Waist circumference, body mass index, and disability among older adults in Latin American and the Caribbean

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Abstract

Purpose—To examine the association between waist circumference (WC) and body mass index (BMI) on disability among older adults from Latin America and the Caribbean.

Methods—Cross-sectional, multicenter city study of 5,786 subjects aged 65 years and older from the Health, Well-Being and Aging in Latin America and the Caribbean Study (SABE) (1999-2000). Sociodemographic variables, smoking status, medical conditions, BMI, WC, and activities of daily living (ADL) were obtained.

Results—Prevalence of high WC (>88 cm) in women ranged from 48.5% (Havana) to 72.7% (Mexico City), while among men (>102 cm) it ranged from 12.5% (Bridgetown) to 32.5% (Santiago). The associations between WC and ADL disability were "J" shaped, with higher risks of ADL disability observed above 110 cm for women in Bridgetown, Santiago, Havana, and Montevideo. The association in Sao Paulo is plateau with higher risk above 100 cm, and the association in Mexico City is closer to linear. Among men the associations were "U" (Bridgetown, Sao Paulo, and Havana), "J" shaped (Montevideo), plateau (Santiago), and closer to linear in Mexico City (Figure 3). When WC and BMI were analyzed together, we found that participants from Sao Paolo, Santiago, Havana, and Montevideo in the overweight or obese category with high WC were significantly more likely to report ADL disability after adjusting for all covariates.

Conclusion—The findings of this study suggests that both general and abdominal adiposity are associated with disability and support the use of WC in addition to BMI to assess risk of disability in older adults.

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Keywords

Obesity; body mass index; waist circumference; disability; older adults; Latin America; the Caribbean

1. Introduction

The proportion of older adults has been growing dramatically in the Latin American and Caribbean (LAC) countries during the few decades, and this region now has one of the most rapidly aging populations in the developing nations (Filozof et al., 2001; Santos et al., 2004). The percentage of individuals 65 years and over in the region is projected to increase from 13.9% in 2020 to 25.6% in 2040 (Kinsell k & He W, 2009). The increase in the prevalence of obesity in this aging population is a public health concern, not only in these developing countries but also in developed countries (Filozof et al., 2001). The prevalence of obesity in LAC countries when assessed by body mass index (BMI), calculated as weight in kilograms divided by height in meters squared, ranges from 13.3% to 37.6% (Al Snih et al., 2010). The rise of this trend towards obesity is expected to cause a subsequent increase in many chronic diseases, which in turn would result in an increase in disability rates (Guallar-Castillon et al., 2007; Uauy, Albala, & Kain, 2001).

Several studies have shown that body composition changes with aging, as evidenced by an increase in fat mass and a decrease in muscle mass (Villareal et al., 2005; Zamboni et al., 2005); and that aging is associated with fat redistribution, indicated by an increase in visceral fat and a decrease in subcutaneous fat in the abdomen, thighs and calves (Zamboni et al., 2005). BMI has often been criticized as an inadequate measure of obesity among older adults due to these age-related changes in body composition (Villareal et al., 2005; Zamboni et al., 2005). Waist circumference (WC), a measure of visceral fatness, has been recommended as a better predictor of obesity in older adults (Chen & Guo, 2008; Guallar-Castillon et al., 2007; Visscher et al., 2001).

Several studies have compared the individual and combined effect of BMI and WC on health outcomes in older adults (Angleman et al., 2006; Guallar-Castillon et al., 2007; Jacobs et al., 2010; Janssen et al., 2005). Findings from the Cardiovascular Health Study showed that WC was a positive predictor of mortality independent of BMI (Janssen et al., 2005). Similarly, Jacobs et al., using the Cancer Prevention Study II Nutrition Cohort, found that within all categories of BMI, higher WC was positively associated with mortality (Jacobs et al., 2010). Barcelo et al. reported that WC was more clearly associated than BMI with prevalence of diabetes (Barcelo et al., 2007). Cross-sectional and longitudinal studies have shown that WC is a better predictor of disability than BMI. For example, in a prospective cohort study of elderly Spanish individuals, WC was a better 2-year predictor of disability, independent of BMI (Guallar-Castillon et al., 2007). Angleman et al. found that WC was the best predictor of disability outcomes compared with BMI, weight, hip circumference and waist-hip ratio (Angleman et al., 2006).

Current guidelines with respect to obesity recommend measuring WC in persons with a BMI between 25 and 35 kg/m^2 using the cutoff points of 102 cm in men and 88 cm in women to define abdominal obesity and identify persons at risk for disease (National Heart, 2002). Little is known about the association between high WC and disability among older adults in Latin America and the Caribbean. The objectives of this study are to investigate the association between high waist circumference and disability, and the association of the combined effect of BMI and WC on disability among older adults from six Latin American

cities participating in the Health, Well-Being and Aging in Latin America and the Caribbean (SABE) study.

2. Material and Methods

2.1. Sample

We examined data from the Health, Well-Being and Aging in Latin America and the Caribbean Study (SABE) (Albala et al., 2005). The SABE study is a cross-sectional representative survey of non-institutionalized older adults living in Buenos Aires (Argentina), Bridgetown (Barbados), Sao Paulo (Brazil), Santiago (Chile), Havana (Cuba), Mexico City (Mexico) and Montevideo (Uruguay) (Palloni et al., 2002; Peláez M, 2003). Participants were selected based on a multistage cluster sampling design. In each city, the primary sampling unit (PSU) was a cluster of independent households within predetermined geographic areas. In all countries, except Barbados and Brazil, the sample was chosen in three selection stages. In Barbados and Brazil, two selection stages were used. Each sample consisted of between 1,500 and 2,000 individuals aged 60 and older and their spouses. In total, 10,970 elderly men and women were interviewed during 1999-2000. The objective of SABE was to produce databases to evaluate demographic, socioeconomic and health variables related to the emerging older population. Participants from Argentina were not included in our analyses since anthropometric measures (BMI and WC) were not collected. The response rate for the countries varied from 65.3% in Montevideo to 95.3% in Havana, and the percentage of interviews completed by a proxy varied from 1.4% in Montevideo to 13.1% in Sao Paulo (Palloni et al., 2002).

We analyzed data from the SABE study for six countries and for subjects 65 years and older (N = 5,786). We included participants with complete measures of disability, BMI, WC, and relevant covariates. From the 7,371 interviewed 1,585 participants were excluded: 1,236 had missing information on BMI or a BMI <18.5 kg/m2, 68 had missing data on WC or WC <50 cm or WC >140 cm, and 281 had missing information on covariates. The 1,585 participants excluded were older, more likely to be female or unmarried, current smokers, subjects who had had a stroke or had ADL disability.

The final number of samples included in the analyses was 994 (Bridgetown), 1,285 (Sao Paulo), 844 (Santiago), 1,073 (Havana), 675 (Mexico City) and 915 (Montevideo), for a total of 5,786 participants (Women=3,648 and Men=2,138).

2.2. Measurements

2.2.1. Disability—Disability was assessed using the *Katz Activities of Daily Living* (ADL) scale (Katz et al., 1963). Interviewers asked if participants experienced difficulty or needed assistance performing the following activities: walking across a small room, bathing, dressing, eating, getting in and out of the bed, and using the toilet. ADL limitations were dichotomized as having difficulty or no difficulty in performing one or more of the six activities.

2.2.2. Body Mass Index (BMI)—BMI was computed by dividing weight in kilograms by height in meters squared (kg/m^2). BMI was grouped according to the following standards of the National Institute of Health (NIH) (National Heart, 2002): (<18.5 = underweight, 18.5–24.9 = normal weight, 25.0–29.9 = overweight, 30.0–34.9 = obesity category I, 35.0–39.9 = obesity category II, and 40.0 = extreme obesity). For the analyses, a BMI of 18.5 to 24.9 kg/m^2 (normal weight) was used as the reference category.

2.2.3. Waist circumference (WC)—WC was measured at the level of the umbilicus (i.e., belly button) with the subject standing and wearing no more than one layer of outer clothing, using a non-stretchable measuring tape and recorded in centimeters to the nearest millimeter. WC was dichotomized according to NIH recommendations (men, low WC 102 cm and high WC >102 cm; women, low 88 cm and high WC >88 cm) (National Heart, 2002).

2.2.4. Covariates—Sociodemographic variables included age (continuous), gender, years of formal education (continuous) and marital status (married = 1, not married/widowed/ separated = 0). Smoking status was assessed by asking whether participants were current smokers, former smokers or never smokers. The presence of medical conditions was assessed by asking if participants had ever been told by a doctor or nurse that they had arthritis, diabetes, heart attack, hypertension, stroke or cancer.

2.2.5. Statistical Analysis—Participant characteristics were stratified by country and gender, and examined using descriptive statistics. Univariate comparisons based on continuous variables were conducted with one-way analysis of variance and comparisons involving categorical variables with chi-square tests. Participants were grouped into six categories according to BMI and WC (low or high). Normal BMI (18.5 to <25 kg/m^2 and low WC (102 cm in men and 88 cm in women) or high WC (102 cm in men and 88 cm in women); overweight (BMI of 25 to <30 kg/m^2) and low or high WC; and obesity (BMI 30 kg/m^2) and low or high WC.

We examined the association between WC and ADL disability after controlling for all covariates by weighted logistic regression models with restricted cubic splines using three knots (Figure 2 and 3) (Marsh, 1986; Marsh & Cormier, 2001). This method is more flexible in estimating nonlinear association between WC and ADL disability (Marsh, 1986; Marsh & Cormier, 2001). The log likelihood ratio test was used to examine whether each cubic spline significantly predict ADL disability by country and gender.

Weighted logistic regression analysis was used to investigate the association between BMI and WC with ADL disability for each country. Two models were performed. Model 1 included BMI + WC, age and gender; and Model 2 included marital status, education, smoking status and medical conditions along with variables included in Model 1. Interaction effect analyses between BMI and WC, and BMI, WC, and gender were performed All analyses were performed using the SAS for Windows 9.2 survey procedures (PROC SURVEYFREQ, PROC SURVEYLOGIST) (SAS Institute, Cary, NC) to account for design effects and sampling weight in the SABE Study.

3. Results

Table 1 presents the descriptive characteristics for older women by WC (low 88 and high > 88 cm) for each city. The prevalence of high WC ranged from 48.5% (Havana) to 72.7% (Mexico City). Women with high WC were younger than those with low WC across all cities. Women from Mexico City and Montevideo who had high WC were significantly more likely to have lower level of education, and those from Havana and Montevideo were significantly more likely to be married when compared with those with low WC. The prevalence of ADL disability among those with high WC ranged from 15.7% (Bridgetown) to 28.3% (Santiago). The mean of BMI ranged from 28.9 kg/m^2 (Havana) to 31.2 kg/m^2 (Bridgetown and Montevideo), and the mean of WC ranged from 97.9 cm (Havana) to 101.6 cm (Sao Paulo) among those with high WC. Obesity (BMI 30 kg/m^2) was prevalent among all women with high WC. Arthritis, diabetes, and hypertension were significantly more likely to be reported among those with high WC when compared with those with low WC.

Table 2 presents the descriptive characteristics for older men by WC (low 102 and high > 102 cm) for each city. The prevalence of high WC ranged from 12.5% (Bridgetown) to 32.5% (Santiago). The prevalence of ADL disability among those with high WC ranged from 14.3% (Bridgetown) to 27.3% (Santiago). The mean of BMI ranged from 27.2 kg/m^2 (Montevideo) to 31.4 kg/m^2 (Bridgetown), and the mean of WC ranged from 101.6 cm (Sao Paulo) to 112.7 cm (Montevideo) among those with high WC. Obesity (BMI 30 kg/m2) was prevalent among all men with high WC. Men from Sao Paulo with high WC were significantly more likely to report diabetes, and men in Santiago and Havana were significantly more likely to report hypertension when compared with those with low WC.

The percent of participants with ADL disability by WC (low or high) and BMI categories after adjusting for sampling weights and design effects for each city is shown in Figure 1. Percent of ADL disability among those with high WC and normal weight ranged from 8.7% (Bridgetown) to 37.2% (Mexico City). Percent of ADL disability among those with high WC and overweight ranged from 17.9% (Bridgetown) to 28.9% (Santiago). Percent of ADL disability among those with high WC and obesity ranged from 14.5% (Bridgetown) to 27.0% (Santiago).

Figure 2 shows the adjusted probability of ADL disability as a function of WC. The associations between WC and ADL disability were "J" shaped, with higher risks of ADL disability observed above 110 cm for women from Bridgetown, Santiago, Havana, and Montevideo. The association for Sao Paulo is plateau with higher risk above 100 cm while the association for Mexico City is closer to linear. Among men the associations between WC and ADL disability were "U" (Bridgetown, Sao Paulo, and Havana), "J" shaped (Montevideo), plateau (Santiago), and closer to linear in Mexico City (Figure 3). All the associations were significant (p-value < 0.05) except for men from Santiago.

Table 3 presents the odds ratio for ADL disability as a function of WC and BMI category. Overweight or obese participants with high WC from Sao Paulo, Santiago, Havana, and Montevideo were significantly more likely to report ADL disability after adjusting for age and gender (Model 1). When education, marital status, smoking status, and medical conditions were added to Model 1, the association remained statistically significant except for Santiago (Model 2). No significant association was found between high WC and BMI category among participants from Bridgetown and Mexico City. No significant interaction effects were found between BMI and WC, and between BMI, WC, and gender.

4. Discussion

This study examined the prevalence of high WC (> 88 cm in women and > 102 cm in men) and the combined effect of BMI and WC on ADL disability among older adults from six Latin American and Caribbean cities. The highest prevalence of high WC was found in Mexico City for women and Santiago for men. The highest prevalence of ADL disability among those with high WC was seen in men and women from Santiago. The association between WC and ADL disability were mostly "J" shaped among women and "U" or "J" shaped among men. When examining the combined effect of BMI and WC on ADL disability, we found that overweight or obese participants with high WC from Sao Paulo, Santiago, Havana, and Montevideo were significantly more likely to report ADL disability.

These findings are consistent with previous research showing that high WC is significantly associated with disability among older adults (Chen & Guo, 2008; Guallar-Castillon et al., 2007; Janssen et al., 2005). Data from a cross-sectional study of elderly Hispanics in Massachusetts demonstrated a relationship between greater WC and higher frequency of ADL limitations (Chen & Guo, 2008). Guallar-Castillion *et al.* found an association between

WC and self-reported disability, independent of BMI, among people aged 60 years and over in a longitudinal study in Spain (Guallar-Castillon et al., 2007).

The increase of obesity in older adults is a public health concern in the region of Latin America and the Caribbean because this trend may lead to a subsequent increase in many chronic diseases, which, in turn, would result in a dramatic increase in functional disabilities (Guallar-Castillon et al., 2007; Uauy et al., 2001). **As people grow old, muscle mass and strength** decrease, and body fat increases (National Heart, 2002). Moreover, obesity including overweight is likely to cause pain on weight-bearing, limiting older people's ability to exercise continually, and regularly (Houston et al., 2009). Also, metabolic abnormalities in obesity lead to higher rate of cardiovascular disease (CVD), diabetes, and arthritis, all associated with higher risk of disability (Houston et al., 2009).

BMI has usually been the measurement indicator when examining the relationship between obesity and disability. However, WC alone or combined with BMI should be considered as another predictor of disability in the older adult population. A high WC is one of the primary risk factors for Type 2 diabetes, dyslipidemia, hypertension, and CVD particularly in overweight and obese people (National Heart, 2002; Kuczmarski et al., 1997; Chan et al., 1994; Zhu et al., 2004). WC is the measurement of sagittal abdominal diameter, which offers higher precision and better correlation with CVD risk factors and comorbidities, independently of BMI (National Heart, 2002; Turcato et al., 2000). WC and BMI as a combined obesity marker for the older population could offer a measurement for use in research and clinical settings, linking obesity to disability and other health outcomes.

Our study has some limitations. First, this research could not investigate the causal relationship between high WC and ADL disability due to the cross-sectional research design. Second, since disability and medical conditions were self-reported; matters of recall bias may be an issue, particularly for older adult participants. However, other investigators have found good agreement between self-reported medical events and comorbid diseases or conditions (Haapanen et al., 1997; Simpson et al., 2004). Fourth, exclusion of participants with missing information could underestimate the effect of WC on disability. Despite these limitations, this study has several strengths. First, the survey data in six capital cities was from a large well-defined organized sample. Survey measurements were consistent across all cities, allowing for direct comparisons. Although different groups of interviewers implemented this survey, all had consistent and uniform training in data collection and measurement procedures in each city for assessment of BMI, WC, and disability. Second, this research was generalizable to all older adults in the cities of origin in Latin America and the Caribbean because most of the older adults in these areas live in urban settings (Economic Commission for Latin America and the Caribbean, 2004).

5. Conclusions

We found a "J" or "U" shaped association between WC and ADL disability; and that overweight and obese participants with high WC have significant odds of ADL disability. The findings of this study suggests that both general and abdominal adiposity are associated with disability and support the use of WC in addition to BMI to assess risk of disability in older adults.

Acknowledgments

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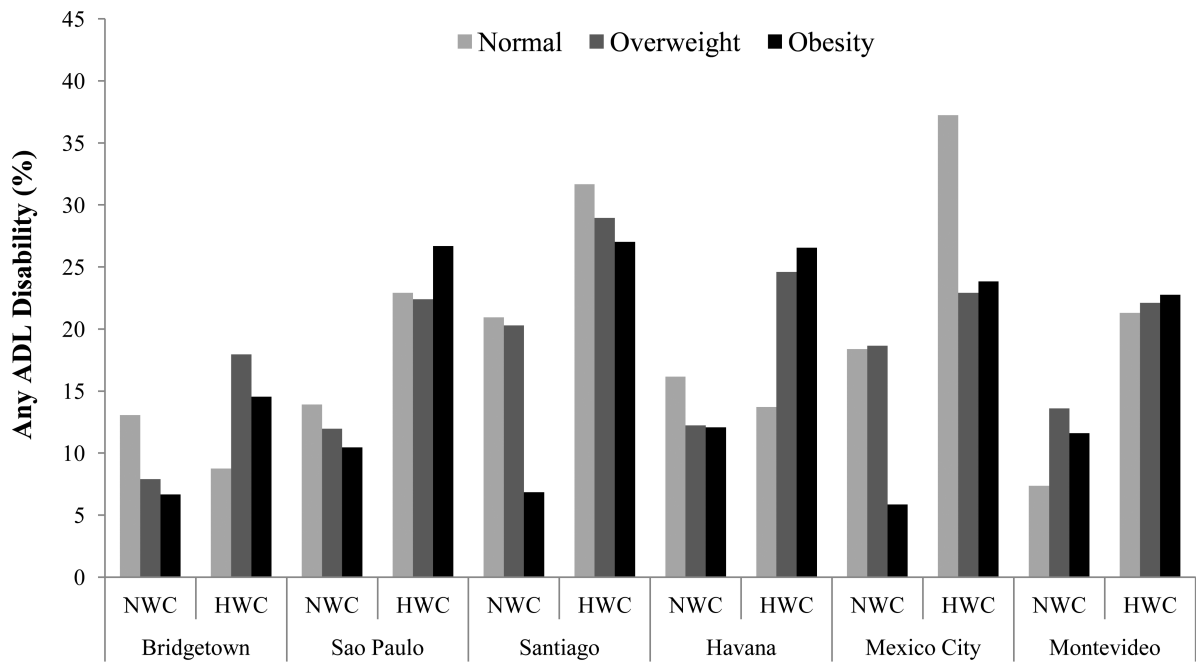
Note: SABE = Health, Well-Being and Aging in Latin America and the Caribbean

Percents were obtained after adjusting for sampling weights and design effects used in SABE study

LWC = Waist circumference ≤88 cm in women and ≤102 cm in men; HWC = High waist circumference >88 cm in women and >102 cm in men

Norma l = BMI of 18.5 to <25 kg/m^2; Overweight = BMI of 25 <30 kg/m^2 Obesity = BMI ≥30 kg/m^2

Figure 1.
Percentage of persons with ADL disability by BMI and WC among older adults living in Latin American and the Caribbean (N = 5786).
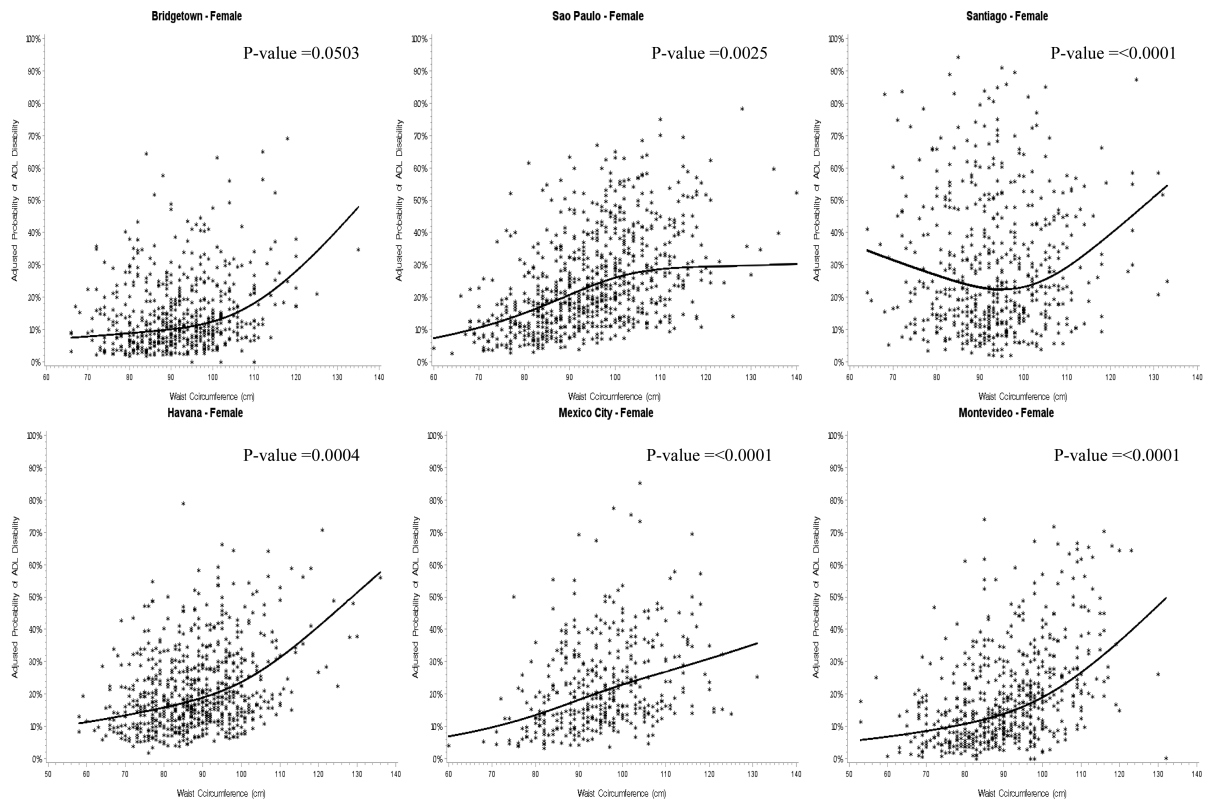
Note: WC=Waist Circumference; ADL= Activities of Daily Living; SABE = Health, Well-Being and Aging in Latin America and the Caribbean.

Analyses were controlled by age, marital status, education, smoking status, and medical conditions (arthritis, diabetes, heart attack, stroke, hypertension, and cancer) using sampling weights and design effects for SABE studies.

The adjusted probability of ADL as a function of WC for each city were derived from restricted cubit spline regression, with knots placed at 83.3, 100.5, 117.8 (Bridgetown); 80.0, 100.0, 120.0 (Sao Paulo); 81.3, 98.5, 115.8 (Santiago); 77.5, 97.0, 116.5 (Havana); 77.8, 95.5, 113.3 (Mexico City); 72.8, 92.5, 112.3 (Montevideo).

Figure 2.
Adjusted probability of ADL disability as a function of WC for older women living in Latin American and the Caribbean (N =3648).
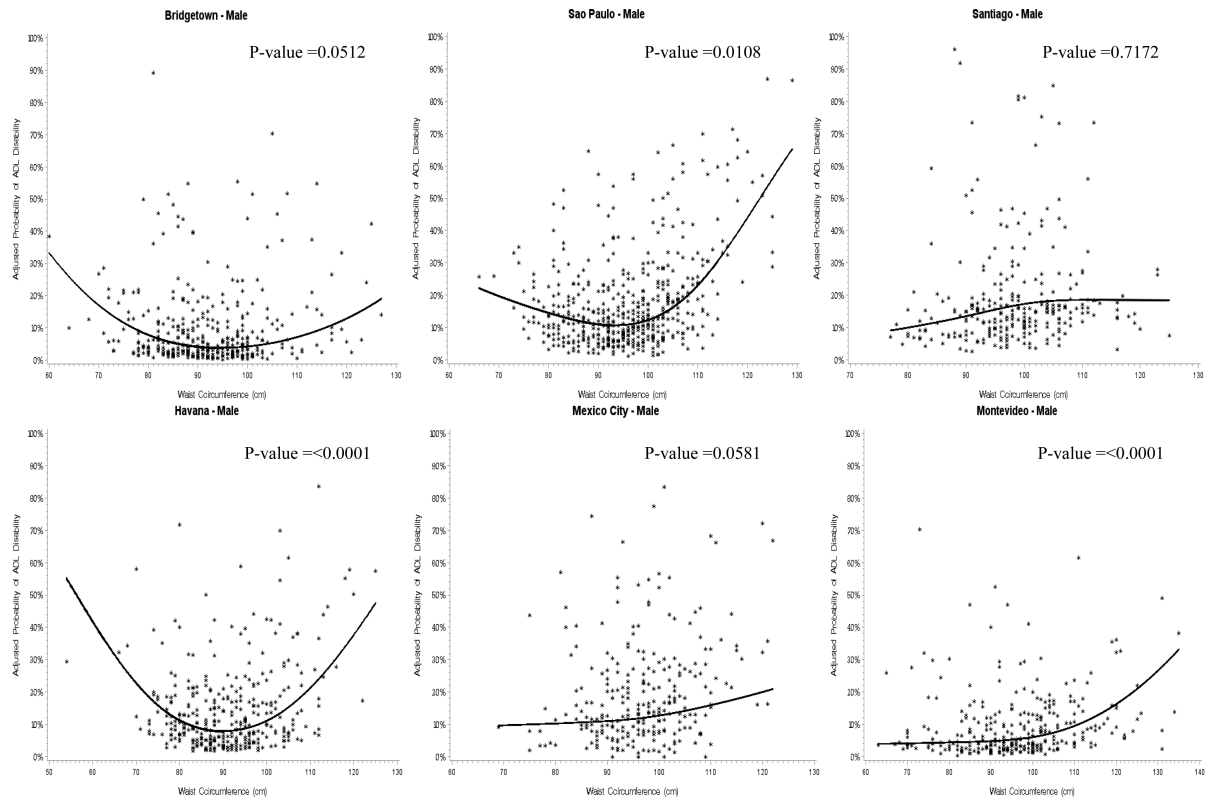
Note: WC=Waist Circumference; ADL= Activities of Daily Living; SABE = Health, Well-Being and Aging in Latin America and the Caribbean.

Analyses were controlled by age, marital status, education, smoking status, and medical conditions (arthritis, diabetes, heart attack, stroke, hypertension, and cancer) using sampling weights and design effects for SABE studies.

The adjusted probability of ADL as a function of WC for each city were derived from restricted cubit spline regression, with knots placed at 76.8, 93.5, 110.3 (Bridgetown); 81.8, 97.5, 113.3 (Sao Paulo); 89.0, 101.0, 113.0 (Santiago); 71.8, 89.5, 107.3 (Havana); 82.3, 95.5, 108.5 (Mexico City); 81.0, 99.0, 117.0 (Montevideo).

Figure 3.
Adjusted probability of ADL disability as a function of WC for older men living in Latin American and the Caribbean (N =2138).

Table 1

Descriptive characteristics for older female living in Latin America and the Caribbean by waist circumference (WC) (N =3648)

Variables	Bridgetown N=601 n (%)		Sao Paulo N=768 n (%)		Santiago N=563 n (%)		Havana N=718 n (%)		Mexico City N=411 n (%)		Montevideo N=587 n (%)	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Total	222 (37.0)	379 (63.0)*	253 (34.8)	515 (65.2)	186 (35.7)	377 (64.3)	369 (51.5)	348 (48.5)	109 (27.3)	302 (72.7)	258 (41.6)	329 (58.4)
Age (years), Mean (SE)	76.0 (0.5)	74.1 (0.3)†	72.3 (0.5)	72.8 (0.4)	74.2 (0.5)	73.8 (0.5)	75.8 (0.5)	73.3 (0.4)*	73.5 (0.7)	73.2 (0.4)	74.5 (0.5)	72.5 (0.3)†
Education (years), Mean (SE)	5.1 (0.2)	5.2 (0.2)	3.0 (0.3)	2.5 (0.2)	6.3 (0.6)	5.4 (0.6)	6.2 (0.2)	6.5 (0.2)	4.6 (0.4)	3.5 (0.2)‡	6.1 (0.3)	5.7 (0.3)*
Married marital status (married)	55 (24.6)	86 (22.6)	91 (42.8)	164 (33.7)	44 (38.0)	101 (37.8)	41 (11.1)	66 (19.5)†	37 (34.2)	102 (34.0)	66 (25.8)	119 (35.7)‡
Smoking status				†								
Never	202 (91.0)	346 (91.3)	192 (74.1)	384 (72.0)	121 (64.9)	248 (66.2)	252 (66.7)	238 (67.7)	83 (75.4)	244 (80.7)	202 (79.8)	250 (76.7)
Former	20 (9.0)	29 (7.6)	30 (11.5)	96 (20.1)	43 (26.0)	108 (28.0)	49 (14.2)	61 (18.0)	17 (16.0)	43 (14.3)	29 (11.8)	57 (16.7)
Current	0 (0.0)	4 (1.1)	31 (14.3)	35 (7.9)	22 (9.1)	21 (5.8)	68 (19.1)	50 (14.3)	9 (8.6)	15 (5.0)	27 (8.5)	22 (6.6)
BMI (kg/m²), Mean (SE)	24.1 (0.3)	31.2 (0.4)*	23.4 (0.1)	29.7 (0.3)*	24.5 (0.4)*	30.5 (0.4)	23.2 (0.2)	28.9 (0.4)*	23.6 (0.2)	29.9 (0.2)*	28.8 (0.4)	31.2 (0.4)*
BMI (kg/m²) category		*		*		*		*		*		†
18.5 - <25	146 (66.1)	40 (10.7)	3 (3.2)	50 (9.9)	99 (51.4)	26 (6.4)	257 (71.4)	48 (12.8)	73 (67.9)	28 (9.5)	80 (28.4)	49 (15.2)
25- <30	58 (25.9)	143 (37.8)	79 (51.9)	230 (42.8)	78 (43.9)	159 (42.2)	98 (25.3)	176 (49.6)	36 (32.1)	128 (42.7)	83 (33.5)	99 (28.5)
30	18 (8.0)	196 (51.5)	53 (44.9)	235 (47.3)	9 (4.7)	192 (51.4)	14 (3.2)	125 (37.6)	0 (0.0)	146 (47.8)	95 (38.0)	181 (56.3)
WC (cm), Mean (SE)	81.3 (0.3)	98.7 (0.4)*	80.8 (0.4)	101.6 (0.6)*	81.4 (0.5)	99.5 (1.0)*	79.2 (0.3)	97.9 (0.4)*	82.0 (0.5)	100.0 (0.5)*	78.9 (0.5)	99.5 (0.5)*
Any ADL limitation	31 (14.2)	59 (15.7)	41 (14.2)	143 (25.1)†	53 (26.2)	121 (28.3)	72 (18.2)	81 (23.6)	17 (17.1)	73 (25.5)	39 (14.7)	72 (24.1)‡
Medical conditions												
Arthritis	113 (51.1)	248 (65.5)†	92 (37.0)	253 (48.7)†	70 (37.2)	173 (47.1)‡	230 (60.5)	258 (73.1)†	39 (36.7)	98 (32.3)	126 (52.1)	196 (59.7)‡
Diabetes	36 (16.3)	104 (27.5)†	30 (11.8)	116 (23.1)†	18 (8.8)	60 (16.9)‡	56 (16.5)	92 (25.8)‡	20 (17.5)	65 (21.1)	26 (11.4)	58 (18.3)‡
Hypertension	109 (48.8)	225 (59.3)‡	124 (46.8)	339 (65.8)†	97 (46.3)	225 (59.8)†	153 (42.4)	196 (55.8)†	51 (46.8)	168 (55.6)	101 (39.7)	186 (56.9)†
Stroke	9 (4.2)	23 (6.1)	8 (3.2)	32 (5.8)	11 (6.0)	23 (6.5)	32 (8.9)	35 (9.9)	7 (6.5)	19 (6.7)	11 (4.4)	6 (1.7)
Heart attack	22 (9.9)	53 (13.9)	45 (15.4)	128 (24.3)‡	68 (37.5)	139 (35.6)	89 (23.4)	118 (34.6)†	12 (11.5)	36 (12.0)	66 (28.7)	73 (22.1)
Cancer	5 (2.1)	15 (3.9)	9 (2.4)	21 (4.0)	10 (6.3)	17 (4.4)	18 (5.1)	6 (1.7)‡	3 (2.8)	5 (1.5)	17 (6.8)	19 (6.3)

Note: Low WC 88 cm and High WC > 88 cm. Means and Percents were obtained after adjusting for sampling weights and design effects used in SABE study

P-values denote differences between subjects with low and high waist circumference for each SABE study

ADL = Activities of Daily Living; SABE = Health, Well-Being and Aging in Latin America and the Caribbean; BMI = Body Mass Index

*
P-value <0.0001

†
p-value < 0.001

‡
p-value < 0.01

Table 2

Descriptive characteristics for older male living in Latin America and the Caribbean by waist circumference (WC) (N=2138)

Variables	Bridgetown N= 393 n (%)		Sao Paulo N=517 n (%)		Santiago N=281 n (%)		Havana N=355 n (%)		Mexico City N=264 n (%)		Montevideo N=328 n (%)	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Total	343 (87.5)	50 (12.5) *	382 (75.0)	135 (25.0) *	192 (67.5)	89 (32.5) *	302 (84.8)	53 (15.2) *	197 (74.2)	67 (25.8) *	242 (73.4)	86 (26.6) *
Age (years), Mean (SE)	74.1 (0.4)	73.0 (0.8)	72.5 (0.5)	72.0 (0.9)	73.3 (0.7)	72.4 (0.6)	73.8 (0.4)	72.4 (0.8)	72.5 (0.4)	72.6 (0.7)	72.5 (0.4)	72.9 (0.7)
Education (years), Mean (SE)	5.1 (0.2)	6.7 (0.6)	3.5 (0.3)	3.8 (0.5)	7.3 (0.9)	6.1 (0.7)	7.2 (0.3)	7.4 (0.5)	5.4 (0.4)	4.8 (0.7)	6.4 (0.3)	5.8 (0.2)
Married marital status (married)	183 (52.8)	28 (56.2)	288 (80.5)	97 (74.9)	131 (75.5)	61 (77.0)	179 (59.2)	37 (72.8)	143 (73.8)	46 (71.6)	171 (71.0)	57 (68.8)
Smoking status				‡								†
Never	149 (43.6)	20 (40.4)	104 (24.7)	38 (29.0)	73 (37.6)	38 (40.8)	79 (24.9)	16 (31.9)	56 (26.8)	21 (30.1)	65 (25.5)	18 (22.4)
Former	146 (42.4)	26 (51.7)	205 (53.4)	86 (61.3)	85 (42.3)	46 (49.0)	101 (36.0)	20 (40.2)	78 (39.5)	30 (44.8)	129 (51.5)	53 (57.4)
Current	48 (14.0)	4 (7.9)	73 (21.9)	11 (9.7)	34 (20.1)	5 (10.3)	122 (39.1)	17 (27.9)	63 (33.7)	16 (25.1)	48 (22.0)	15 (19.9)
BMI (kg/m², Mean (SE)	25.0 (0.3)	31.4 (0.9) *	24.2 (0.2)	29.4 (0.3) *	25.4 (0.3)	30.7 (0.5) *	23.1 (0.2)	28.8 (0.5) *	25.2 (0.2)	30.9 (0.2) *	25.8 (0.3)	27.2 (0.6)
BMI (kg/m²) category		*		*		*		*		*		†
18.5 - <25	205 (60.3)	1 (2.2)	214 (49.9)	3 (3.2)	75 (35.9)	2 (2.8)	215 (71.5)	2 (6.0)	79 (38.3)	1 (1.5)	100 (41.0)	32 (33.5)
25-<30	112 (32.0)	24 (47.1)	160 (47.4)	79 (51.9)	106 (55.1)	34 (34.2)	78 (25.6)	33 (61.1)	105 (55.0)	25 (37.5)	98 (42.4)	26 (29.2)
30	26 (7.7)	25 (50.7)	8 (2.7)	53 (45.0)	11 (9.0)	53 (63.0)	9 (2.9)	18 (32.8)	13 (6.7)	41 (61.0)	44 (16.6)	28 (37.3)
WC (cm), Mean (SE)	89.3 (0.4)	110.8 (1.0) *	91.9 (0.5)	101.6 (0.6) *	93.9 (0.5)	108.8 (0.7) *	88.1 (0.5)	108.5 (0.8) *	93.1 (0.5)	108.5 (0.7) *	90.1 (0.6)	112.7 (1.1) *
Any ADL limitation	30 (8.9)	7 (14.3)	61 (12.16)	40 (22.2)	33 (14.0)	18 (27.3)	38 (11.9)	14 (26.3)	38 (18.4)	14 (20.5)	17 (7.0)	15 (15.2)
Medical conditions												
Arthritis	118 (34.5)	20 (40.2)	78 (21.4)	44 (29.2)	24 (10.3)	19 (23.1)	126 (40.0)	25 (48.1)	30 (15.2)	12 (17.3)	78 (33.3)	30 (34.3)
Diabetes	50 (14.5)	13 (25.9)‡	53 (15.0)	38 (30.7)†	25 (11.6)	12 (11.3)	23 (7.0)	8 (13.3)	48 (23.8)	16 (24.8)	26 (10.9)	14 (20.6)
Hypertension	132 (38.3)	26 (51.0)	168 (47.1)	76 (57.7)	77 (35.3)	57 (66.3)‡	100 (33.2)	23 (43.3)†	63 (32.3)	22 (35.6)	86 (33.8)	42 (47.5)
Stroke	15 (4.6)	8 (15.7)†	35 (9.1)	8 (3.6)	13 (4.8)	4 (8.5)	34 (10.9)	5 (7.9)	12 (6.1)	3 (4.7)	10 (4.7)	1 (0.7)
Heart attack	43 (12.4)	11 (21.5)	82 (19.0)	36 (8.6)	58 (28.8)	29 (34.7)	56 (20.5)	16 (32.4)	22 (10.9)	6 (10.0)	68 (27.9)	25 (28.1)
Cancer	8 (2.2)	3 (6.2)	12 (3.6)	4 (3.4)	9 (2.63)	0 (0.0)	7 (2.2)	2 (2.9)	4 (2.0)	1 (10)	14 (5.8)	3 (3.4)

Note: Low WC 88 cm and High WC > 88 cm. Means and Percents were obtained after adjusting for sampling weights and design effects used in SABE study

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ADL = Activities of Daily Living; SABE = Health, Well-Being and Aging in Latin America and the Caribbean; BMI = Body Mass Index

P-values denote differences between subjects with low and high waist circumference for each SABE study

*
P-value <0.0001

†
p-value < 0.001

‡
p-value < 0.01

Table 3

Odds ratio of ADL disability as a function of BMI and WC for older adults living in Latin American and the Caribbean (N = 5796).

Variables	Bridgetown N = 994 OR (95 % CI) [a]	Sao Paulo N = 1285 OR (95 % CI) [a]	Santiago N = 844 OR (95 % CI) [a]	Havana N = 1073 OR (95 % CI) [a]	Mexico City N = 675 OR (95 % CI) [a]	Montevideo N = 915 OR (95 % CI) [a]
Model 1						
LWC + Normal BMI	1.00	1.00	1.00	1.00	1.00	1.00
LWC + Overweight	0.74 (0.38-1.45)	1.01 (0.57-1.78)	1.22 (0.77-1.96)	0.81 (0.47-1.38)	1.18 (0.62-2.26)	1.18 (0.62-2.26)
LWC + Obesity	0.60 (0.16-2.20)	0.87 (0.11-6.96)	0.44 (0.07-2.73)	0.77 (0.26-2.27)	0.30 (0.04-2.37)	0.30 (0.37-2.37)
HWC + Normal BMI	0.57 (0.19-1.73)	1.84 (0.83-4.06)	1.66 (0.45-6.14)	0.86 (0.37-1.99)	2.13 (0.81-5.57)	2.13 (0.81-5.57)
HWC + Overweight	1.46 (0.83-2.56)	1.78 (1.14-2.79)	1.55 (0.83-2.87)	1.74 (1.04-2.91)	1.35 (0.74-2.46)	1.35 (0.74-2.46)
HWC + Obesity	1.43 (0.81-2.54)	2.45 (1.56-3.86)	1.68 (1.01-2.80)	2.15 (1.27-3.65)	1.62 (0.89-2.97)	1.62 (0.89-2.97)
Model 2						
LWC + Normal BMI	1.00	1.00	1.00	1.00	1.00	1.00
LWC + Overweight	0.80 (0.41-1.57)	0.97 (0.54-1.76)	1.26 (0.72-2.20)	0.79 (0.45-1.37)	1.24 (0.63-2.45)	1.24 (0.63-2.45)
LWC + Obesity	0.65 (0.17-2.43)	0.66 (0.07-6.09)	0.38 (0.05-2.61)	0.84 (0.30-2.35)	0.20 (0.04-1.05)	0.20 (0.04-1.05)
HWC + Normal BMI	0.59 (0.18-1.84)	2.01 (0.89-4.53)	1.41 (0.32-6.20)	0.74 (0.31-1.76)	1.99 (0.74-5.36)	1.99 (0.74-5.36)
HWC + Overweight	1.26 (0.70-2.28)	1.67 (1.04-2.68)	1.12 (0.56-2.24)	1.58 (0.93-2.68)	1.41 (0.73-2.70)	1.41 (0.73-2.70)
HWC + Obesity	1.21 (0.67-2.21)	1.98 (1.21-3.24)	1.38 (0.76-2.52)	1.95 (1.15-3.31)	1.52 (0.81-2.86)	1.52 (0.81-2.86)

Model 1: Controlled for age and gender

Model 2: Controlled for age, gender, marital status, education, smoking status, and medical conditions (arthritis, diabetes, heart attack, stroke, hypertension, and cancer)

ADL =Activities of daily living; SABE = Health, Well-Being and Aging in Latin America and the Caribbean; BMI = Body mass index; WC = Waist circumference; CI = Confidence Interval

LWC = Low waist circumference 88 cm in women and 102 cm in men

HWC = High waist circumference >88 cm in women and >102 cm in men

Normal BMI = 18.5 to <25 kg/m^2

Overweight = BMI of 25 <30 kg/m^2

Obesity = BMI 30 kg/m^2

[a] Odds ratio and 95% CI were obtained after adjusting for sampling weights and design effects used in SABE study