VISCERAL ADIPOSITY INDEX AS A TOOL FOR CARDIOMETABOLIC RISK IN OBESE OLDER WOMEN

Índice de adiposidade visceral como ferramenta para avaliar o risco cardiometabólico em idosas obesas

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ABSTRACT

OBJECTIVE: To correlate anthropometric measurements, lipid profile, cardiorespiratory fitness, and visceral adiposity index (VAI) in sedentary obese older women. **METHODS:** Twenty-seven insufficiently active and overweight older women were included in this cross-sectional study. We evaluated their anthropometric profile (body weight and stature, body mass index, waist and hip circumferences) and body composition (fat mass, body fat percentage, and musculoskeletal mass). Venous blood samples were analyzed for high and low-density lipoproteins (HDL-c and LDL-c), triglycerides (TG), and the LDL/HDL ratio. Peak oxygen uptake (VO₂ peak) was measured using an adapted Bruce test using direct spirometry. We tested data normality and applied Pearson's correlation, assuming a $p \leq 0.05$. **RESULTS:** The following correlations were observed: VAI and HDL ($r = -0.53$); VAI and LDL ($r = 0.35$); VAI and TG ($r = 0.86$); VAI and TG/HDL ($r = 0.99$) and VAI and VO₂ peak ($r = -0.55$), with $p < 0.01$ for all analyses. **CONCLUSION:** The findings suggested that VAI may be used as a tool to assess cardiometabolic risk in obese older women. Future studies should evaluate the applicability of VAI as a cardiometabolic risk factor indicator in older adults. **KEYWORDS:** obesity; aging; aged.

RESUMO

OBJETIVO: Correlacionar medidas antropométricas, perfil lipídico, aptidão cardiorrespiratória e índice de adiposidade visceral (IAV) em idosas obesas sedentárias. **METODOLOGIA:** Vinte e sete idosas insuficientemente ativas e com sobrepeso foram incluídas neste estudo transversal. Foram avaliados o perfil antropométrico (peso corporal e estatura, índice de massa corporal, circunferências da cintura e quadril) e composição corporal (massa gorda, percentual de gordura corporal e massa musculoesquelética). Amostras de sangue venoso foram analisadas para lipoproteínas de alta e baixa densidade (HDL-c e LDL-c), triglicerídeos (TG) e a relação LDL/HDL. O consumo de oxigênio de pico (VO₂ pico) foi medido usando um teste de Bruce adaptado usando espirometria direta. Testamos a normalidade dos dados e aplicamos a correlação de Pearson, assumindo um $p \leq 0,05$. **RESULTADOS:** Foram observadas as seguintes correlações: IAV e HDL ($r = -0,53$); IAV e LDL ($r = 0,35$); IAV e TG ($r = 0,86$); IAV e TG/HDL ($r = 0,99$); e IAV e VO₂ pico ($r = -0,55$), com $p < 0,01$ para todas as análises. **CONCLUSÃO:** Os achados sugerem que o IAV pode ser utilizado como ferramenta para avaliar o risco cardiometabólico em idosas obesas. Estudos futuros devem avaliar a aplicabilidade do IAV como indicador de fator de risco cardiometabólico em idosos. **PALAVRAS-CHAVE:** obesidade; envelhecimento; idoso.

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INTRODUCTION

Over the past decades, the prevalence of cardiometabolic risk factors — hypertension, impaired glucose regulation, and dyslipidemia — has increased worldwide. This scenario mostly results from changes in social and behavioral factors, such as population aging, rapid urbanization, and unhealthy lifestyles characterized by physical inactivity and poor diet, commonly seen in low- and middle-income countries.¹

Although men and women are both susceptible to cardiometabolic disorders, the health consequences are sex specific.² Changes in cardiometabolic risk factors are more prevalent in women than in men, particularly before the onset of type 2 diabetes. Furthermore, visceral adipose tissue seems to be more strongly associated with cardiometabolic risk markers in women than in men.³ Moreover, genetic data corroborate the idea that visceral adiposity is a potentially independent risk factor for cardiovascular and metabolic disease in females,⁴ emphasizing the need for a more careful analysis of this parameter.

Throughout the aging process, visceral adiposity-related comorbidities are ever more worrying.⁵ Anthropometric and body composition changes are common with aging, with a gradual loss of lean mass and a shift to central fat accumulation.⁶ This picture gets even worse when it comes to women.⁷ In older and obese women, visceral adiposity is strongly associated with cardiometabolic risk factors.⁸ For this specific population, visceral adiposity measurement can be considered a useful tool for the assessment of cardiometabolic disease risk.⁸ Thus, understanding the relationships between visceral adiposity, aging, and physical inactivity in women may be decisive for the design of more accurate strategies to maintain the quality of life of this population.

Visceral adiposity can be estimated by magnetic resonance imaging (MRI), by computerized tomography (CT) scan or by dual-energy X-ray absorptiometry (DXA). However, these techniques are expensive and time-consuming. In this sense, as an alternative method, the visceral adiposity index (VAI) was suggested as a marker of visceral adiposity.⁹ VAI is a reliable formula based on simple anthropometric data, such as body mass index (BMI) and waist circumference (WC), as well as some metabolic parameters, such as triglycerides (TG) and high-density lipoprotein (HDL).¹⁰ It is considered as a marker of adipose tissue function and distribution associated with cardiometabolic risk in the general population.⁹

Recent evidences showed BMI, WC, waist-to-hip ratio (WHR), waist-to-height ratio (WHtR), TG, and HDL-c¹¹

present lower predictive parameters to quantify diabetes when compared to VAI, being an equation consisting of WC, BMI, TG/HDL-c ratio. This condition was assessed for 10 years in ATTICA Study.¹¹ Thus, it is possible to conclude that anthropometric and biochemical variables can predict better pathological conditions related to type 2 diabetes. Therefore, given its applicability, we investigated herein possible correlations between anthropometric measurements, lipid profile, cardiorespiratory fitness, and VAI in obese older women. As a hypothesis, it is believed that VAI may be a useful instrument to verify cardiometabolic risks.

METHODS

Study design and participants

This is a cross-sectional study conducted with older women (67.1 ± 4.9 years old) from the municipality of Maringá, State of Paraná, Brazil. Women were recruited through media releases: radio, newspaper, internet, television, and delivery folders at the Basic Health Unit (UBS), localized in University Center. All study disclosures were conducted by the University, as people participating in the study were those who lived close to the University. They were recruited for convenience. As inclusion criteria, women with the following characteristics were accepted:

- age ≥ 60 years old;
- being overweight or obese within the cut-off ranges proposed by the Pan American Health Organization;¹²
- being insufficiently active, following the International Physical Activity Questionnaire (IPAQ).¹³

Presenting a mental or degenerative disease of the central nervous system, according to the Mini-Mental State Examination (MMSE),¹⁴ was the exclusion criteria. All participants were informed about the study objectives and signed the informed consent form. All ethical and legal aspects were respected. The Research Ethics Committee approved the study with protocol n. 3.373.307/2018. Based on the responses observed in the present study, each older woman received instructions regarding her health, self-care (if possible), medical, physiotherapeutic, and nutritional referral. Also, the older women were offered community health services at the University, such as multi-professional monitoring for the treatment of obesity, composed of medical doctors, physical education professionals, physiotherapists, nutritionists, and psychologists.

Clinical evaluation

Anamnesis was conducted to track possible pathologies, ingestion of alcoholic beverages, use of illicit drugs, cigarette consumption, continuous-use drugs, allergies, and the presence of musculoskeletal pain. Pulmonary and cardiac auscultation were verified, blood pressure was measured according to the standard established by the 7th Brazilian Hypertension Guideline,¹⁵ and peripheral oxygen saturation (SatO₂) was consumed.

Two questionnaires were applied. One was the MMSE for cognitive performance, consisting of two parts, one covering orientation, memory, and attention, with a maximum score of 21 points. The other addressed specific skills such as naming and understanding, with a top score of 9 points, totaling a score of 30 points.¹⁴ Besides, the women completed the IPAQ short version, consisting of six open-ended questions that allowed us to verify the time spent on physical activities in days and weeks, in the most varied dimensions that included physical activities such as walking and physical exertion of moderate and vigorous-intensity. Thus, duration (minutes/day) and frequency (days/week) of physical activity were verified.

Blood collection

The collections of biochemical exams were conducted in the Clinical Analysis Laboratory of the Universidade Cesumar. All lipid profile analysis was conducted by a biomedical team blinded to other assessments. The participants were previously instructed to fast for 12 hours. Blood samples were collected by venipuncture for analysis of HDL-c, low-density lipoprotein (LDL-c), and TG. Additionally, the TG/HDL and LDL/HDL ratios were calculated. Tubes for vacuum blood collection (Vacutainer, Becton Dickinson, Plymouth, UK) were used, with clot additive gel separator. The samples were centrifuged at 3,600 rpm for 11 minutes at a controlled temperature (24°C) for serum and plasma separation. For the biochemical analyses, Siemens equipment (Advia 1800 Chemistry Analyzer®, Siemens Healthcare Diagnostics, Illinois, United States) was used. All analyses were conducted in triplicate means by Siemens reagents (Frimley, Camberley, United Kingdom), following the fabricant's specifications.

Anthropometric and body composition analysis

Body composition analysis was performed via tetra-polar bioelectrical impedance with eight electrodes (InBody, Seoul, South Korea). The following parameters were evaluated: body weight in kg, BMI, lean mass index (LMI), fat mass index (FMI), lean mass (LM), body fat percentage, and

skeletal muscle mass (SMM). Participants were instructed not to consume food and drink (solid and liquid) within 4 hours prior to the test, to urinate 30 minutes before the test, not to exercise during the last 24 hours, not to drink caffeinated beverages 12 hours before the measurement itself, and to wear light, metal-free clothing.¹⁶ Additionally, they were measured using an inextensible tape (Sanny, São Paulo, Brazil) for the WC and hip circumference (HC). The waist/hip ratio (WHR) was calculated, following the standardization proposed by Heyward.¹⁶ For anthropometric analysis, height was measured using a metal stadiometer (Sanny, São Paulo, Brazil), with a precision of 0.1 cm. The device was fixed to the wall, and those being measured were instructed not to wear footwear, to stand with heels and knees aligned, with arms loose and positioned along the body, with palms facing the thighs, with straight legs, relaxed shoulders, and with heads in the Frankfurt plane (looking at the horizon in a straight line at eye level).¹⁶ The anthropometrical measures were conducted by a nutritional team, without access to biochemical measurements and results.

Visceral adiposity index

The VAI is a mathematical formula aiming to identify cardiometabolic risks using sex-specific equations, as well as WC in centimeters, BMI, TG, and HDL-c. Thus, the validated equation 1 for females was used, according to Amato et al.:¹⁷

$$VAI = \frac{CC}{36,58 + (1,89 \times IMC)} \times \frac{TG}{0,81} \times \frac{1,52}{HDL - c} \quad (1)$$

Cardiorespiratory fitness test

The treadmill exercise test assessed the participants' functional capacity and physical performance. For the test, a heart rate monitor (Model FT1, Polar, Kempele, Finland) was worn by each participant to monitor the heart rate during exercise. It was adapted for the Bruce protocol, which is indicated for the older people, consisting of stages (with inclination and increased treadmill speed) lasting 3 minutes. In addition, 30 seconds before the end of each stage, peripheral oxygen saturation (SpO₂) was verified by a finger oximeter (G-TECHR, São Paulo, Brazil). Similarly, the women had a reading done of their rating of perceived exertion (RPE) on a scale of 6 to 20, as proposed by Borg.¹⁸ Standardization of the adapted Bruce test on the treadmill was conducted consisting of the following variations and inclinations:

- the first stage, with a speed of 2.70 km/h without inclination;

- the second stage, with a speed of 2.70 km/h and 5% inclination;
- the third stage, with a speed of 2.70 km/h and 10% inclination;
- the fourth stage, with a speed of 4 km/h and a slope of 12%;
- the fifth stage, with a speed of 5.40 km/h and 14% inclination;
- the sixth stage, with a speed of 6.70 km/h and a slope of 16%;
- the seventh stage, with a speed of 8 km/h and an inclination of 18%;
- the eighth stage, with a speed of 8.80 km/h and 20% slope;
- ninth stage, with a speed of 9.60 km/h and a slope of 22%.¹⁹

Direct analysis of oxygen consumption

For direct analysis of oxygen consumption (VO_2), a metabolic gas analyzer (VO2000, Med Graphics, St. Paul, MN, USA) was used to quantify VO_2 peak, with heart rate monitoring using a heart rate monitor, as well as blood pressure measurement via sphygmomanometer and standard stethoscope. Expired gases analyzed VO_2 peak during the test, the duration of which was performed until voluntary exhaustion. Prior to each test, the equipment was calibrated to the manufacturer's specifications.

Statistical analysis

First, the data normality was tested using the Shapiro-Wilk test. After the confirmation, the data were presented in mean, standard deviation ($\pm$), and 95% confidence interval (95%CI). Besides, a Pearson's correlation was applied between all variables used in the present study. All analyses were conducted by a supervisor that did not have access to any measurements performed in this study. A significance level of 5% was adopted for all variables. We used the SPSS 22.0 (IBM, Armonk, NY, USA) to conduct the statistical analysis.

RESULTS

Table 1 presents the anthropometric measurements, body composition, lipid profile, and VO_2 peak of the participants of the present study ($n = 27$).

Table 2 presents the correlations between anthropometric measurements, body composition, lipid profile, VO_2 peak, and VAI of the older women participating in the present study ($n = 27$).

Table 1 Anthropometric measurements, body composition, lipid profile, and VO_2 peak of the older women participating in the present study ($n = 27$).

Variables	Mean	SD	95%CI
BMI (kg/m^2)	32.80	6.10	30.70 – 35.00
LMI (kg/m^2)	17.90	2.00	17.20 – 18.60
FMI (kg/m^2)	14.90	4.70	13.30 – 16.50
WC (cm)	103.80	13.40	99.00 – 108.80
HC (cm)	115.60	11.70	111.50 – 120.70
WHR (cm/cm)	0.90	0.10	0.87 – 0.93
LM (kg)	45.50	7.20	43.00 – 48.30
FM (kg)	37.50	11.20	33.50 – 41.80
SMM (kg)	24.80	4.20	23.30 – 26.50
HDL (mg/dL)	49.60	10.40	45.40 – 53.30
LDL (mg/dL)	97.30	37.70	84.20 – 112.10
TG (mg/dL)	139.00	90.30	109.20 – 178.40
TG/HDL (mg/dL)	3.10	2.70	2.30 – 4.30
LDL/HDL (mg/dL)	2.00	0.80	1.70 – 2.30
VO_2 peak ($\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$)	19.00	5.10	17.00 – 20.80
VAI	6.00	4.80	4.40 – 8.30

SD: standard deviation; 95%CI: 95% confidence interval; BMI: body mass index; LMI: lean mass index; FMI: fat mass index; WC: waist circumference; HC: hip circumference; WHR: waist-hip ratio; LM: lean mass; FM: fat mass; SMM: skeletal muscle mass; HDL: high density lipoproteins; LDL: low density lipoproteins; TG: triglycerides; VO_2 peak: peak oxygen consumption; VAI: visceral adiposity index.

DISCUSSION

Considering the main objective of the present study was to evaluate possible correlations between anthropometric measurements, lipid profile, cardiorespiratory fitness and VAI in obese older women, the main results observed were:

- VAI and HDL-c ($r = -0.53$);
- VAI and LDL-c ($r = -0.35$);
- VAI and TG ($r = 0.86$);
- (d) VAI and TG/HDL ($r = 0.99$);
- VAI and VO_2 peak ($r = -0.55$).

Secondarily, the following correlations were observed:

- VO_2 peak and LDL/HDL ($r = -0.58$);
- VO_2 peak and LDL-c ($r = -0.39$);
- VO_2 peak and FM ($r = -0.46$);
- VO_2 peak and HC ($r = -0.43$);

Table 2 Correlations between anthropometric measurements, body composition, lipid profile, VO₂ peak, and VAI of the older women participating in the present study (n = 27).

	BMI	LMI	FMI	WC	HC	WHR	LM	FM	SMM	HDL	LDL	TG	TG/HDL	LDL/HDL	VO ₂ peak	VAI
BMI	1.00	0.82**	0.97**	0.75**	0.94**	-0.03	0.50**	0.96**	0.52**	-0.39*	-0.12	0.13	0.25	0.07	-0.39*	0.24
LMI	0.82**	1.00	0.82**	0.64**	0.71**	0.10	0.82**	0.70**	0.83**	-0.27	-0.28	0.14	-0.18	-0.15	-0.08	0.14
FMI	0.97**	0.64**	1.00	0.71**	0.93**	-0.08	0.30	0.96**	0.32	-0.39*	-0.03	0.10	0.24	0.16	-0.47**	0.17
WC	0.75**	0.64**	0.71**	1.00	0.74**	0.55**	0.61**	0.71**	0.61**	-0.36	-0.29	-0.07	0.06	-0.15	-0.34	0.07
HC	0.94**	0.71**	0.93**	0.74**	1.00	-0.11	0.48**	0.94**	0.49**	-0.34*	-0.02	-0.04	0.11	0.12	-0.43*	0.04
WHR	-0.02	0.10	-0.08	0.54**	-0.11	1.00	0.33*	0.03	0.33*	-0.09	-0.54**	-0.03	-0.06	-0.53**	0.18	0.03
LM	0.50**	0.82**	0.30	0.61**	0.48**	0.33*	1.00	0.51**	0.99**	-0.23	-0.37*	0.02	0.14	-0.27	0.01	0.14
FM	0.96**	0.70**	0.96**	0.80**	0.94**	0.03	0.51**	1.00	0.52**	-0.41*	-0.09	0.09	0.27	0.09	-0.46**	0.21
SMM	0.52**	0.83**	0.32	0.61**	0.49**	0.33*	0.99**	0.52**	1.00	-0.24	-0.38*	0.04	0.15	-0.28	0.00	0.16
HDL	-0.38*	-0.27	-0.39*	-0.36*	-0.34*	-0.09	-0.23	-0.41*	-0.24	1.00	0.25	-0.12	-0.51**	-0.25	0.31	-0.53**
LDL	-0.11	-0.28	-0.03	-0.29	-0.02	-0.54**	-0.37*	-0.09	-0.38*	0.25	1.00	-0.31	-0.29	0.85**	-0.39*	0.35*
TG	0.12	0.14	0.10	-0.07	-0.04	-0.03	0.02	0.09	0.04	-0.12	-0.31	1.00	0.87**	-0.11	-0.04	0.86**
TG/HDL	0.24	0.18	0.24	0.06	0.15	-0.06	0.14	0.27	0.15	-0.51**	-0.29	0.87**	1.00	0.08	-0.29	0.99**
LDL/HDL	0.07	-0.14	0.15	-0.15	0.12	-0.53**	-0.27	0.09	-0.28	-0.25	0.85**	-0.11	0.08	1.00	-0.58**	0.02
VO ₂ peak	-0.39*	-0.08	-0.47**	-0.34*	-0.43*	0.18	0.01	-0.46**	0.00	0.31	-0.39*	-0.04	-0.29	-0.58**	1.00	-0.55**
VAI	0.17	0.13	0.16	0.07	0.04	0.03	0.14	0.21	0.13	-0.53**	0.35*	0.86**	0.99**	0.02	-0.55**	1.00

BMI: body mass index; LMI: lean mass index; FMI: fat mass index; WC: waist circumference; HC: hip circumference; WHR: waist-hip ratio; LM: lean mass; FM: fat mass; SMM: skeletal muscle mass; HDL: high density lipoproteins; LDL: low density lipoproteins; TG: triglycerides; VO₂ peak: peak oxygen consumption; VAI: visceral adiposity index; * = < 0,05; ** = < 0,01.

- VO₂ peak and WC (r = -0.34);
- VO₂ peak and BMI (r = -0.47);
- VO₂ peak and BMI (r = -0.39).

The negative correlation detected between VAI and HDL-c may be associated with increased cardiometabolic risk, increased adipose tissue, and reduced sensitivity to insulin action, as demonstrated previously by other study.²⁰ In this case, the higher the VAI, it is suggested, the lower the HDL-c.²¹ These also suggest that the elevation of LDL-c and serum TG increase the cardiometabolic risk in sedentary people. The literature points to biomarkers of inflammation that show anthropometric parameters in the obese older people, in addition to vascular damage, resistance to insulin action, and atherosclerosis.²² The higher the VAI, the higher the TG/LDL and LDL/HDL ratios, as visceral risk factors.⁹

Thus, the TG/LDL and LDL/HDL ratios can be incorporated as a cardiometabolic risk assessment instrument in blood tests, since preventive measures and treatment

can be performed to improve the quality of life of people. Another point that can be emphasized is the incorporation of the calculation of VAI in biochemical exams at the time the evaluated patients have their body weight and height measured. Thus, considering that VAI has cut-off points that indicate risks associated with visceral adiposity,¹⁷ health professionals will note possible risks related to visceral adiposity in a less expensive way, as VAI and imaging exams are interconnected as to the risks of visceral adiposity.¹² Postmenopausal women with high TG/HDL ratio are also associated with a higher likelihood of carotid plaque deposition.²³ However, it should be highlighted that image diagnostics such as MRI, CT, and DXA are, in fact, the gold standard measurements. Although there are limitations regarding the use of anthropometry to estimate health risks, the use of the lipid profile and VAI together can be interesting strategies (considering their respective limitations) in the first levels of primary health care.

Therefore, another point that can be considered is the elaboration of cut-off ranges based on the TG/HDL ratio, intending to provide risk indicators, so that the health professional promotes more assertive behaviors to the evaluated public. Within the context of health promotion, especially in senescence, the limitation of gait speed is related to the reduction of activities of daily living and, consequently, favors functional disability and increased fat mass, which is closely associated to the low energy expenditure added to the high caloric consumption.²⁴ Preventive and therapeutic measures are recommended to promote health in the older people, such as the encouragement of physical exercise, including resistance and aerobic exercises.²⁵

The incorporation of regular aerobic exercise is fundamental in this age range because the results of the present study have suggested that the VO_2 peak is inversely correlated with VAI. In this sense, low values of VO_2 peak are related to lower life expectancy. Besides that, the increase in BMI is negatively correlated with VO_2 peak, and low aerobic fitness is related to shorter life expectancy.²⁶ Thus, the incorporation of aerobic exercises in a physical activity program for older adults is indispensable for the maintenance of cardiovascular health. Also, fat mass, BMI, and high BMI are correlated with reduced aerobic fitness. The decrease in VO_2 peak in women with senescence is greater than in men and is related to cardiorespiratory disease in aging.²⁷ Weight reduction associated with physical activity represents a decrease in myocardial damage, such as heart failure in the obese.²⁸

Another point that cannot be overlooked to improve the older people quality of life and consequent healthy aging is a substantial awareness and stimulus for physical activity, especially resistance exercises, to maintain and even increase muscle mass in order to improve functional capacity and reduce physical inactivity and risks associated with falls.²⁹ In overweight individuals, waist circumference does not differ from the visceral adipose tissue from the cutaneous adipose tissue.³⁰ In this context, the present study indicated negative correlations between VO_2 peak and WC and HC, suggesting that circumferences may negatively impact aerobic fitness. It is further emphasized that being overweight and being obese are risk factors among older adults for the acquisition of mild cognitive impairment.³¹

Finally, it is relevant to emphasize that, in general, obesity and sedentary lifestyle in the older women population are related to cardiovascular risk. Given this, the incorporation

of preventive strategies to increase physical activity, healthy food consumption, and HDL-c, reducing sedentary time, as well as decreasing obesity, insulin resistance, LDL-C, very-low-density lipoprotein (VLDL-c), and TG, can improve vascular aging.³² Despite the essential data presented, this study has some limitations. First, the cross-sectional design, which prevents inferring causality. Second, the non-probabilistic and small sample, which prevents the generalization of the results.

CONCLUSION

VAI is associated with lipid profile and cardiorespiratory fitness in older women, with negative correlations between HDL-c and VO_2 peak, suggesting these variables are negatively influenced by visceral adiposity. Besides, TG, LDL-c, and TG/HDL showed positive correlations with VAI. These responses recommend other analyses in order to confirm possible risks for health. In addition, the responses of the present study advocate that VAI may be used as a cardiometabolic risk marker, especially among obese older women. It is suggested that further studies may be conducted combining VAI, diet, and socioeconomic conditions to identify the presence of these changes. Given the aspects explored in this study, it is evident that obesity is a worrying factor in aging, and its risks can be easily detected by professionals in various health areas in their clinical practice. More studies are needed to better understand the applicability of VAI as a cardiometabolic risk factor indicator in older adults.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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None.

AUTHORS' CONTRIBUTION

ARC: conceptualization, data curation, writing – original draft. DVO: writing – original draft. PVB: writing – original draft, formal analysis. MPB: formal analysis. SMMGB: writing – original draft. BHMB: conceptualization, data curation, writing – original draft.

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