predicting  $\geq 2$  non-adipose MetS components according to the 2009 Harmonized Joint Scientific Statement. The area under the curve (AUC) measures the discriminatory ability of the model, and values > 0.7 are considered acceptable. Moreover, the cutoff value of each model was used to calculate the sensitivity, specificity, and the Youden index *J* (YI) of the test. The YI is a measure of overall diagnostic effectiveness and defined as (sensitivity + specificity-1). YI with values closer to 1 indicate a perfect diagnostic test [13]. Subsequently, gender-specific MetS prevalence rates were examined according to the ATP III, the IDF, and the Harmonizing Joint Scientific Statement definitions. Similarly, the prevalence of MetS using optimal country-specific WC cutoff values was compared with standard definitions. Statistical analyses were performed using SPSS, V.17 (SPSS Inc, Chicago, Illinois, USA) and MedCalc Statistical Software version 18.10.2 (MedCalc Software bvba, Ostend, Belgium). For all analyses, sample weights were incorporated to account for the survey design and to estimate MetS nationwide prevalence rates.

## 4. Results

A total of 2306 participants with a mean age of 70.6 (SD 8) years comprised the sample size, representing 1.1 million older adults in Ecuador. Of those, women accounted for 55.5% of the subjects. Table 1 shows the demographic characteristics and cardio metabolic profile of participants. In general, more men were literate, smokers, and drink alcohol regularly. Moreover, a higher proportion of men engaged in vigorous physical activities than women. In contrast, the prevalence of elevated fasting glucose, elevated blood pressure, elevated triglycerides, and reduced HDL cholesterol was significantly increased among women.

Figs. 1 and 2 shows the optimal WC cutoff values for discriminating the presence of  $\geq 2$  non-adipose MetS components in women and men, respectively. In women, the optimal WC cutoff value was 90.7 cm with a sensitivity of 66.1% (95% CI, 62.0, 69.3), specificity of 65.6% (95% CI, 60.6, 70.5), and YI of 0.31 (95% CI, 0.25, 0.36). In men, based on a WC cutoff value of 91.2 cm for WC, the sensitivity was 73.2% (95% CI, 69.5, 76.8), the specificity was 62.8% (95%, 58.3, 67.3), and the YI was 0.36 (95% CI, 0.29, 0.40). Moreover, these WC cutoff values corresponded to an AUC in women and men of 0.696 (95% CI, 0.663, 0.728) and 0.733 (95% CI, 0.702, 0.764), respectively. Table 2 shows the gender-distribution of selected WC cutoff values with their corresponding sensitivity, specificity, and YI. Overall, as the WC cutoff values increased, the sensitivity of the WC for predicting MetS decreased with a corresponding increase in the specificity of the measurement. Indeed, a WC > 90 cm in both genders was the optimal cutoff value for defining MetS according to the highest YI.

As shown in Table 3, the prevalence of abdominal obesity differed considerably according to the WC cutoff values used to define it. Overall, the prevalence of abdominal obesity applying optimal country-specific WC cutoff values was 56.3% in men and 58.3% in women. In women, using a WC cutoff of >90.7 cm significantly decreased the prevalence of MetS from 64.6% to 45.6% according to the IDF consensus and from 65.8% to 56.7% by the 2009 Harmonizing Joint Scientific Statement definition. In men, the prevalence of MetS was similar using standard or country-specific WC values. However, significant lower MetS prevalence rates were seen according to the ATP definition.

**Table 1**  
Characteristics of participants in the SABE survey.

|   | Men (n = 1049) | Women (n = 1257) |
|---|----------------|------------------|
| Age (years), mean (SD)                                | 71.6 (8.1)     | 71.5 (8.2)       |
| Region, % (SE)  |                |                  |
| Urban Andes Mountains                                 | 28.3 (1.3)     | 31.4 (1.7)       |
| Urban Coast   | 35.9 (1.9)     | 36.6 (1.7)       |
| Rural Andes Mountains                                 | 20.5 (1.5)     | 20.3 (1.5)       |
| Rural Coast   | 15.3 (1.4)     | 11.7 (1.2)       |
| Literacy,% (SE)                                       | 77.3 (1.6)     | 63.5 (1.8)*      |
| Smoking,% (SE)  |                |                  |
| Current   | 20.3 (1.7)     | 3.3 (0.7)*       |
| Former  | 49.6 (2.0)     | 12.0 (1.2)       |
| Never   | 30.2 (1.7)     | 84.7 (1.3)       |
| Alcohol intake per week, % (SE)                       |                |                  |
| None  | 63.1 (1.9)     | 89.3 (1.2)*      |
| ≤ 1 day   | 31.5 (1.9)     | 10.1 (1.2)       |
| ≥ 2 days  | 5.4 (1.0)      | 0.6 (0.3)        |
| Physical activity per week (min),% (SE)               |                |                  |
| None  | 54.3 (2.0)     | 76.6 (2.0)*      |
| < 150 min   | 21.7 (1.6)     | 15.4 (1.3)       |
| ≥ 150 min   | 24.0 (1.0)     | 8.0 (1.0)        |
| Waist circumference (cm), mean (SD)                   | 92.9 (10.6)    | 93.4 (14.1)      |
| Elevated blood pressure (mmHg),% (SE) <sup>a</sup>    | 61.6 (1.9)     | 69.2 (1.7)*      |
| Elevated fasting glucose (mg/dl), % (SE) <sup>b</sup> | 39.6 (1.9)     | 51.5 (1.8)*      |
| Elevated triglycerides (mg/dl), % (SE) <sup>c</sup>   | 38.3 (1.9)     | 47.6 (1.8)*      |
| Reduced HDL cholesterol (mg/dl),% (SE) <sup>d</sup>   | 36.1 (1.8)     | 55.0 (1.8)*      |
| Non-adipose Mets components, % (SE)                   |                |                  |
| 0   | 14.3 (1.4)     | 5.9 (0.7)*       |
| 1   | 32.2 (1.9)     | 24.1 (1.5)       |
| 2   | 25.9 (1.7)     | 27.7 (1.7)       |
| 3   | 18.8 (1.4)     | 25.2 (1.6)       |
| 4   | 8.8 (1.0)      | 17.1 (1.4)       |

\*P &lt; .0001.

<sup>a</sup> Systolic ≥ 130 mmHg and/or diastolic ≥ 85 mmHg; antihypertensive drug treatment is an alternate indicator.<sup>b</sup> Fasting glucose ≥ 100 mg/dl; drug treatment of elevated glucose is an alternate indicator.<sup>c</sup> Triglycerides ≥ 150 mg/dl.<sup>d</sup> HDL cholesterol < 40 mg/dl in men and < 50 mg/dl in women.

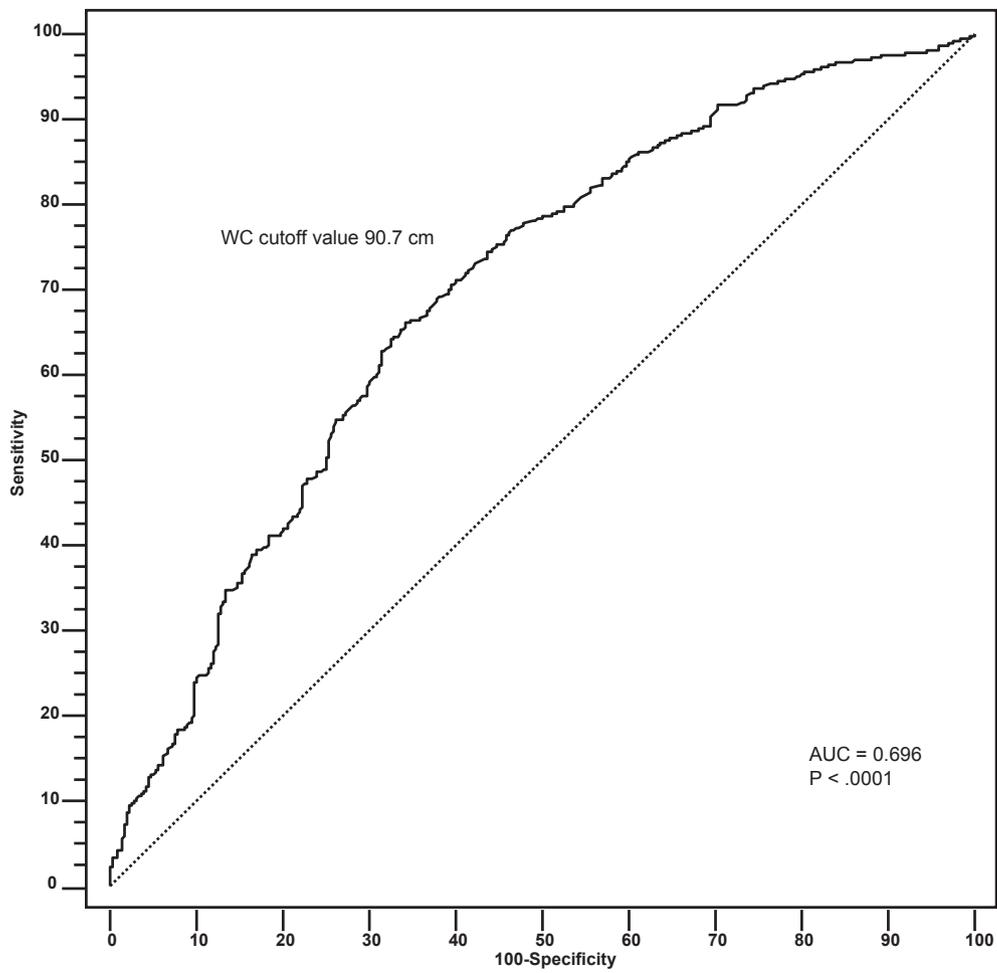
## 5. Discussion

The present findings indicate that a WC of 90.7 cm for women and 91.2 cm for men were optimal cutoff values for predicting MetS among older adults in Ecuador. The study results are consistent with those reported by Blumel et al. in which a WC of 88 cm was the optimal cutoff point for defining MetS among Latin American postmenopausal women [14]. Similarly, Aschner et al. demonstrated that among middle-aged subjects in five Latin American countries, WC cutoffs of 94 cm for men and between 90 and 92 cm for women were highly discriminative of excess visceral adipose tissue identified by abdominal CT. Moreover, the authors concluded that WC cutoff values for defining abdominal obesity in Latin America were similar between men and women, which is in agreement with our findings [8]. More recently, a cross-sectional study of 318 subjects with a mean age of 42.8 years from Cuenca, Ecuador demonstrated that a WC of 91.5 cm for women and 95.5 cm for men were the optimal cutoff values for predicting MetS [15]. In contrast, studies among postmenopausal Asian women have reported WC cutoff values for detecting MetS of 81.9 cm in South

Korea, 79.9 cm in China, and 83.0 cm in Japan [16–18]. In men, a WC cutoff value of 85 cm also predicted cardiometabolic risk among Japanese aged 60–69 years [18]. Notably, these WC cutoff values for defining MetS in Asian women were considerably lower than those described in middle-aged and older women in Cuenca, Ecuador [15].

We previously reported that the prevalence of abdominal obesity among older Ecuadorians was 65.9% in women and 16.3% in men according to a WC cutoff value of >88 cm and >102 cm for women and men, respectively [19]. Notably, the present findings also suggest that a WC > 80 cm, as defined in the MetS 2009 Harmonized definition and the IDF consensus may significantly increase the prevalence of abdominal obesity among Ecuadorian women. Moreover, the mean WC among older Ecuadorians was 92.8 for men and 93.4 cm for women.

In general, previous studies have reported that abdominal obesity (WC > 90 cm in men and >80 cm in women) was the most prevalent MetS component among older adults in Ecuador with rates between 75% and 87.5% in women and from 37% to 60.8% in men [3,4]. Similarly, among participants aged 20 years and older in



**Fig. 1.** WC cutoff value for predicting  $\geq 2$  non-adipose MetS components in older women.

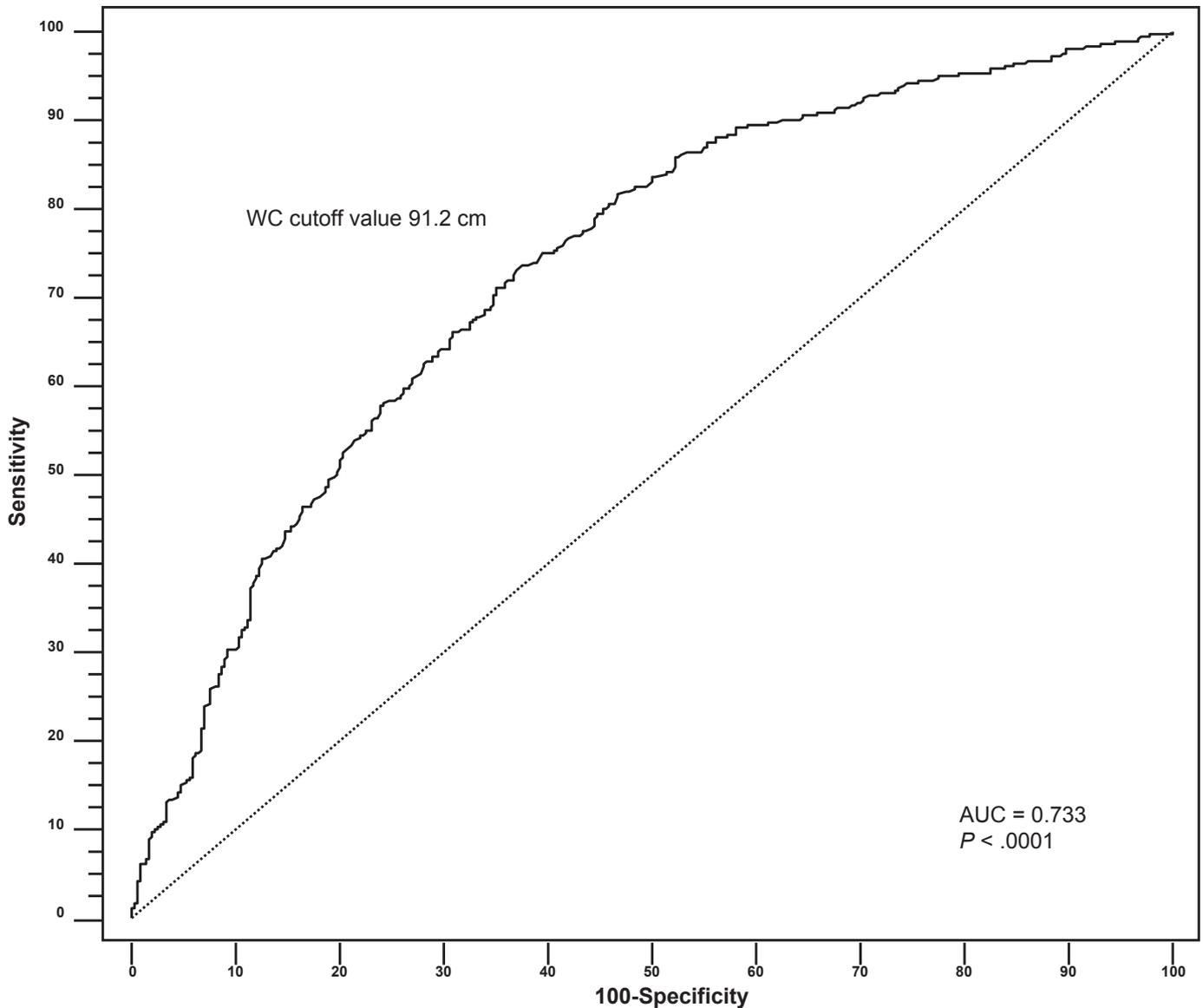


Fig. 2. WC cutoff value for predicting  $\geq 2$  non-adipose MetS components in older men.

the Mexican National and Nutrition Survey 2006, the prevalence of abdominal obesity according to the IDF consensus was 83.8% in women and 62.9% in men, which is consistent with our study results [20]. Thus, it appears that higher WC cutoff values to define abdominal obesity may decrease the prevalence of MetS, particularly in older women. For instance, 65.8% of women were defined as having MetS according to the 2009 Harmonizing Statement definition (WC > 80 cm) compared with 57.7% according to the country-specific WC cutoff value of >90.7 cm. In men, similar MetS prevalence rates were seen across standard definitions and using optimal country-specific WC cutoff values, except for lowest MetS prevalence according to the IDF consensus, which may be explained by a decrease in the prevalence of abdominal obesity with a waist circumference cutoff value of >102 cm. Since the initial report in the early 1980's that an abdominal distribution of fat for a given BMI was associated with increased insulin resistance and risk of developing type 2 diabetes and cardiovascular disease, the correlation between abdominal fat and metabolic dysfunction has been validated in numerous studies [22]. Of relevance, a previous study conducted among non-diabetic older Ecuadorians also

demonstrated that abdominal obesity was the MetS component with the highest prevalence of insulin resistance. Notably, after adjustment for potential confounders, older women and men defined with abdominal obesity were 3.7 and 3.2 times more likely to have insulin resistance compared with their non-abdominally obese counterparts, respectively [3].

The present study has several limitations. First, the SABE survey is a cross-sectional analysis. Therefore, the present findings do not infer causation. Second, the discriminatory ability of WC cutoff values to predict MetS in both genders was considered acceptable based on the AUC results. Despite this evidence, further research is needed to measure abdominal adipose tissue distribution among older Ecuadorians and confirm our findings. Third, race/ethnicity-specific WC cutoff values were not examined in the present analysis. However, Mestizos account for 71.9% of the population in the country [21]. Fourth, the present findings may be generalizable to older adults with similar demographic characteristics residing along the coastal and Andes Mountains region in Latin America.

In conclusion, the optimal waist circumference cutoff values for predicting MetS among older Ecuadorians were 90.7 cm for women

**Table 2**  
Waist circumference cutoff values predicting MetS among older adults in Ecuador.

| Waist (cm)   | ≥2 MetS components     |                        |                |
|--------------|------------------------|------------------------|----------------|
|              | Sensitivity % (95% CI) | Specificity % (95% CI) | Youden index J |
| <b>Men</b>   |                        |                        |                |
| >80          | 95.5 (93.5, 97.1)      | 17.9 (14.5, 21.7)      | 0.134          |
| >85          | 90.2 (87.5, 92.5)      | 36.0 (31.7, 40.6)      | 0.262          |
| >90          | 77.0 (73.4, 80.4)      | 57.2 (52.6, 61.8)      | <b>0.342</b>   |
| >95          | 57.8 (53.8, 61.9)      | 75.8 (71.6, 79.6)      | 0.336          |
| >100         | 34.0 (30.2, 38.1)      | 88.5 (85.3, 91.3)      | 0.225          |
| <b>Women</b> |                        |                        |                |
| >80          | 91.9 (89.9, 93.7)      | 28.6 (24.1, 33.5)      | 0.205          |
| >85          | 82.1 (79.5, 84.7)      | 44.3 (39.2, 49.5)      | 0.264          |
| >90          | 69.1 (66.0, 72.2)      | 62.1 (57.0, 67.1)      | <b>0.312</b>   |
| >95          | 50.7 (47.4, 54.1)      | 74.5 (69.8, 79.0)      | 0.252          |
| >100         | 31.9 (28.8, 35.1)      | 87.3 (83.5, 90.5)      | 0.192          |

Numbers in bold are statistically significant.

**Table 3**  
MetS prevalence rates according to standard definitions and country-specific WC optimal cutoff values.

| MetS definitions         | Abdominal obesity | Standard WC       | Country-specific WC* |
|--------------------------|-------------------|-------------------|----------------------|
|                          | % (95% CI)        | % (95% CI)        | % (95% CI)           |
| <b>Women</b>             |                   |                   |                      |
| IDF <sup>a</sup>         | 88.0 (85.4, 90.2) | 64.6 (61.1, 68.0) | 45.6 (42.1, 49.1)    |
| ATP III <sup>b</sup>     | 66.7 (63.2, 70.1) | 53.8 (50.2, 57.3) | 51.7 (48.2, 55.3)    |
| Harmonizing <sup>a</sup> | 88.0 (85.4, 90.2) | 65.8 (62.3, 69.1) | 57.7 (54.2, 61.2)    |
| <b>Men</b>               |                   |                   |                      |
| IDF <sup>a</sup>         | 62.1 (58.3, 65.9) | 41.8 (38.1, 45.5) | 39.5 (35.9, 43.3)    |
| ATP III <sup>b</sup>     | 19.7 (16.9, 22.9) | 26.8 (23.7, 30.0) | 40.4 (36.8, 44.2)    |
| Harmonizing <sup>a</sup> | 62.1 (58.3, 65.9) | 46.9 (43.1, 50.7) | 45.7 (41.9, 49.5)    |

\* MetS prevalence according to country-specific WC cutoff values of >90.7 cm for women and >91.2 cm for men.

<sup>a</sup> IDF consensus and the 2009 Harmonizing Joint Scientific Statements definitions (WC > 80 cm in women and >90 cm in men).

<sup>b</sup> ATP III 2001 definition (WC > 88 cm in women and >102 cm in men).

and 91.2 cm for men. Moreover, current standard definitions of abdominal obesity may overestimate the prevalence of MetS, particularly in Latin American women.

### Conflicts of interest

The authors have no conflict of interest.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.dsx.2019.01.013>.

### References

[1] Alberti KG, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JJ, Donato KA, et al.

- International diabetes federation task force on epidemiology and prevention.; national heart, lung, and blood institute.; American heart association.; world heart federation.; international atherosclerosis society.; international association for the study of obesity. 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;120:1640–5.
- [2] Ford ES. Risks for all-cause mortality, cardiovascular disease, and diabetes associated with the metabolic syndrome: a summary of the evidence. *Diabetes Care* 2005;28:1769–78.
- [3] Orces CH, Gavilanez EL. The prevalence of metabolic syndrome among older adults in Ecuador: results of the SABE survey. *Diabetes Metab Syndr* 2017;Suppl 2:S555–60.
- [4] Sempértegui F, Estrella B, Tucker KL, Hamer DH, Narvaez X, Sempértegui M, et al. Metabolic syndrome in the elderly living in marginal peri-urban communities in Quito, Ecuador. *Public Health Nutr* 2011;14:758–67.
- [5] Del Brutto OH, Mera RM, Zambrano M. Metabolic syndrome correlates poorly with cognitive performance in stroke-free community-dwelling older adults: a population based, cross-sectional study in rural Ecuador. *Aging Clin Exp Res* 2016;28(321-Suppl 2):S555–60.
- [6] <https://www.idf.org/e-library/consensus-statements/60-idfconsensus-worldwide-definition-of-the-metabolic-syndrome>. Accessed on September 2018.
- [7] Grundy SM, Cleeman JJ, Daniels SR, Donato KA, Eckel RH, Franklin BA, et al. American heart association; national heart, lung, and blood institute. Diagnosis and management of the metabolic syndrome: an American heart association/national heart, lung, and blood institute scientific statement. *Circulation* 2005;112:2735–52.
- [8] Aschner P, Buendía R, Brajkovich I, Gonzalez A, Figueredo R, Juarez XE, Uriza F, Gomez AM, Ponte CI. Determination of the cutoff point for waist circumference that establishes the presence of abdominal obesity in Latin American men and women. *Diabetes Res Clin Pract* 2011;93:243–7.
- [9] Aschner P, Ruiz A, Balkau B, Massien C, Haffner SM. Latin America and the caribbean international day for evaluation of abdominal adiposity (IDEA) national coordinators and investigators. Association of abdominal adiposity with diabetes and cardiovascular disease in Latin America. *J Clin Hypertens (Greenwich)* 2009;11:769–74.
- [10] <http://www.ecuadorencifras.gob.ec/encuesta-de-salud-bienestar-del-adulto-mayor/Accessed October 2018>.
- [11] Menke A, Casagrande S, Geiss L, Cowie CC. Prevalence of and trends in diabetes among adults in the United States, 1988–2012. *JAMA* 2015;314:1021–9.
- [12] Expert Panel on detection and treatment of high blood cholesterol in adults. Executive summary of the second report of the 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). *JAMA* 2001;285:2486–97.
- [13] Ruopp MD, Perkins NJ, Whitcomb BW, Schisterman EF. Youden Index and optimal cut-point estimated from observations affected by a lower limit of detection. *Biom J* 2008;50:419–30.
- [14] Blümel JE, Legorreta D, Chedraui P, Ayala F, Bencosme A, Danckers L, et al. Collaborative Group for Research of the Climacteric in Latin America (RED-LINC). Optimal waist circumference cutoff value for defining the metabolic syndrome in postmenopausal Latin American women. *Menopause* 2012;19:433–7.
- [15] Torres-Valdez M, Ortiz-Benavides R, Siguenza-Cruz W, Ortiz Benavides A, Anez R, Salazar J, Rojas J, et al. Punto de corte de circunferencia abdominal para el agrupamiento de factores de riesgo metabólico: una propuesta para la población adulta de Cuenca, Ecuador. *Rev Argent Endocrinol Metab* 2016;53:43–76.
- [16] Kim HR, Kim HS. Optimal cutoffs of cardiometabolic risk for postmenopausal Korean women. *Asian Nurs Res (Korean Soc Nurs Sci)* 2017;11:107–12.
- [17] Liu P, Ma F, Lou H, Zhu Y. Utility of obesity indices in screening Chinese postmenopausal women for metabolic syndrome. *Menopause* 2014;21:509–14.
- [18] Narisawa S, Nakamura K, Kato K, Yamada K, Sasaki J, Yamamoto M. Appropriate waist circumference cutoff values for persons with multiple cardiovascular risk factors in Japan: a large cross-sectional study. *J Epidemiol* 2008;18:37–42.
- [19] Orces CH, Montalvan M, Tettamanti D. Prevalence of abdominal obesity and its association with cardio metabolic risk factors among older adults in Ecuador. *Diabetes Metab Syndr* 2017;11(Suppl 2):S727–33.
- [20] Rojas R, Aguilar-Salinas CA, Jiménez-Corona A, Shamah-Levy T, Rauda J, Avila-Burgos L, et al. Metabolic syndrome in Mexican adults: results from the national Health and nutrition survey 2006. *Salud Publica Mex* 2010;52(Suppl 1):S11–8.
- [21] <http://www.ecuadorencifras.gob.ec/Accessed December 2018>.
- [22] Smith U. Abdominal obesity: a marker of ectopic fat accumulation. *J Clin Invest* 2015;125:1790–2.