INTERNATIONAL JOURNAL of NURSING PRACTICE

International Journal of Nursing Practice 2013; **19**: 360–367

RESEARCH PAPER

Anthropometric indicators of obesity as screening tools for high blood pressure in the elderly

João de Souza Leal Neto

Graduate student in Physical Education, Núcleo de Estudos em Epidemiologia do Envelhecimento (NEPE), Departamento de Saúde, Universidade Estadual do Sudoeste da Bahia, Jequié, Bahia, Brazil

Raildo da Silva Coqueiro M.S.

Assistant Professor, Núcleo de Estudos em Epidemiologia do Envelhecimento (NEPE), Departamento de Saúde, Universidade Estadual do Sudoeste da Bahia, Jequié, Bahia, Brazil

Roberta Souza Freitas

Graduate student in Physiotherapy, Núcleo de Estudos em Epidemiologia do Envelhecimento (NEPE), Departamento de Saúde, Universidade Estadual do Sudoeste da Bahia, Jequié, Bahia, Brazil

Marcos Henrique Fernandes PhD

Adjunct professor, Núcleo de Estudos em Epidemiologia do Envelhecimento (NEPE), Departamento de Saúde, Universidade Estadual do Sudoeste da Bahia, Jequié, Bahia, Brazil

Daniela Sousa Oliveira Spec.

Masters student in Nursing, Programa de Pós-Graduação em Enfermagem, Universidade Federal da Bahia, Salvador, Bahia, Brazil

Aline Rodrigues Barbosa PhD

Adjunct professor, Departamento de Educação Física, Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, Brazil and, Núcleo de Estudos em Epidemiologia do Envelhecimento (NEPE), Departamento de Saúde, Universidade Estadual do Sudoeste da Bahia, Jequié, Bahia, Brazil

Accepted for publication August 2012

Leal Neto JS, Coqueiro RS, Freitas RS, Fernandes MH, Oliveira DS, Barbosa AR. *International Journal of Nursing Practice* 2013; **19**: 360–367

Anthropometric indicators of obesity as screening tools for high blood pressure in the elderly

The study objectives were to investigate the indicators of obesity most associated with high blood pressure in community-dwelling elderly and identify among these which one best discriminates high blood pressure. This is an epidemiological, population, cross-sectional and home-based study of elderly people (≥ 60 years, $n = 316$) residing in northeastern Brazil. The results showed that the body mass index and the body adiposity index were the indicators more closely associated with high blood pressure in both sexes. Both in female and male genders, body mass index showed high values of specificity and low sensitivity values for discriminating high blood pressure, whereas the body adiposity index showed high sensitivity and

Correspondence: Raildo da Silva Coqueiro, Universidade Estadual do Sudoeste da Bahia, Departamento de Saúde, Núcleo de Estudos em Epidemiologia do Envelhecimento, Av. José Moreira Sobrinho, S/N, Jequiezinho, Jequié - BA 45206-190, Brazil. Email: rscoqueiro@uesb.edu.br

doi:10.1111/ijn.12085

moderate specificity values. In clinical practice and health surveillance, it is suggested that both indicators be used as screening tools for hypertension in the elderly.

Key words: anthropometry, health of elderly, hypertension, nutritional status, obesity

INTRODUCTION

Hypertension is a triggering factor for death and disability and one of the major public health problems in the world.[1] Its prevalence increases with age, reaching about 50–70% of elderly Brazilians.[2]

A major determinant of hypertension in the elderly is the excess body fat, even though the location of body fat is also of importance.[3–6] In epidemiological studies,[3,5,6] the main anthropometric indicators used to detect excess body fat have been the body mass index (BMI), waist circumference, conicity index, waist hip ratio (WHR) and waist stature ratio (WSR). Recently, the body adiposity index (BAI) was proposed as an indicator that reflects the percentage of body fat in individual adults and can be configured as an alternative assessment in the elderly.[7]

Determining the measure of obesity with the best predictive ability for high blood pressure can be tricky because of the biological variation between different sociocultural groups and the population as a whole.[4,5] Thus, it seems necessary to evaluate the performance of each indicator within specific populations.

Concerning the elderly, studies comparing the impact of different anthropometric indicators in hypertension are scarce. It is necessary to investigate more effective indicators of obesity in screening for hypertension in older people, including even new anthropometric indicators, such as the BAI. The objectives of this study were to identify the impact of different anthropometric indicators of obesity in high blood pressure, as well as identify the best indicator that discriminates against high blood pressure in community-dwelling elderly.

METHODS

This is a cross-sectional study that analyzed data from a home-based epidemiological survey called 'Nutritional status, risk behaviors and health conditions of elderly in Lafaiete Coutinho-BA'. The city studied, located in northeastern Brazil, had 4162 inhabitants during the period of data collection, all registered with the Family Health Program (FHP). Two FHP teams (one doctor, one nurse, auxiliary nurses and community health workers) covered the entire town. This programme aims to increase the population's access to primary care.[8] The city has one of the worst human development indexes (HDIs) in Brazil, occupying the 4487th position on the longevity category (longevity-HDIM = 0.635).[9]

A complete census was conducted in the city of Lafaiete Coutinho in January 2011 so as to identify the individuals participating in the survey. All residents in the urban aged $\geq$ 60 years (n = 355) were selected for interviews and examinations. The location of the housing is effected by means of information of the FHP. Of the 355 elderly who comprised the population, 316 (89.0%) participated in the study: there were 17 refusals (4.8%) and 22 (6.2%) individuals were not located after three home visits on alternate days and were considered a loss.

We used a form, based on the questionnaire used in the survey on Health, Well-Being, and Aging—SABE—(http://hygeia.fsp.usp.br/sabe/Questionario.html), held in seven countries of Latin America and the Caribbean,[10] the exception of the physical activity questionnaire[11] that in the present study was broader.

Data collection occurred in two stages. The first consisted of an interview, conducted by only the individual interviewer, including personal information, health status, medication use and lifestyle. The second stage was conducted in two units of the FHP of the city and included blood pressure measurement and anthropometry; this step was scheduled with an interval of 1–3 days after the home interview.

The data from household interviews and blood pressure were obtained by undergraduate and graduate students in the health field, who received special training before testing, refinement and calibration of the interviewer. Anthropometric data were obtained by three physical education students, who received theoretical and practical training, aiming at the standardization of the anthropometric techniques used in the study. The precision and accuracy of the evaluators were confirmed prior to data collection in 20 volunteers, through the analysis of the technical errors of measurement inter- and intra-examiner, and all showed changes consistent with acceptable experience evaluators.[12]

The following information was used in this study: (i) sociodemographic characteristics (age, sex, and literacy and illiteracy); (ii) lifestyle (smoking, alcohol intake,

physical activity); (iii) blood pressure; and (iv) anthropometry (weight, stature, waist and hip circumference).

The study protocol was approved by the Ethics Committee, participation was voluntary and all subjects signed an informed consent.

High blood pressure (dependent variable)

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured following standard procedures[13] using an automatic digital blood pressure monitor (HEM-742INT, Omron Healthcare, Shanghai, China). High blood pressure (SBP $\geq$ 140 mmHg and/or DBP $\geq$ 90 mmHg and/or use of medication to control blood pressure) was defined according to current guidelines in Brazil.[13]

Anthropometric indicators of obesity (independent variables)

Body mass was measured with a portable digital scale (6 G-Tech Glass, Zhongshan Camry Electronic, Zhongshan, China), with the individual barefoot and using as little clothing as possible. Stature was measured according to the Frisancho technique,[14] using a compact portable stadiometer (Wiso, Shanghai, China) installed in a suitable place, according to the manufacturer's standards. The waist and hip circumferences were measured with an anthropometric tape according to the standardization of Callaway *et al*.[15] All anthropometric measurements except body mass were performed in triplicate, and mean values were used in the analyses. We calculated the BMI (body mass (kg)/stature^2 (m)), the WHR (waist/hip circumference), the WSR (waist circumference (cm)/stature (cm)), the conicity index[16] and the BAI.[7]

Adjustment variables

Sociodemographic variables: age (continuous variable) and the literacy and illiteracy (yes or no).

Lifestyle: smoking (smoker, former smoker or never smoked), alcohol intake ($\geq$ 1 time/week or $<$ 1 time/week) and physical activity (insufficiently active or active). The instrument used to assess the level of regular physical activity was the International Physical Activity Questionnaire extended version.[11] Those who performed less than 150 min per week in moderate or vigorous physical activity were considered insufficiently active and those who performed 150 min or more per week were considered active.[17]

Statistical procedure

For descriptive analysis of the characteristics of the sample, the frequencies, means and medians, standard deviations and or interquartile ranges were calculated. The differences between sexes were compared using the chi-square test (qualitative variables) and Mann–Whitney *U* or Student's *t*-tests for independent samples (quantitative variables), after verification of normality using the Kolmogorov–Smirnov test. The association between anthropometric indicators of obesity (independent variables) and high blood pressure (dependent variables) was tested by means of the Poisson regression technique. We calculated robust models to estimate adjusted prevalence ratios (PR), with their respective confidence intervals 95% (95%). The power of diagnostics of high blood pressure of anthropometric indicators of obesity and the identification of best cut-off points were evaluated using the parameters provided by the receiver operating characteristic (ROC) curve: area under the ROC curve (AUC), sensitivity and specificity.

In all analyses the level of significance was 5% ($\alpha = 0.05$). The data were analyzed in the Statistical Package for Social Sciences for Windows (SPSS. 15.0, 2006, SPSS, Inc, Chicago, IL, USA) and MedCalc (version 9.1.0.1, 2006; MedCalc Software bvba, Ostend, Belgium).

RESULTS

The participants were 173 women (54.7%) and 143 men (45.3%). The ages ranged from 60 to 105 years (74.2 $\pm$ 9.8). The other characteristics of the studied population according to the sex are shown in Table 1. The frequencies of individuals who could read and write, who smoked and who drank alcohol once or more per week were significantly higher in males. Significant differences were observed in mean or median values of all anthropometric variables except WHR, with women having higher values in all of them. The prevalence of high blood pressure in the studied populations was high (83.7%) and showed no differences between sexes (Table 1).

Table 2 shows the PR high blood pressure with an increase of the indicators of obesity. For females, BMI, waist circumference, WSR and BAI were associated with high blood pressure. BMI ($P = 0.003$) and BAI ($P = 0.016$) had higher strength of association. The data showed that each increment of one unit in BMI and BAI increased by approximately 2% and 1%, respectively, the probability of elderly women presenting high blood pressure. WHR and the conicity index were not associated

Table 1 Descriptive characteristics of the sample according to sex. Lafaiete Coutinho-BA, Brazil, 2011

Variables	Total	Females	Males	*P*-value
Age (years)	73.0 ± 15.0	74.0 ± 14.0	73.0 ± 14.0	0.191
Literacy and illiteracy (%)				
Yes	33.2	27.7	39.9	0.031
No	66.8	72.3	60.1	
Smoker (%)				
Current	11.1	4.0	19.7	< 0.001
Former	46.7	36.4	59.2	
Never	42.2	59.6	21.1	
Alcohol consumption (%)				
1 or + day/week	8.6	3.5	14.8	< 0.001
< 1 day/week	91.4	96.5	85.2	
Physical activity (%)				
Insufficiently active	47.7	47.3	48.2	0.967
Active	52.3	52.7	51.8	
High blood pressure (%)				
Yes	83.7	87.0	79.6	0.112
No	16.3	13.0	20.4	
BMI (kg/m^2)	24.5 ± 4.7	25.3 ± 4.9	23.7 ± 4.1	0.003
Waist circumference (cm)	91.8 ± 18.2	94.3 ± 17.9	89.3 ± 18.2	< 0.001
WHR	0.97 ± 0.08	0.98 ± 0.08	0.97 ± 0.09	0.073
WSR	0.59 ± 0.12	0.63 ± 0.13	0.55 ± 0.08	< 0.001
Conicity index	1.37 ± 0.14	1.42 ± 0.12	1.32 ± 0.12	< 0.001
BAI	30.6 ± 9.56	35.0 ± 8.8	26.5 ± 4.7	< 0.001

Values are expressed as median ± interquartile range or percentage, except for BMI, which is expressed as mean ± standard deviation. BAI, body adiposity index; BMI, body mass index; WHR, waist hip ratio; WSR, waist stature ratio.

Table 2 Prevalence ratios for high blood pressure with increasing obesity indicators in the elderly. Lafaiete Coutinho, Bahia, Brazil, 2011

Variables	Females			Males		
	PR[†]	95%CI	*P*-value	PR[†]	95%CI	*P*-value
BMI (kg/m^2)	1.017	1.006–1.029	0.003	1.021	1.001–1.041	0.040
Waist circumference (cm)	1.005	1.001–1.009	0.023	1.000	0.992–1.008	0.989
WHR	0.928	0.337–2.557	0.885	0.639	0.221–1.847	0.408
WSR	1.913	1.058–3.460	0.032	1.077	0.271–4.279	0.917
Conicity index	0.974	0.636–1.493	0.905	0.634	0.293–1.372	0.247
BAI	1.010	1.002–1.018	0.016	1.020	1.001–1.040	0.049

[†] Adjusted for age, literacy and illiteracy, smoking, alcohol consumption and physical activity. PR, prevalence ratio; 95%CI, confidence interval 95%; BMI, body mass index; WHR, waist hip ratio; WSR, waist stature ratio; BAI, body adiposity index.

with high blood pressure in women. For males, BMI and BAI were the only anthropometric indicators of obesity associated with high blood pressure, and each increase of one unit in these indicators increased by approximately 2% the probability of elderly men presenting high blood pressure.

After regression analysis indicated that BMI and BAI were the anthropometric indicators of obesity most

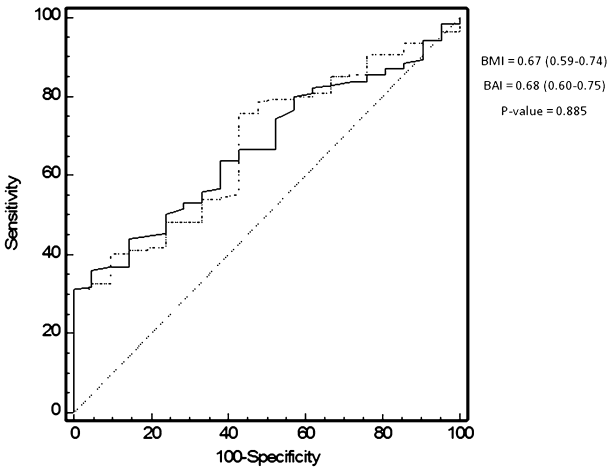

Figure 1. Areas under the receiver operating characteristic curves of anthropometric indicators of obesity and high blood pressure in elderly individuals (females). Lafaiete Coutinho, Bahia, Brazil, 2011. BAI, body adiposity index; BMI, body mass index. (—) BMI; (··) BAI.

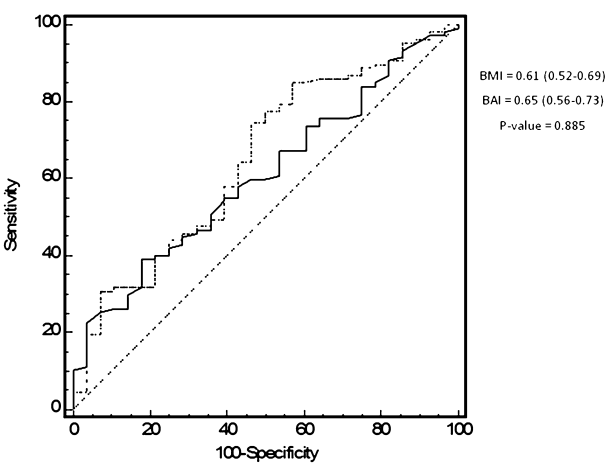

Figure 2. Areas under the receiver operating characteristic curves of anthropometric indicators of obesity and high blood pressure in elderly individuals (males). Lafaiete Coutinho, Bahia, Brazil, 2011. BAI, body adiposity index; BMI, body mass index. (—) BMI; (··) BAI.

associated with high blood pressure in both sexes, it was decided to proceed with the ROC curve analysis to identify, among the two, which best discriminates high blood pressure.

The comparison of AUC between BMI and BAI in males and females can be observed in Figures 1 and 2, respectively. There was no statistical difference in the percentage of AUC between the indicators.

The sensitivity and specificity for the BMI and the BAI, and their respective cut-off points are presented in Table 3. In both sexes, BMI showed high specificity and low sensitivity values. The BAI has obtained high sensitivity and moderate specificity for discriminating high blood pressure.

DISCUSSION

To our knowledge, this is the first known, home-based epidemiological study of the population, conducted so as to comparatively investigate the predictive and discriminatory capacity of all anthropometric indicators of obesity to high blood pressure in the elderly.

The results of this study showed that BMI and BAI are the best predictive indicators for high blood pressure in the elderly of both sexes, regardless of other factors such as age, smoking, alcohol consumption and physical activity. Furthermore, the parameters of the ROC curve showed that these two indicators appeared to have different qualities. The BMI has a higher specificity and the BAI has greater sensitivity to discrimination of elderly with high blood pressure. This finding suggests that the use of two indicators simultaneously can result in greater efficiency in assessing the risk of hypertension in the elderly.

Our findings are consistent with those of a study conducted in India with adult men (≤ 61 years), which used a similar method and analysis, and also identified BMI as the indicator most closely associated with blood pressure elevation.[18] However, because it is a recently proposed indicator, we found no studies using the BAI to allow comparison with this study.

The literature has few references to comparative evaluations between anthropometric indexes and hypertension in the elderly, and the results are not consistent. Most existing studies[3,5,6,19] assessed anthropometric indicators as categorical variables based on cut-off points established internationally or created from the samples themselves.

Some of these studies showed BMI as the indicator most strongly associated with hypertension[6,19] whereas others have shown that the combination of BMI and waist circumference may provide better support for research of cardiovascular disease.[20,21] Research conducted with the elderly population of Cuba and Barbados[5] showed that BMI was not associated with self-reported hypertension in the elderly Bridgetown/Barbados and that, despite being related to the outcome in the elderly in Havana/Cuba, was not the best predictor for males.

Although it is important to take precaution in the use of comparisons, because of methodological differences

Table 3 Cut-off points, sensitivity and specificity of anthropometric indicators of obesity as discriminators of high blood pressure in the elderly. Lafaiete Coutinho, Bahia, Brazil, 2011

Variables	Females			Males		
	Cut-off points	Sen	Spec	Cut-off points	Sen	Spec
BMI (kg/m^2)	27.3	35.9	95.2	24.7	39.3	82.1
BAI	31.8	75.9	57.1	25.3	74.8	53.6

BAI, body adiposity index; BMI, body mass index; Sen, sensitivity; Spec, specificity.

between studies, the evidence suggests that the relationship of anthropometric indicators of obesity with high blood pressure can vary depending on the sociocultural, economic and environmental context and be influenced by genetic variability populations. This reinforces the need to test the predictive ability of anthropometric indicators in specific populations.

The parameters of the ROC curve indicated that the cut-off points with better sensitivity and specificity for diagnosis of high blood pressure varied between the sexes, both for BMI and for the BAI, both of which were higher in women. This suggests that the use of a universal cut-off point for assessing cardiovascular risk in elderly men and women may be inadequate.

The discussion about the best cut-off points of BMI for cardiovascular risk in the elderly is controversial and there is no consensus in literature. The World Health Organization (WHO)[22] has no specific cut-off points for the elderly and recommends values > 24.99 kg/m^2 as indicative of excess weight for adults while acknowledging that different cut-off points above or below can be used. The Nutrition Screening Initiative[23] suggests, specifically for the elderly, values > 27 kg/m^2, the cut-off point adopted in Brazil by the Ministry of Health for monitoring food and nutrition.[24] The Pan American Health Organization[25] has used the value of BMI $\geq$ 28 kg/m^2 for excess weight individuals aged $\geq$ 60 years. The results of this study indicate that the best cut-off point of BMI to demarcate high blood pressure in women (27.3 kg/m^2) resembles the recommendation of the Nutrition Screening Initiative. The best cut-off point for men (24.7 kg/m^2) is similar to that recommended by the WHO.

Some considerations must be made in relation to the BAI. Although this indicator has been proposed as a parameter that reflects the percentage of corporal fat,[7] until now, specific cut-off points for highlighting health risks have not yet been proposed. In addition, the BAI was developed based on a population study involving individuals 18–67 years and was validated in another population aged 20–50 years. Thus, one must be cautious about its use in elderly populations.

This study has limitations inherent to cross-sectional design, which somewhat limits established causal relationship between obesity and high blood pressure. Another limiting factor is the fact that blood pressure has been observed during a given period of time, making it impossible to determine the diagnosis of hypertension because a number of factors, extrinsic and intrinsic, can cause momentary peaks but no sustained arterial pressure.[13] However, the use of information on a medication for hypertension helped minimize bias, as individuals who use this type of product usually has the medical diagnosis of the disease. In addition, blood pressure measurements were performed following all the technical parameters established by the national guidelines[13] and used the validated automatic monitor[26] to reduce the chances of human error and obtain more accurate and precise measurements.

According to the results of this study we conclude that (i) the BMI and the BAI were anthropometric indicators of obesity most strongly associated with high blood pressure in the population studied and (ii) the BMI had better specificity and the BAI showed better sensitivity in discriminating against high blood pressure. These findings demonstrate that both the BMI and the BAI can be used as screening tools for high blood pressure in the elderly. However, it is believed that the use of both, all together, may provide a better indication of cardiovascular risk. As BMI and BAI are derived from easily obtainable anthropometric measures (procedures quick and low cost), both stand as important information for clinical practice and health surveillance of elderly populations.

These results should be viewed with caution for use in populations with characteristics differing from those in the present study and raise the need for further studies in the elderly with different characteristics.

ACKNOWLEDGEMENTS

Leal Neto JS received scientific initiation scholarship from the Universidade Estadual do Sudoeste da Bahia (UESB). The research was partly funded by the UESB (UESB 117/2009 and 011/2010). The authors thank the Municipal Secretariat of Health of Lafaiete Coutinho-BA and the elderly who participated in the study.

REFERENCES

1 Lawes CMM, Hoorn SV, Rodgers AA. Global burden of blood-pressure-related disease, 2001. *Lancet* 2008; **371**: 1513–1518.
2 Ministério da Saúde, Secretaria de Vigilância em Saúde, Secretaria de Gestão Estratégica e Participativa. *Vigitel Brasil 2009—Vigilância De Fatores De Risco E Proteção Para Doenças Crônicas Por Inquérito Telefônico*. Brasília, Brazil: Ministério da Saúde, 2010.
3 Redón J, Cea-Calvo L, Moreno B *et al*. Independent impact of obesity and fat distribution in hypertension prevalence and control in the elderly. *Journal of Hypertension* 2008; **26**: 1757–1764.
4 Tuan NT, Adair LS, Suchindran CM, He K, Popkin BM. The association between body mass index and hypertension is different between East and Southeast Asians. *The American Journal of Clinical Nutrition* 2009; **89**: 1905–1912.
5 Barbosa AR, Munaretti DB, Coqueiro RS, Borgato AF. Anthropometric indexes of obesity and hypertension in elderly from Cuba e Barbados. *The Journal of Nutrition, Health and Aging* 2011; **15**: 17–21.
6 Munaretti DB, Barbosa AR, Marucci MFN, Lebrão ML. Self-rated hypertension and anthropometric indicators of body fat in elderly. *Revista Da Associacao Medica Brasileira* 2011; **57**: 25–30.
7 Bergman RN, Stefanovski D, Buchanan TA *et al*. A better index of body adiposity. *Obesity* 2011; **19**: 1083–1089.
8 Brandão JRM, Gianini RJ, Novaes HMD, Goldbaum M. The family health system: Analysis of a health survey in São Paulo, Brazil. *Journal of Epidemiology and Community Health* 2011; **65**: 483–490.
9 Programa das Nações Unidas para o Desenvolvimento. *Atlas de desenvolvimento humano no Brasil*. Brasília: PNUD, 2012. Avaliable from URL: http://www.pnud.org.br/atlas/textos_analiticos/index.php. Accessed 2 March 2012.
10 Albala C, Lebrão ML, Díaz EML *et al*. Encuesta Salud, Bienestar y Envejecimiento (SABE): metodología de la encuesta y perfil de la población estudiada. *Revista Panamericana De Salud Publica* 2005; **17**: 307–322.
11 Craig CL, Marshall AL, Sjostrom M *et al*. International Physical Activity Questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise* 2003; **35**: 1381–1395.
12 Pederson D, Gore C. Erros de medição em antropometria. In: Norton K, Olds T (eds). *Antropométrica: um livro sobre medidas corporais para o esporte e cursos na área da saúde*. Porto Alegre, Brazil: Artmed, 2005; 89–104.
13 Sociedade Brasileira de Cardiologia, Sociedade Brasileira de Hipertensão, Sociedade Brasileira de nefrologia. VI Diretrizes Brasileiras de Hipertensão. *Brazil Journal of Hypertension* 2010; **1**: 1–60.
14 Frisancho AR. *Anthropometric Standards for the Assessment of Growth and Nutritional Status*. Ann Arbor, MI, USA: The University of Michigan Press, 1990.
15 Callaway WC, Chumlea WC, Bouchard C *et al*. Circumferences. In: Lohman TG, Roche AF, Martorell R (eds). *Anthropometric Standardization Reference Manual*. Champaign, IL, USA: Human Kinetics, 1988; 39–54.
16 Valdez R. A simple model-based index of abdominal adiposity. *Journal of Clinical Epidemiology* 1991; **44**: 955–956.
17 Hallal PC, Victora CG, Wells JC, Lima RC. Physical inactivity: Prevalence and associated variables in Brazilian adults. *Medicine and Science in Sports and Exercise* 2003; **35**: 1894–1900.
18 Ghosh JR, Bandyopadhyay AR. Comparative evaluation of obesity measures: Relationship with blood pressures and hypertension. *Singapore Medical Journal* 2007; **48**: 232–235.
19 Sanchez-Viveros S, Barquera S, Medina-Solis CE, Velazquez-alva MC, Valdez R. Association between diabetes mellitus and hypertension with anthropometric indicators in older adults: Results of the Mexican Health Survey, 2000. *The Journal of Nutrition, Health and Aging* 2008; **12**: 327–333.
20 Wannamethee SG, Shaper AG, Morris RW, Whincup PH. Measures of adiposity in the identification of metabolic abnormalities in elderly men. *The American Journal of Clinical Nutrition* 2005; **81**: 1313–1321.
21 Ying X, Song Z, Zhao C, Jiang Y. Body mass index, waist circumference, and cardiometabolic risk factors in young and middle-aged Chinese women. *Journal of Zhejiang Univ-Science B (Biomed &Biotechnol)* 2010; **11**: 639–646.
22 World Health Organization. Defining the problem of overweight and obesity. In: World Health Organization (ed.). *Obesity: Preventing and Managing the Global Epidemic: Report of a WHO Consultation*. Geneva, Switzerland: World Health Organization, 2000; 241–243. (WHO Technical Report Series, 894).

23 American Academy of Family Physicians, American Dietetic Association, National Council on the Aging. *Nutrition Screening e Intervention Resources for Healthcare Professionals Working with Older Adults*. Nutrition Screening Initiative. Washington: American Dietetic Association, 2002. Avaliable from URL: http://www.eatright.org. Accessed 21 July 2011.

24 Ministério da Saúde. *Vigilância alimentar e nutricional - Sisvan: orientações para a coleta e análise de dados antropométricos em serviços de saúde*. Brasília, Brazil: Ministério da Saúde, 2008.

25 Pan American Health Organization. *XXXVI Meeting of the Advisory Commttee on Health Research. Multicenter Survey: Health, Welfare, and Aging in Latin America and the Caribbean (SABE)—Preliminary Report*. Kingston: Pan American Health Organization, 2001.

26 Coleman A, Freeman P, Steel S, Shennan A. Validation of the Omron MX3 Plus oscilometric blood pressure monitoring device according to the European Society of Hypertension International protocol. *Blood Pressure Monitoring* 2005; **10**: 165–168.