Anthropometric Indicators in Hypertriglyceridemia Discrimination: Application as Screening Tools in Older Adults

Article *in* Journal of Nursing Measurement · August 2016

DOI: 10.1891/1061-3749.24.2.215

Carlos Alencar Souza Alves Junior
Federal University of Santa Catarina

Raildo da Silva Coqueiro
Universidade Estadual do Sudoeste da Bahia

José Ailton Oliveira Carneiro
State University of Southwest Bahia, UESB, Jequié

Rafael Pereira
Universidade Estadual do Sudoeste da Bahia

JNM

Journal of Nursing Measurement

SPRINGER PUBLISHING COMPANY

www.springerpub.com/jnm

Journal of Nursing Measurement, Volume 24, Number 2, 2016

Anthropometric Indicators in Hypertriglyceridemia Discrimination: Application as Screening Tools in Older Adults

Carlos Alencar Souza Alves Júnior, Lic
Raildo da Silva Coqueiro, MS
José Ailton Oliveira Carneiro, PhD

Núcleo de Estudos em Epidemiologia do Envelhecimento,
Universidade Estadual do Sudoeste da Bahia, Jequié, Brazil

Rafael Pereira, PhD

Universidade Estadual do Sudoeste da Bahia, Jequié, Brazil

Aline Rodrigues Barbosa, PhD

Universidade Federal de Santa Catarina, Florianópolis, Brazil
Núcleo de Estudos em Epidemiologia do Envelhecimento, Jequié, Brazil
Universidade Estadual do Sudoeste da Bahia, Jequié, Brazil

Amélia Cristina Mendes de Magalhães, PhD
Márcio Vasconcelos Oliveira, PhD

Universidade Federal da Bahia, Vitória da Conquista, Brazil

Marcos Henrique Fernandes, PhD

Núcleo de Estudos em Epidemiologia do Envelhecimento,
Universidade Estadual do Sudoeste da Bahia, Jequié, Brazil

Background and Purpose: The use of anthropometric indicators as discriminators of hypertriglyceridemia has not been thoroughly investigated. The purpose of this article is to comparatively evaluate anthropometric indicators as discriminators of hypertriglyceridemia in older Brazilian adults. Methods: This cross-sectional study derived from population-based epidemiological research involving 316 community-dwelling older adults (60–105 years old). Results: Except for the conicity index and the body adiposity index in the group of women, all other anthropometric indicators (i.e., body mass index, waist and calf circumferences, triceps skinfold thickness, and waist–stature and waist–hip ratios) were sufficient to identify hypertriglyceridemia in the population. Conclusions: We endorse anthropometric indicators for use in screening for hypertriglyceridemia in older Brazilian adults.

Keywords: anthropometry; dyslipidemia; health of the elderly; hypertriglyceridemia; obesity

http://dx.doi.org/10.1891/1061-3749.24.2.215

Hypertriglyceridemia, defined as an abnormal concentration of triglycerides in the blood (Pejic & Lee, 2006), results from the accumulation of very low-density lipoproteins (VLDLs) and/or chylomicron in the blood plasma (Xavier et al., 2013). In the Brazil, the prevalence of this form of dyslipidemia is approximately 25% in adults (Garcez, Pereira, Fontanelli, Marchioni, & Fisberg, 2014; Moraes, Checchio, & Freitas, 2013), reaching approximately 41% in the older adults (Coqueiro et al., 2014). Hypertriglyceridemia is considered to be an important public health problem because besides the high prevalence is associated with cardiometabolic disorders (Christian, Bourgeois, Snipes, & Lowe, 2011), diabetes (D'Agostino et al., 2004), pancreatitis (Athyros et al., 2002) and is an independent risk factors for cardiovascular diseases (Abdel-Maksoud, Eckel, Hamman, & Hokanson, 2012), which account for 30% of deaths worldwide (Mendis, Puska, & Norrving, 2011).

Plasma triglyceride levels are determined by several key metabolic pathways, which include the intestinal absorption of dietary fat, chylomicron remnants, production, and hepatic clearance of VLDL, as well as via the remodeling of triglyceride-rich lipoproteins induced by peripheral lipolysis (Hassing et al., 2012). Abnormalities in these pathways may be determined by genetic defects (primary hypertriglyceridemia) or acquired causes (secondary hypertriglyceridemia), such as a high-fat diet, obesity, diabetes, hypothyroidism, and certain medications (Pejic & Lee, 2006).

Among the acquired conditions that influence a lipid profile, the excessive accumulation of body fat is a major factor associated with hypertriglyceridemia in adults and older adults (Karaouzene et al., 2011; Lee et al., 2013). Longitudinal study originated evidence showed that for every increment in body fat mass of 1kg/m^2, there is an increase of approximately 12 mg/dL in the levels of plasma triglycerides of middle-aged adults (Schubert et al., 2006). The increase obesity-induced in levels of triglyceride is because the accumulation of body fat, particularly the visceral type, increases the rate of lipolysis and results in high levels of free fatty acids that contribute to the development of insulin resistance in various tissues. Insulin resistance is the cardinal metabolic defect underlying the early development of obesity-induced hypertriglyceridemia because it interferes with the ability of adipocytes to adequately store excess triglycerides (Subramanian & Chait, 2012).

Several methods exist for assessing body fat mass. Although methods such as dual-energy x-ray absorptiometry, computed tomography, and magnetic resonance imaging are considered to be the most accurate (Heyward, 2001), anthropometry is more applicable to epidemiological research. Anthropometric assessment is a practical and low-cost method (Coqueiro, Barbosa, & Borgatto, 2009) recommended by the World Health Organization (WHO) to evaluate the body fat mass in individuals and populations and can be used in household surveys, clinical practices, and primary health care (WHO, 2000).

The use of anthropometric indicators as discriminators of hypertriglyceridemia has not been thoroughly investigated. In our review of the literature (PubMed, Scopus, CINAHL, Medline, Web of Science, etc.) we found only two studies focused on this subject (Lee et al., 2013; Gharipour et al., 2014). The study by Lee et al. (2013) was conducted with adults ranging in age from 19 to 64 years, and focused on body mass index (BMI) and waist circumference. Gharipour et al. (2014) evaluated older adult men and included only a few indicators (BMI, waist circumference, waist–hip ratio [WHR] and waist–stature ratio [WSR]) in their investigation. Thus, it is possible to conclude that older women have not yet been investigated in this regard. In addition, other important anthropometric indicators have been overlooked. It is important to note that the cutoff values of anthropometric indicators obtained from populations younger than 60 years may not be suitable for older adults. Changes in the amount and distribution of body fat are inherent in the aging process, as are increased visceral fat deposits and decreased subcutaneous fat stores (Coqueiro et al., 2009), which particularize the use of anthropometry in older adults. Likewise, the use of anthropometry should always consider gender, ethnic groups, and populations (de Onis & Habicht, 1996).

Considering the absence of these studies involving Brazilian older adults, the best anthropometric indicators to discriminate hypertriglyceridemia in older adults are not known. Furthermore, it remains to be determined if the predictive ability of these indicators differs according to gender.

Here, we comparatively evaluate anthropometric indicators as discriminators of hypertriglyceridemia in older Brazilian adults of both genders.

METHOD

Setting and Study Population

This study is based on data from an epidemiologic cross-sectional, population-based household survey entitled "Nutritional status, risk behaviors, and health conditions of the older adults of Lafaiete Coutinho-Bahia, Brazil". Details about the location, study population, and the data collection have been previously published (Leal Neto et al., 2013). Briefly, a census was conducted in Lafaiete Coutinho in January 2011 to identify older adults (≥60 years). Their places and their residences were identified using information from The family health strategy, a program that covers the entire county and aims to increase the population's access to primary health care (Brandão, Gianini, Novaes, & Goldbaum, 2011). All older adults residing in urban areas ($N = 355$) were contacted. Of the 355 individuals who comprised the study population, 316 (89%) participated in the study; 17 refusals were recorded (4.8%); and 22 individuals (6.2%) could not be located after three visits on alternate days and were therefore considered to be sample loss. The study was conducted in compliance with the Declaration of Helsinki, and the study purpose and protocol was reviewed and approved by the Research Ethics Committee of the Universidade Estadual do Sudoeste da Bahia (number 064/10). Before the data were collected, the participants signed a consent form acknowledging that they understood the purpose of the study.

Measures

Hypertriglyceridemia. We used the Accutrend Plus system (Roche Diagnostics, Germany) to measure triglycerides after 12 hours of fasting. This technique was previously validated by Coqueiro et al. (2014). We collected capillary blood samples via a transcutaneous puncture on the medial side of the tip of the middle finger using a disposable hypodermic lancet. Prior to puncture, 70% alcohol was applied to promote antisepsis. Hypertriglyceridemia (triglycerides ≥150 mg/dL) was defined according to current Brazilian guidelines (Xavier et al., 2013).

Anthropometric Indicators. We assessed the following anthropometric indicators: BMI (kg/m^2), waist circumference, calf circumference, triceps skinfold thickness (TST), WHR, WSR, conicity index (Valdez, 1991), and body adiposity index (BAI; Bergman et al., 2011).

Details about the procedures and techniques used and the precision and accuracy of the evaluators have been previously published (Coqueiro et al., 2013). Briefly, body mass was measured using a portable digital scale (Zhongshan Camry Electronic, G-Tech Glass 6, China) with the individual having taken his or her shoes off and wearing as little clothing as possible. Stature was measured according to the Frisancho technique (Frisancho, 1984) using a compact portable stadiometer (Wiso, China) installed in a suitable place according to the manufacturer's instructions. TST was measured with an adipometer (WCS, Brazil), according to Harrison et al. (1988). Waist circumference was measured at the level of the umbilical scar; the hip, and calf circumferences were measured as proposed by Callaway et al. (1988) using an anthropometric inelastic tape (ABN, Brazil).

Data Analysis

Absolute and relative frequencies and means and standard deviations were used for descriptive analysis of the sample characteristics. The discriminative ability of anthropometric indicators, as well as their best cutoff points for identifying hypertriglyceridemia, were evaluated using the parameters provided by the receiver operating characteristic (ROC) curve—the area under the ROC curve (AUC), sensitivity, and specificity. The level of significance adopted was 5% ($\alpha = .05$). The data were analyzed using MedCalc (Version 9.1.0.1, 2006).

RESULTS

We analyzed data from 173 women (54.7%) and 143 men (45.3%) ranging in age from 60 to 105 years old ($M = 74.2 \pm 9.8$ years). The mean age of the women was 74.9 ± 10.0 years and the mean age of the men was 73.4 ± 9.4 years. The prevalence of hypertriglyceridemia was 40.6%, and the prevalence was higher in women (47.9%) than in men (31.7%). Anthropometric characteristics, according to gender, are listed in Table 1. The women exhibited higher mean values of BMI, waist circumference, WSR, conicity index, TST, and BAI. However, men exhibited higher mean calf circumference values.

The AUC between anthropometric indicators and hypertriglyceridemia from older adult women is presented in Figure 1. Anthropometric indicators, except for the conicity index and BAI, showed discriminative power for hypertriglyceridemia. For women, the

TABLE 1. Anthropometric Characteristics According to Gender of the Older Adults

	Women	Men	Total
Variable	$M \pm SD$	$M \pm SD$	$M \pm SD$
BMI (kg/m^2)	25.3 ± 4.9	23.7 ± 4.1	24.5 ± 4.7
Waist circumference (cm)	94.7 ± 12.5	89.9 ± 15.1	92.5 ± 13.6
Calf circumference (cm)	32.6 ± 3.5	33.9 ± 3.7	33.2 ± 3.6
WHR	0.97 ± 0.06	0.97 ± 0.14	0.97 ± 0.10
WSR	0.64 ± 0.09	0.56 ± 0.09	0.60 ± 0.10
Conicity index	1.42 ± 0.10	1.34 ± 0.19	1.38 ± 0.16
TST (mm)	20.9 ± 9.4	11.3 ± 5.0	16.3 ± 8.4
BAI	36.0 ± 6.6	27.2 ± 3.9	31.9 ± 7.1

Note. BMI = body mass index; WHR = waist–hip ratio; WSR = waist–stature ratio; TST = triceps skinfold thickness; BAI = body adiposity index.

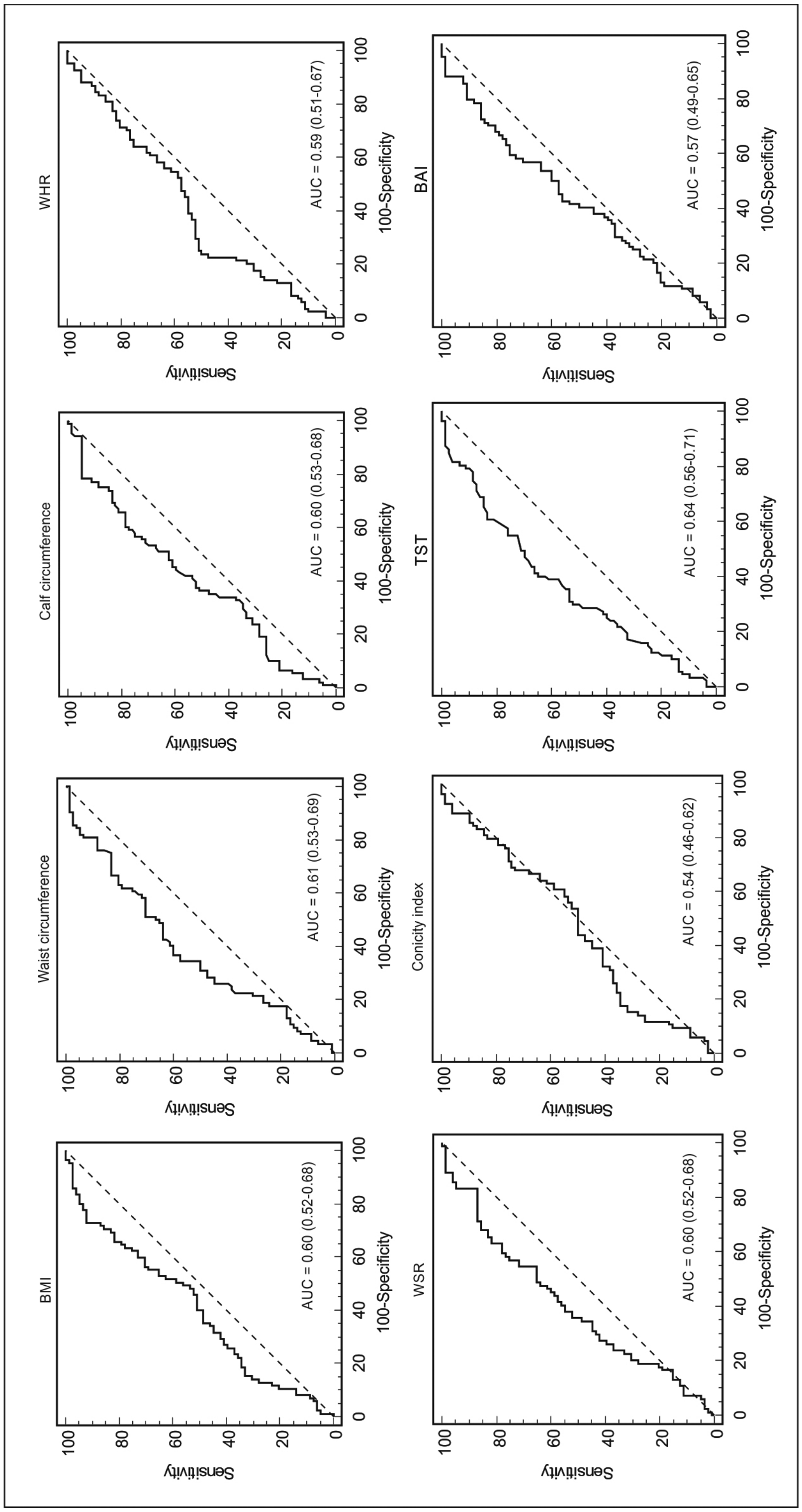

Figure 1. ROC curves of different anthropometric indicators used as discriminators of hypertriglyceridemia in older adult women. BMI = body mass index; AUC = area under the ROC curve; WHR = waist–hip ratio; WSR = waist–stature ratio; TST = triceps skinfold thickness; BAI = body adiposity index.

TABLE 2. Receiver Operating Characteristic Curve Parameters of Different Anthropometric Indicators Used as Discriminators of Hypertriglyceridemia in Older Adults Sorted According to Gender

Variable	AUC [CI, 95%]	Cutoff point	Sensitivity	Specificity
Women				
BMI	0.60 [0.52, 0.68]	20.9	92.3	27.1
Waist circumference	0.61 [0.53, 0.69]	95.0	60.3	63.1
Calf circumference	0.60 [0.53, 0.68]	31.1	78.7	39.8
WHR	0.59 [0.51, 0.67]	0.99	51.3	75.0
WSR	0.60 [0.52, 0.68]	0.58	82.1	36.9
Conicity index	0.54 [0.46, 0.62]	—	—	—
TST	0.64 [0.56, 0.71]	18.5	66.2	58.6
BAI	0.57 [0.49, 0.65]	—	—	—
Men				
BMI	0.77 [0.69, 0.84]	26.2	56.8	88.2
Waist circumference	0.81 [0.74, 0.87]	92.4	70.5	81.7
Calf circumference	0.68 [0.60, 0.76]	32.3	90.9	44.2
WHR	0.78 [0.70, 0.85]	1.01	50.0	93.5
WSR	0.78 [0.70, 0.84]	0.58	61.4	84.9
Conicity index	0.77 [0.70, 0.84]	1.36	65.9	84.9
TST	0.76 [0.68, 0.83]	13.8	52.3	89.5
BAI	0.67 [0.59, 0.75]	27.4	61.4	71.0

Note. AUC = area under the curve; CI 95% = 95% confidence interval; BMI = body mass index; WHR = waist–hip ratio; WSR = waist–stature ratio; TST = triceps skinfold thickness; BAI = body adiposity index.

parameters from the ROC curve indicated that BMI was the indicator with the highest sensitivity; WHR had higher specificity. A cutoff of 95 cm for waist circumference showed the best balance between sensitivity and specificity (Table 2).

Table 2 and Figure 2 shown that, for men, all anthropometric indicators exhibited discriminative power for hypertriglyceridemia. The parameters from the ROC curve showed that calf circumference had the highest sensitivity; WHR had the highest specificity. A cutoff point of 92.4 cm for waist circumference showed the best balance between sensitivity and specificity (Table 2).

DISCUSSION

To the best of our knowledge, this study is the first household-based investigation of various anthropometric indicators as discriminators of hypertriglyceridemia in older adults of both gender. We found that all of the evaluated anthropometric indicators were able to discriminate hypertriglyceridemia for men. For women, the conicity index and BAI failed

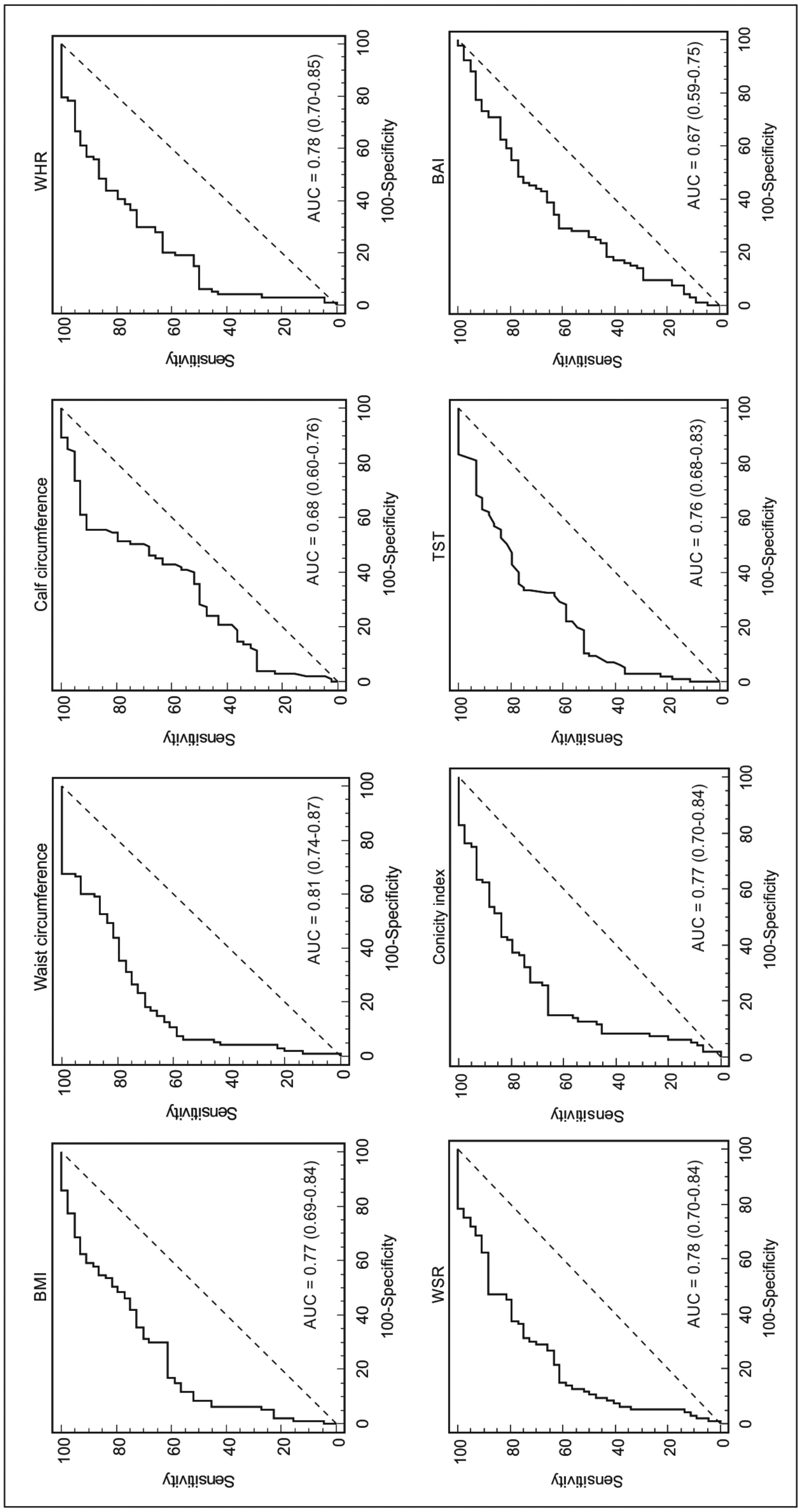

Figure 2. ROC curves of different anthropometric indicators used as discriminators of hypertriglyceridemia in older adult men. BMI = body mass index; AUC = area under ROC curve; WHR = waist–hip ratio; WSR = waist–stature ratio; TST = triceps skinfold thickness; BAI = body adiposity index; ROC = receiver operating characteristic.

in their discriminatory power. Moreover, according to the AUC, the discriminative power of all anthropometric indicators was higher for men than for women.

There have been few studies investigating the use of anthropometric indicators as discriminators of hypertriglyceridemia. Lee et al. (2013) evaluated 5,036 Koreans, aged 19–64 years, and demonstrated that BMI (AUC = 0.69) and waist circumference (AUC = 0.72) have similar predictive abilities. These findings were similar to ours, because we found a similarity between these two indicators for both men (BMI, AUC = 0.77 vs. waist circumference, AUC = 0.81) and women (BMI, ASC = 0.60 vs. waist circumference, ASC = 0.61). Despite this congruence of results, it is important to highlight two important methodological differences that are cause for caution in making comparisons: Lee et al. (2013) studied adults within a large age range (19–64 years) and the ROC curve analysis was grouped for all participants; in this study, however, we investigated exclusively older adults (≥60 years) and the ROC curve analysis was stratified according to gender.

Only one study (Gharipour et al., 2014) has assessed the discriminative ability of four anthropometric indicators (BMI, waist circumference, WHR, and WSR) in older men. These authors studied 206 older Iranian men and did not find significant differences in the discriminative ability of anthropometric indicators; the AUC ranged from 0.59 (WHR) to 0.63 (waist circumference). Similarly, we did not observe any significant differences in the discriminative abilities of these four anthropometric indicators. However, these indicators had higher predictive abilities than those observed by Gharipour et al. (2014), with the AUC ranging from 0.77 (BMI) to 0.81 (waist circumference). The absence of studies that have the same purposes and that include older women limits other comparisons.

Body fat distribution seems to be more important than the total amount of fat for the determination of the lipid profile. Subcutaneous adipose tissue apparently does not contribute significantly to increased levels of triglycerides. Therefore, it does not result in a significant increase in cardiometabolic risk (Wajchenberg, 2000). Moreover, visceral adiposity may be primarily responsible for the increased cardiometabolic risk, secondary to increased rates of lipolysis in the intra-abdominal fat deposits (Subramanian & Chait, 2012).

It is postulated that intra-abdominal fat is highly vascularized and drains directly into the portal vein. In addition, the ability of insulin to suppress lipolysis and reesterify free fatty acids is significantly lower in visceral adipocytes (Zierath et al., 1998). Therefore, it is plausible to hypothesize that anthropometric indicators commonly used as markers of abdominal adiposity—such as waist circumference, WHR, WSR, and conicity index—are more likely to discriminate hypertriglyceridemia. However, our results showed that these anthropometric indicators, which focused on abdominal adiposity, did not have significant advantages compared with indicators of overall (BMI) and subcutaneous (TST) adiposity. Although this result may seem surprising, it is justified because BMI and TST, although not direct indicators of visceral fat accumulation, are positively correlated with indicators of abdominal adiposity (dos Santos & Sichieri, 2005).

It is interesting to note the low performance of BAI for discriminating hypertriglyceridemia because it was unable to discriminate hypertriglyceridemia among women. BAI furthermore had the lowest discriminating power of the evaluated anthropometric indicators for men. BAI is a promising anthropometric indicator that has recently been proposed as an indicator of body fat percentage; it is calculated based on measurements of hip circumference and stature (Bergman et al., 2011). Some qualifications should be made in regard to BAI: (a) This index was developed based on data from American adults, aged 18–67 years (Bergman et al., 2011) and, despite having provided valid estimates for older Americans, its accuracy in people with extreme percentages of fat (i.e., high or low percentages of fat) is not good (Chang, Simonsick, Ferrucci, & Cooper, 2014); (b) as far as we know, the validity of BAI has not yet been tested in Brazilian older adults. Therefore, it is possible that BAI does not adequately reflect the body composition of Brazilian older adults and, perhaps, it could be necessary adequate the equation to use in Brazilian people.

We observed in the perspective of clinical nursing that none of the recommended cutoff points of the anthropometric indicators simultaneously showed high sensitivity and specificity for women. For men, only waist circumference showed high and balanced sensitivity and specificity (sensitivity = 70.5%; specificity = 81.7%). Thus, we suggest that a cutoff of 92.4 cm for waist circumference is a good criterion for identifying older men at risk for developing hypertriglyceridemia in the population that we studied. For women, perhaps an alternative identification system could be adopted consisting of anthropometric indicators that display high sensitivity combined with indicators that show high specificity (e.g., using both BMI $>$20.9 kg/m^2 [sensitivity = 92.3%] + WHR $>$0.99 [specificity = 75.0%] as a diagnostic criterion).

From the perspective of health monitoring and/or community-based nursing where the most important focus is screening and not the identification of potential patients with hypertriglyceridemia, it would be appropriate to invest in high sensitivity indicators. High sensitivity is more important than specificity for screening purposes (Rothman, Greenland, & Lash, 2008). Therefore, based on our results, we suggest that good screening tools for hypertriglyceridemia in the population studied here are a cutoff point for BMI of 20.9 kg/m^2 for women and a cutoff point for calf circumference of 32.3 cm for men.

The characteristics of this study do not allow us to deduce the reasons for the better performance of the anthropometric indicators in discriminating hypertriglyceridemia in older men than in older women. However, there is evidence indicating that menopause is closely associated with an increase in plasma levels of triglycerides, independent of obesity (Stevenson, Crook, & Godsland, 1993). It is therefore possible to hypothesize that a deficiency of sex hormones, specifically estrogen decline owing to ovarian failure, may influence the predictive ability of anthropometric indicators for hypertriglyceridemia in older women. Further studies should investigate this issue by comparing postmenopausal older women who are or are not taking hormonal replacement therapy.

The limitations of this study are inherent in its cross-sectional design, which did not allow for tracing a causal relationship between changes in anthropometric indicators and hypertriglyceridemia. However, it is important to note that this study enhances the appreciation and encouragement of the use of anthropometric indicators in clinical practice by nurses and other health professionals, particularly in primary care, to monitor lipid levels in older adults.

According to our results, we can conclude that (a) all studied anthropometric indicators, except for the conicity index and BAI in older women, can be used as discriminators of hypertriglyceridemia in an older population; (b) the studied anthropometric indicators were better discriminators of hypertriglyceridemia in older men than in women; (c) the choice of the best indicator must take into account the purpose of the application (clinical practice or health surveillance) and the gender of the individuals.

Considering the low cost and the ease of obtaining anthropometric measures, we suggest that these anthropometric indicators and their identified cutoffs be used by nurses and other health professionals in primary care for screening and monitoring lipid levels in older Brazilian adults until more comprehensive studies are conducted in Brazil.

REFERENCES

Abdel-Maksoud, M. F., Eckel, R. H., Hamman, R. F., & Hokanson, J. E. (2012). Risk of coronary heart disease is associated with triglycerides and high-density lipoprotein cholesterol in women and non-high-density lipoprotein cholesterol in men. *Journal of Clinical Lipidology*, *6*, 374–381.

Athyros, V. G., Giouleme, O. I., Nikolaidis, N. L., Vasiliadis, T. V., Bouloukos, V. I., Kontopoulos, A. G., & Eugenidis, N. P. (2002). Long-term follow-up of patients with acute hypertriglyceridemia-induced pancreatitis. *Journal of Clinical Gastroenterology*, *34*, 472–475.

Bergman, R. N., Stefanovski, D., Buchanan, T. A., Sumner, A. E., Reynolds, J. C., Sebring, N. G., . . . Watanabe, R. M. (2011). A better index of body adiposity. *Obesity*, *19*, 1083–1089.

Brandão, J. R., Gianini, R. J., Novaes, H. M., & Goldbaum, M. (2011). The family health system: Analysis of a health survey in São Paulo, Brazil. *Journal of Epidemiology and Community Health*, *65*, 483–490.

Callaway, W. C., Chumlea, W. C., Bouchard, C., Himes, J. H., Lohman, T. G., Martin, A. D., . . . Seefeldt, V. D. (1988). Circumferences. In T. G. Lohman, A. F. Roche & R. Martorell (Eds.). *Anthropometric standardization reference manual* (pp. 39–54). Champaign, IL: Human Kinetics.

Chang, H., Simonsick, E. M., Ferrucci, L., & Cooper, J. A. (2014). Validation study of the body adiposity index as a predictor of percent body fat in older individuals: Findings from the BLSA. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *69*(9), 1069–1075. http://dx.doi.org/10.1093/gerona/glt165

Christian, J. B., Bourgeois, N., Snipes, R., & Lowe, K. A. (2011). Prevalence of severe (500 to 2,000 mg/dl) hypertriglyceridemia in United States adults. *The American Journal of Cardiology*, *107*, 891–897.

Coqueiro, R. S., Barbosa, A. R., & Borgatto, A. F. (2009). Anthropometric measurements in the elderly of Havana, Cuba: Age and sex differences. *Nutrition*, *25*, 33–39.

Coqueiro, R. S., Fares, D., Barbosa, A. R., Passos, T. D. R. O., Reis-Júnior, W. M., & Fernandes, M. H. (2014). Anthropometric indicators as predictors of serum triglycerides and hypertriglyceridemia in older adults. *Medical Express*, *1*, 202–205.

Coqueiro, R. S., Santos, G. A. F., Borges, L. J., Sousa, T. F., Fernandes, M. H., & Barbosa, A. R. (2013). Anthropometric indicators of obesity and hyperglycaemia in Brazilian older people. *Journal of Diabetes Nursing*, *17*, 351–355.

D'Agostino, R. B., Jr., Hamman, R. F., Karter, A. J., Mykkanen, L., Wagenknecht, L. E., & Haffner, S. M. (2004). Cardiovascular disease risk factors predict the development of type 2 diabetes: The Insulin Resistance Atherosclerosis Study. *Diabetes Care*, *27*, 2234–2240.

de Onis, M., & Habicht, J. P. (1996). Anthropometric reference data for international use: Recommendations from a World Health Organization Expert Committee. *The American Journal of Clinical Nutrition*, *64*, 650–658.

dos Santos, D. M., & Sichieri, R. (2005). Body mass index and measures of adiposity among elderly adults. *Revista de Saúde Pública*, *39*, 163–168.

Frisancho, A. R. (1984). New standards of weight and body composition by frame size and height for assessment of nutritional status of adults and the elderly. *The American Journal of Clinical Nutrition*, *40*, 808–819.

Garcez, M. R., Pereira, J. L., Fontanelli, M. M., Marchioni, D. M. L., & Fisberg, R. M. (2014). Prevalence of dyslipidemia according to the nutritional status in a representative sample of São Paulo. *Arquivos Brasileiros de Cardiologia*, *103*, 476–484.

Gharipour, M., Sadeghi, M., Dianatkhah, M., Bidmeshgi, S., Ahmadi, A., Tahri, M., . . . Sarrafzadegan, N. (2014). The cut-off values of anthropometric indices for identifying subjects at risk for metabolic syndrome in Iranian elderly men. *Journal of Obesity*, *2014*, 907149.

Harrison, G. G., Buskirk, R. E., Carter, J. E. L., Johnston, F. E., Lohman, T. G., Pollock, M. L., . . . Wilmore J. (1988). Skinfold thickness and measurement technique. In T. G. Lohman, A. F. Roche, & R. Martorell. *Anthropometric standardization reference manual* (pp. 55–70). Champaign, IL: Human Kinetics.

Hassing, H. C., Surendran, R. P., Mooij, H. L., Stroes, E. S., Nieuwdorp, M., & Dallinga-Thie, G. M. (2012). Pathophysiology of hypertriglyceridemia. *Biochimica et Biophysica Acta*, *1821*, 826–832.

Heyward, V. (2001). ASEP methods recommendation: Body composition assessment. *Journal of Exercise Physiology Online*, *4*, 1–12.
Karaouzene, N., Merzouk, H., Aribi, M., Merzouk, A. S., Berrouiguet, A. Y., Tessier, C., & Narce, M. (2011). Effects of the association of aging and obesity on lipids, lipoproteins and oxidative stress biomarkers: A comparison of older with young men. *Nutrition Metabolism and Cardiovascular Diseases*, *21*, 792–799.
Leal Neto, J. S., Coqueiro, R. S., Freitas, R. S., Fernandes, M. H., Oliveira, D. S., & Barbosa, A. R. (2013). Anthropometric indicators of obesity as screening tools for high blood pressure in the elderly. *International Journal of Nursing Practice*, *19*, 360–367.
Lee, H. H., Lee, H. J., Cho, J. I., Stampfer, M. J., Willett, W. C., Kim, C. I., & Cho, E. (2013). Overall and abdominal adiposity and hypertriglyceridemia among Korean adults: The Korea National Health and Nutrition Examination Survey 2007–2008. *European Journal of Clinical Nutrition*, *67*, 83–90.
Mendis, S., Puska, P., & Norrving B. (2011). *Global Atlas on cardiovascular disease prevention and control*. Geneva, Switzerland: World Health Organization.
Moraes, S. A., Checchio, M. V., & Freitas, I. C. M. (2013). Dislipidemia e fatores associados em adultos residentes em Ribeirão Preto, SP. Resultados do Projeto EPIDCV [Dyslipidemia and correlates in adults living in Ribeirã Preto, SP: Results of the EPIDCV Project], *Arquivos Brasileiros de Endocrinologia e Metabologia*, *57*, 691–701.
Pejic, R. N., & Lee, D. T. (2006). Hypertriglyceridemia. *Journal of the American Board of Family Medicine: JABFM*, *19*, 310–316.
Rothman, K. J., Greenland, S., & Lash, T. L. (2008). *Modern epidemiology* (6th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.
Schubert, C. M., Rogers, N. L., Remsberg, K. E., Sun, S. S., Chumlea, W. C., Demerath, E. W., . . . Siervogel, R. M. (2006). Lipids, lipoproteins, lifestyle, adiposity and fat-free mass during middle age: The Fels Longitudinal Study. *International Journal of Obesity*, *30*, 251–260.
Subramanian, S., & Chait, A. (2012). Hypertriglyceridemia secondary to obesity and diabetes. *Biochimica et Biophysica Acta*, *1821*, 819–825.
Stevenson, J. C., Crook, D., & Godsland, I. F. (1993). Influence of age and menopause on serum lipids and lipoproteins in healthy women. *Atherosclerosis*, *98*, 83–90.
Valdez, R. (1991). A simple model-based index of abdominal adiposity. *Journal of Clinical Epidemiology*, *44*, 955–956.
Wajchenberg, B. L. (2000). Subcutaneous and visceral adipose tissue: Their relation to the metabolic syndrome. *Endocrine Reviews*, *21*, 697–738.
World Health Organization. (2000). *Obesity: Preventing and managing the global epidemic (Technical Report Series 894)*. Geneva, Switzerland: Author.
Xavier, H. T., Izar, M. C., Faria Neto, J. R., Assad, M. H., Rocha, V. Z., Sposito, A. C., . . . Ramires, J. A. F. (2013). *V Diretriz Brasileira de Dislipidemias e Prevenção da Aterosclerose* [V Brazilian Guidelines on Dyslipidemias and Prevention of Atherosclerosis]. *Arquivos Brasileiros de Cardioliologia*, *101*(4 Suppl. 1), S1–S20.
Zierath, J. R., Livingston, J. N., Thörne, A., Bolinder, J., Reynisdottir, S., Lönnqvist, F., & Arner, P. (1998). Regional difference in insulin inhibition of non-esterified fatty acid release from human adipocytes: Relation to insulin receptor phosphorylation and intracellular signalling through the insulin receptor substrate-1 pathway. *Diabetologia*, *41*, 1343–1354.

Acknowledgments. This work was supported by the Universidade Estadual do Sudoeste da Bahia (grant numbers UESB 117/2009 and 011/2010) and Fundação de Amparo à Pesquisa do Estado da Bahia (grant number PPP0070/2011). The first author (CASAJ) received scientific initiation scholarship from the Fundação de Amparo à Pesquisa do Estado da Bahia (grant number 2392/2012). The authors thank the Municipal Secretariat of Health of Lafaiete Coutinho-Bahia and the older adults who participated in the study.

Correspondence regarding this article should be directed to Raildo da Silva Coqueiro, MS, Universidade Estadual do Sudoeste da Bahia, Departamento de Saúde, Núcleo de Estudos em Epidemiologia do Envelhecimento, Av. José Moreira Sobrinho, S/N, Jequiezinho, Jequié-Bahia, Brazil. E-mail: rscoqueiro@uesb.edu.br