cadernos
Saúde Coletiva
ISSN 2358-291X (Online)

ORIGINAL ARTICLE

Hypertriglyceridemic waist phenotype in older adults: prevalence and associated factors

Fenótipo da cintura hipertrigliceridêmica em pessoas idosas: prevalência e fatores associados

Yuri Silva de Souza[1], Lucas dos Santos[2], Débora Jesus da Silva[1], Raquel dos Santos Barbosa[1], Lélia Lessa Teixeira Pinto[3], Paulo da Fonseca Valença Neto[4], Cezar Augusto Casotti[1]

[1]*Universidade Estadual do Sudoeste da Bahia (UESB) – Jequié (BA), Brasil.*
[2]*Universidade Estadual do Tocantins (UNITINS) – Augustinópolis (TO), Brasil.*
[3]*Escola Baiana de Medicina e Saúde Pública (EBMSP) – Salvador (BA), Brasil.*
[4]*Ministério da Saúde (MS) – Brasília (DF), Brasil.*

How to cite: Souza YS, Santos L, Silva DJ, Barbosa RS, Pinto LLT, Valença Neto PF, Casotti CA. Hypertriglyceridemic waist phenotype in older adults: prevalence and associated factors. Cad Saúde Colet, 2024;32(4):e32040610. https://doi.org/10.1590/1414-462X202432040610

Abstract

Background: The hypertriglyceridemic waist (HW) phenotype is characterized by abdominal obesity and elevated blood triglycerides, indicating high cardiovascular risk in older adults. **Objective:** To identify the prevalence and factors associated with HW in older adults. **Method:** A cross-sectional epidemiological study was conducted with 223 older adults (mean age 71.80 ± 7.70 years) residing in Aiquara, Bahia, Brazil. HW was diagnosed by the presence of elevated waist circumference (women: ≥ 88 cm; men: ≥ 102 cm) in conjunction with hypertriglyceridemia (triglycerides ≥ 150 mg/dL). Poisson regression with robust variance was used for analysis, along with estimates of Prevalence Ratios (PR) and their respective 95% Confidence Intervals (CI). **Results:** The prevalence of HW was 23.30%. Female sex (PR: 2.50; 95% CI: 1.35–4.63), marital status (separated or divorced) (PR: 2.30; 95% CI: 1.33-3.96), elevated non-HDL cholesterol (PR: 2.15; 95% CI: 1.37–3.49), and low HDL cholesterol (PR: 2.35; 95% CI: 1.49–3.72) presented a greater probability of HW. Additionally, low weight presented a lower probability of HW (PR: 0.17; 95% CI: 0.04–0.60). **Conclusion:** A high prevalence of HW was identified, with positive associations with female sex, separated or divorced marital status, elevated non-HDL cholesterol, and low HDL cholesterol. Conversely, low weight showed an inverse association with HW.

Keywords: aging; epidemiology; hypertriglyceridemia; abdominal obesity.

Resumo

Introdução: O fenótipo cintura hipertrigliceridêmica (CH) é caracterizado por obesidade abdominal e triglicerídeos elevados no sangue, indicando alto risco cardiovascular em pessoas idosas. **Objetivo:** Identificar a prevalência e os fatores associados à CH em pessoas idosas. **Método:** Estudo epidemiológico transversal realizado com 223 pessoas idosas (idade média de 71,80 ± 7,70 anos) residentes em Aiquara, Bahia, Brasil. A CH foi diagnosticada pela presença de circunferência da cintura elevada (mulheres: ≥ 88 cm; homens: ≥102 cm) em conjunto com hipertrigliceridemia (triglicerídeos ≥150 mg/dL). A regressão de Poisson com variância robusta foi utilizada para análise, com estimativas das Razões de Prevalência (RP) e seus respectivos Intervalos de Confiança (IC) de 95%. **Resultados:** A prevalência de CH foi de 23,30%. O sexo feminino (RP: 2,50; IC 95%: 1,35–4,63), estado civil (separado ou divorciado) (RP: 2.30; IC95%: 1.33-3.96), colesterol não-HDL elevado (RP: 2,15; IC95%: 1,37–3,49) e colesterol HDL baixo (RP: 2,35; IC95%: 1,49–3,72) apresentaram maior probabilidade para a CH. Além disso, o baixo peso apresentou menor probabilidade para a CH (RP: 0,17; IC95%: 0,04–0,60). **Conclusão:** Foi identificada uma alta prevalência de CH, com associações positivas

Correspondence: Lucas dos Santos. E-mail: lsantos.ed.f@gmail.com
Financial support: The research was funded by the Brazilian Unified Health System Research Program, Call for Proposals 20/2013/SUS0055/2013, through the Bahia State Research Support Foundation.
Conflict of interests: The authors declare that they have no conflicts of interest.
Received on: Dec 30, 2021. Accepted on: June 11, 2022

cadernos Saúde Coletiva

com o sexo feminino, estado civil separado ou divorciado, colesterol não-HDL elevado e colesterol HDL baixo. Por outro lado, o baixo peso apresentou associação inversa com a CH.

Palavras-chave: envelhecimento; epidemiologia; hipertrigliceridemia; obesidade abdominal.

INTRODUCTION

During human aging, several physiological changes occur, leading to excessive fat accumulation in adipose tissue, particularly in the abdominal region[1]. Additionally, alterations in the lipid profile are often observed, such as elevated blood triglyceride levels[2.]

This combination defines the hypertriglyceridemic waist (HW) phenotype[3], an adverse health condition in older adults that increases the likelihood of cardiovascular diseases and raises mortality risk[4,5].

However, investigations into this outcome in older populations remain limited[6,7], as most studies addressing this topic include a broad age range[2,4,8-10]. This gap highlights the need for health surveys to determine the prevalence of this condition and to identify the subgroups in which it is more common in later life stages, especially given that cardiovascular diseases account for 30.30% of morbidity in older adults and are a leading cause of illness and life-years lost in this population[11].

Epidemiological surveys can thus aid in the early identification and screening of at-risk individuals, supporting targeted and more effective interventions in primary health care. With this purpose in mind,the presnt study aimed to identify the prevalence and factors associated with hypertriglyceridemic waist in older adults.

MATERIAL AND METHODS

Study design, setting, and population

This cross-sectional study was based on data from a census, population-based household survey titled "Health Conditions and Lifestyle of Older Adults in a Small Municipality," conducted with older adults living in the urban community of Aiquara, a town in the Center-South region of the state of Bahia, Brazil[12]. The municipality covers approximately 167 km^2 and has an estimated population of 4,416 residents. It has a low Human Development Index (HDI = 0.583), ranking 4,562nd out of 5,565 Brazilian cities[13].

Participants met the following inclusion criteria: being aged ≥ 60 years and not institutionalized. Exclusion criteria included residing in the rural area, cognitive impairment (determined by a score < 13 on the Mini Mental State Examination)[14], and unavailability after three home visits on different days and times.

A census was initially conducted in Aiquara with the support of the Family Health Strategy (*Estratégia Saúde da Família*), covering 100% of the city's population to identify older adults in the urban area. Consequently, all households were organized by territory and visited, identifying 379 older adults, of whom 223 participated in the study (see Figure 1).

Data collection procedures

Data were collected between January and July 2015, involving three stages: questionnaire application, clinical and anthropometric assessments, and blood sample collection.

Household survey

The household survey, conducted in January 2015 through standardized interviews by a team of trained professionals and health science students, collected sociodemographic data, including age group (60–69, 70–79, ≥ 80 years), sex, self-reported skin color (white or non-white [Brown, Black, Indigenous]), education (educated or uneducated [defined as no schooling or only able to write one's name]), marital status (married/stable union, divorced/separated, widowed), monthly income (≤ 1 minimum wage or >

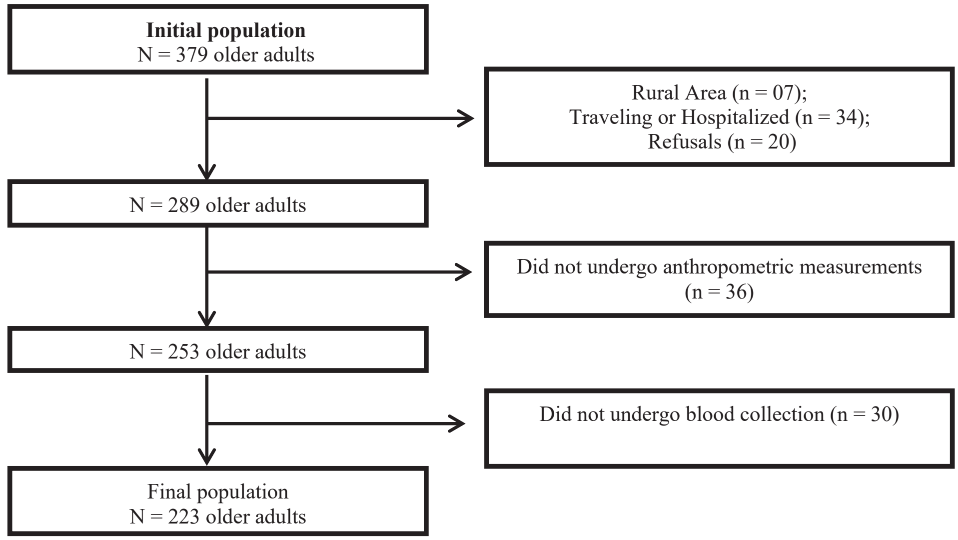

Figure 1. Flowchart of the eligibility process for selecting older adult participants. Aiquara, state of Bahia, Brazil, 2015.

1 minimum wage [2015 minimum wage: BRL 788.00]), and behavioral factors such as tobacco and alcohol consumption (yes or no). The frequency of health service use over the past year was recorded as two or more times, once, or none.

Physical activity was assessed using the long form of the International Physical Activity Questionnaire (IPAQ) [15], validated for older Brazilian[16,17]. Insufficiently active individuals were classified as engaging in less than 150 minutes of moderate to vigorous activity[18]. Sedentary behavior was measured using the 5th domain of the IPAQ, which calculates sitting time on a typical weekday and weekend day. The weighted SB average was calculated as: (5 x min/weekday) + (2 x min/weekend day) / 7. High SB was defined as sitting time above the 75th percentile (430.00 min/day).

Clinical assessment and anthropometric measurements

Clinical and anthropometric measurements were conducted at the Municipal Health Department in Aiquara in March 2015. Blood pressure was measured per the Brazilian Guidelines on Arterial Hypertension[19], using HEM 742 Omron® semi-automatic devices, with two measurements taken at 5-minute intervals. Older adults with a systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg were considered to have high blood pressure[19].

Height (m) was measured using a WiSO® stadiometer, with participants instructed to stand upright, heels together, with heels, buttocks, and shoulder blades against the wall, and eyes fixed on a horizontal plane[20]. Body mass (kg) was measured with a Plenna® digital scale, calibrated with a known-weight object prior to each use. Participants stood still, wearing light clothing and barefoot, with arms at their sides[20]. Based on that information, the body mass index in kg/m^2 was calculated.

Waist circumference was measured using a flexible, non-elastic, anthropometric tape (Sanny®) at the narrowest point between the last floating rib and the iliac crest at the end of normal exhalation[21].

Blood collection

Blood samples were collected from May to July 2015 at the Municipal Health Department of Aiquara in a clean, climate-controlled environment, following national biosafety guidelines[22]. A team of nursing and clinical laboratory technicians, equipped with personal protective

cadernos Saúde Coletiva

equipment including latex gloves, goggles, caps, and waterproof coats, conducted the collection. Participants were instructed to fast for 12 hours before the procedure.

For the procedure, participants sat comfortably with their arms positioned horizontally for venipuncture. The median cubital vein was accessed using a tourniquet applied for no longer than 1.5 minutes, following aseptic site preparation with 70% alcohol. For participants unable to visit the facility, home blood collection was conducted following the same biosafety protocols[22].

Blood was collected in vacuum tubes with an aspiration volume of 3–10 mL. Two tubes were taken per participant: a gray-stoppered tube containing fluoride and EDTA K3 for glucose analysis, and a red-stoppered tube for serum collection for other hormonal and biochemical assessments.

Samples were placed in coolers with reusable ice to maintain temperatures between +2 °C and +8 °C and were processed at the Public Health Laboratory, Pirajá da Silva Reference Center for Endemic Diseases, in Jequié, Bahia, Brazil.

Biochemical analyses included total cholesterol and its fractions (HDL-C, LDL-C, and non-HDL cholesterol), triglycerides, and fasting glucose, measured with SELLECTRA II® automated technology using the colorimetric enzymatic method. HDL-C was measured using direct precipitation, and LDL-C was calculated by the Friedewald equation. Hormonal assays (TSH and vitamin D [25-hydroxy]) were performed with ARCHTTECT® using chemiluminescence. Except for blood glucose, all samples were centrifuged to obtain serum. Variable cutoff points are shown in Chart 1.

Chart 1. Cutoff points for biochemical and hormonal profile categories among older adults participants. Aiquara, state of Bahia, Brazil, 2015.

Authors	Year	Variable	Cutoff point adopted
BDS[23]	2019	Hyperglycemia	≥ 100 mg/dL
Faludi et al.[24]	2017	Low HDL-C	< 40 mg/dL
Faludi et al.[24]	2017	High LDL-C	≥ 130 mg/dL
Faludi et al.[24]	2017	High non-HDL-C	≥ 160 mg/dL
Holick et al.[25]	2011	Insufficient Vitamin D	< 30 pg/dL
Carvalho et al.[26]	2013	High TSH	> 4.5 µUI/ml

HDL: High-Density Lipoprotein, LDL: Low-Density Lipoprotein, THS: Thyroid-Stimulating Hormone; c: cholesterol; BDS: Brazilian Diabetes Society.

Hypertriglyceridemic waist

Hypertriglyceridemic waist was defined as an elevated waist circumference (≥ 88 cm for women and ≥ 102 cm for men)[21] combined with hypertriglyceridemia (triglycerides ≥ 150 mg/dL)[24].

Statistical analysis

Descriptive analyses included absolute and relative frequencies, mean, and standard deviation. For inferential analysis, bivariate associations were examined using Pearson's chi-squared test (χ^2). Variables with a value of less than or equal to 20% ($P \leq 0.20$) were included in the multivariate Poisson regression analysis with robust variance to estimate Prevalence Ratios (PR) and 95% Confidence Intervals (CI).

A hierarchical model was used, with sociodemographic factors as the most distal level (Level 1), behavioral aspects as the intermediate level (Level 2), and health conditions as the most proximal level (Level 3), as illustrated in Figure 2. The model construction began with the most distal variables, with successive levels added progressively. Each variable's effect was adjusted for variables within the same and preceding levels, retaining only those with $P \leq 0.20$ (Wald test for heterogeneity). The significance level for factors associated with the outcome in the final model was 5% ($P \leq 0.05$). The statistical procedures were conducted in the Statistical Package for Social Sciences (SPSS® 21.0, 2013, Inc, Chicago, IL)

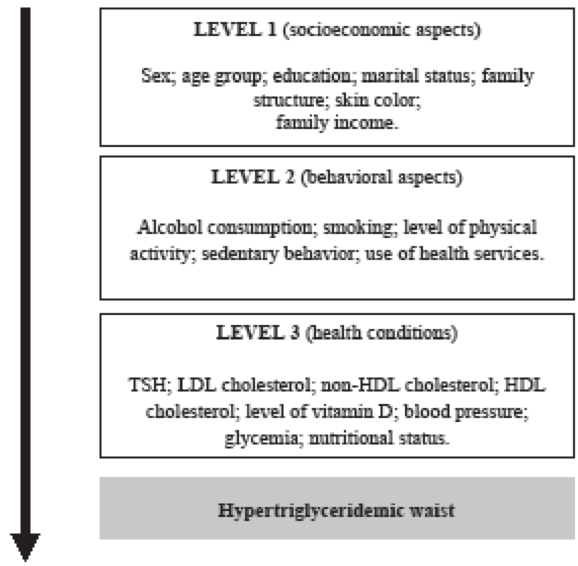

Figure 2. Hierarchical model for identifying factors associated with the hypertriglyceridemic waist in the study population. Aiquara, state of Bahia, Brazil, 2015

Ethical aspects

This study followed the World Medical Association's Declaration of Helsinki and complied with Brazilian National Health Council Resolution No. 466/2012. The Research Ethics Committee of the State University of Southwest Bahia (UESB) approved the study (CAAE No: 10786212.3.0000.0055; Opinion No. 171.464).

RESULTS

A total of 223 older adults participated in the study, with a mean age of 71.80 ± 7.70 years (older women: 71.40 ± 7.10; older men: 72.50 ± 8.40). The prevalence of HW was 23.30%. Among the participants, 57% were women, 43% were insufficiently active, 47.40% had elevated non-HDL cholesterol, 51.80% presented insufficient vitamin D levels, 78% had high blood pressure, and 42.50% had hyperglycemia. Additional population characteristics are detailed in Table 1.

Table 2 presents the bivariate analyses between the independent variables and HW. Sex, marital status, skin color, alcohol consumption, physical activity level, health service use, nutritional status, non-HDL cholesterol, HDL cholesterol, vitamin D level, and glycemia (blood glucose) had a P-value of less than or equal to 20% ($P \leq 0.20$) and were therefore included in the multivariate analysis.

After intra- and inter-level adjustments according to the hierarchical model, the variables alcohol consumption, health service use, vitamin D level, and glycemia did not meet the established statistical criteria ($P \leq 0.20$) and were subsequently removed from the model.

In the final hierarchical Poisson regression model, it was found that being female (PR: 2.50; 95% CI: 1.35-4.63), being divorced or separated (PR: 2.30; 95% CI: 1.33-3.96), having elevated non-HDL cholesterol (PR: 2.15; 95% CI: 1.37-3.49) and low HDL cholesterol (PR: 2.35; 95% CI: 1.49-3.72) were positively associated with HW. In addition, older adults with low weight were less likely to present with the outcome compared to those with normal weight (PR: 0.17; 95% CI: 0.04-0.60) (see Table 3).

DISCUSSION

This study found that 23.30% of older adults in Aiquara, Bahia, Brazil, had hypertriglyceridemic waist, with positive associations identified for female sex, marital status (separated or divorced), elevated non-HDL cholesterol, and low HDL cholesterol. An inverse association was observed between HW and low weight.

cadernos Saúde Coletiva

Table 1. Descriptive analysis of the study population characteristics. Aiquara, state of Bahia, Brazil, 2015.

Variables	% response	N	%
Sex	100.00		
Male		96	43.00
Female		127	57.00
Age group	100.00		
60-69 years		89	39.90
70-79 years		92	41.30
≥ 80 years		42	18.80
Education	98.20		
Educated		101	46.10
Uneducated		118	53.90
Marital status	100.00		
Married/stable union		114	51.10
Divorced/separated		52	23.30
Widowed		57	25.60
Family structure	100.00		
Accompanied		180	80.70
Alone		43	19.30
Skin color	98.70		
White		22	10.00
Non-white		198	90.00
Income	99.10		
≤ 1 minimum wage		191	86.40
> 1 minimum wage		30	13.60
Alcohol consumption	99.60		
No		175	78.80
Yes		47	21.20
Smoking	100.00		
No		187	83.90
Yes		36	16.10
Level of physical activity	100.00		
Sufficient		127	57.00
Insufficient		96	43.00
High sedentary behavior	100.00		
No		168	75.30
Yes		55	24.70
Use of health services	100.00		
≥ 2 times/year		178	79.80
1 time/year		19	8.50
None		26	11.70
Nutritional status	100.00		
Low weight		60	29.90
Normal weight		87	39.30
Overweight/obesity		76	34.10
TSH	93.30		
Normal		197	94.70
Altered		11	5.30
LDL cholesterol	93.30		
Normal		110	52.90
High		98	47.10
Non-HDL cholesterol	94.60		
Normal		111	52.60
High		100	47.40
HDL cholesterol	94.60		
Normal		158	74.90
Low		53	25.10

%: percentage; N: number of participants; TSH: Thyroid-Stimulating Hormone; LDL: Low-Density Lipoprotein; HDL: High-Density Lipoprotein; HW: hypertriglyceridemic waist. *dichotomized by the average (1 minimum wage in 2015 = BRL 788.00).

Cad. Saúde Colet., 2024; 32(4):e32040610 | https://doi.org/10.1590/1414-462X202432040610

Table 1. Continued...

Variables	% response	N	%
Level of vitamin D	88.30		
Sufficient		95	48.20
Insufficient		102	51.80
High blood pressure	100.00		
No		49	22.00
Yes		174	78.00
Glycemia (blood glucose)	99.10		
Normal		127	57.50
High		94	42.50
HW	100.00		
No		171	76.70
Yes		52	23.30

%: percentage; N: number of participants; TSH: Thyroid-Stimulating Hormone; LDL: Low-Density Lipoprotein; HDL: High-Density Lipoprotein; HW: hypertriglyceridemic waist. *dichotomized by the average (1 minimum wage in 2015 = BRL 788.00).

Table 2. Prevalence of hypertriglyceridemic waist among the older adults by independent variables. Aiquara, state of Bahia, Brazil, 2015.

Variables	Hypertriglyceridemic Waist				X^2	P-value
	No		Yes			
	N	%	N	%		
Sex					13.260	**<0.001**
Male	85	88.50	11	11.50		
Female	86	67.70	41	32.30		
Age group					0.544	0.762
60-69 years	67	75.30	22	24.70		
70-79 years	70	76.10	22	23.90		
≥ 80 years	34	81.00	08	19.00		
Education					0.028	0.867
Educated	78	77.20	23	22.80		
Uneducated	90	76.30	28	23.70		
Marital status					13.024	**0.001**
Married/stable union	97	85.10	17	14.90		
Divorced/separated	31	59.60	21	40.40		
Widowed	43	75.40	14	26.40		
Family structure					0.627	0.428
Accompanied	140	77.80	40	22.20		
Alone	31	72.10	12	27.90		
Skin color					2.194	**0.139**
White	14	63.60	08	36.40		
Non-white	154	77.80	44	22.20		
Income*					0.001	0.978
≤ 1 minimum wage	146	76.40	45	23.60		
> 1 minimum wage	23	76.70	07	23.30		
Alcohol consumption						**0.120**
No	130	73.40	45	25.70	2.418	
Yes	40	85.10	07	14.90		
Smoking					1.062	0.303
No	141	75.40	46	24.60		
Yes	30	83.30	06	16.70		
Level of physical activity					2.178	**0.140**
Sufficient	102	80.30	25	19.70		
Insufficient	69	71.90	27	28.10		

%: percentage; N: number of participants; TSH: Thyroid-Stimulating Hormone; LDL: Low-Density Lipoprotein; HDL: High-Density Lipoprotein. *dichotomized by the average (1 minimum wage in 2015 = BRL 788.00).

Table 2. Continued...

Variables	Hypertriglyceridemic Waist				X^2	P-value
	No		Yes			
	N	%	N	%		
High sedentary behavior					0.092	0.762
No	128	76.20	40	23.80		
Yes	43	78.20	12	21.80		
Use of health services					3.848	**0.146**
≥ 2 times/year	133	74.70	45	25.30		
1 time/year	18	94.70	01	5.30		
None	20	76.90	06	23.10		
Nutritional status					22.460	**<0.001**
Low weight	57	95.00	03	5.00		
Normal weight	68	78.20	19	21.80		
Overweight/obesity	46	60.50	30	39.50		
TSH					0.145	0.703
Normal	153	77.70	44	22.30		
Altered	08	72.70	03	27.30		
LDL cholesterol					0.607	0.436
Normal	88	80.00	22	20.00		
High	74	75.50	24	24.50		
Non-HDL cholesterol					7.364	**0.007**
Normal	94	84.70	17	15.30		
High	69	69.00	31	31.00		
HDL cholesterol					14.175	**<0.001**
Normal	132	83.50	26	16.50		
Low	31	58.50	22	41.50		
Level of vitamin D					2.085	**0.149**
Sufficient	78	82.10	17	17.90		
Insufficient	75	73.50	27	26.50		
High blood pressure					0.027	0.871
No	38	77.60	11	22.40		
Yes	133	76.40	41	23.60		
Glycemia (blood glucose)					6.392	**0.011**
Normal	105	82.70	22	17.30		
High	64	68.10	30	31.90		

%: percentage; N: number of participants; TSH: Thyroid-Stimulating Hormone; LDL: Low-Density Lipoprotein; HDL: High-Density Lipoprotein. *dichotomized by the average (1 minimum wage in 2015 = BRL 788.00).

Table 3. Final hierarchical model of the association between hypertriglyceridemic waist and independent variables in the study population. Aiquara, state of Bahia, Brazil, 2015.

Level	Variables	Adjusted PR	95% CI	P-value*
1	**Sex**			**0.003**
	Male	1		
	Female	2.50	1.35-4.63	
	Marital status			**0.006**
	Married/stable union	1		
	Divorced/separated	2.30	1.33-3.96	
	Widowed	1.31	0.69-2.46	
	Skin color			0.136
	White	1		
	Non-white	0.64	0.36-1.14	
2	**Level of physical activity**			0.175
	Sufficient	1		
	Insufficient	1.37	0.86-2.16	

%: percentage; n: number of participants; HDL: High-Density Lipoprotein. *Wald test.

Table 3. Continued...

Level	Variables	Adjusted PR	95% CI	P-value*
3	**Nutritional status**			**0.007**
	Low weight	0.17	0.04-0.60	
	Normal weight	1		
	Overweight/obesity	1.30	0.79-2.15	
	Non-HDL cholesterol			**0.002**
	Normal	1		
	High	2.15	1.37-3.49	
	HDL cholesterol			**<0.001**
	Normal	1		
	Low	2.35	1.49-3.72	

%: percentage; n: number of participants; HDL: High-Density Lipoprotein. *Wald test.

A population-based survey of 316 older adults in Lafaiete Coutinho, Bahia, Brazil, reported a similar HW prevalence of 27.10%[6]. In contrast, a study conducted with 2,102 older adults in Beijing, China, found a higher prevalence of 29.90%[7]. Variations in HW prevalence across studies may stem from differences in sociodemographic profiles and health conditions among participants. Nevertheless, the high frequency of HW in older populations signifies an important public health issue, as this phenotype is linked to the atherogenic metabolic triad (elevated apolipoprotein B, high LDL-c levels, and fasting hyperinsulinemia), which contributes to cardiometabolic diseases and worsens health outcomes for older adults[3,27].

Our findings align with those of the Longitudinal Study on Adult Health (ELSA-Brazil), a multicenter study involving 12,811 adults and older adults (mean age: 51.10 ± 8.80 years) conducted in the Brazilian capitals of São Paulo, Belo Horizonte, Salvador, Rio de Janeiro, and Vitória. This study also observed associations between elevated non-HDL cholesterol (women: OR = 4.69, 95% CI: 3.94–5.58; men: OR = 2.94, 95% CI: 2.45–3.53), low HDL cholesterol (women: OR = 2.56, 95% CI: 2.19–2.99; men: OR = 3.06, 95% CI: 2.34–4.20), and HW[10].

Similarly, research conducted in Spain with 6,732 older adults using data from the *Prevención con Dieta Mediterránea* (PREDIMED-Plus) study identified negative correlations between HDL cholesterol and both triglycerides (r = -0.208; $P < 0.0001$) and waist circumference (r = -0.191; $P<0.0001$) in participants with HW[2].

These associations may reflect the interplay between abdominal obesity and lipid profile changes, as excess visceral fat can lead to adipocyte dysfunction, resulting in increased production and release of pro-inflammatory adipokines. This process elevates LDL and very-low-density lipoprotein (VLDL) cholesterol levels, which contribute to non-HDL cholesterol. Additionally, obesity-related inflammation may reduce HDL cholesterol[10,28].

Our results underscore an adverse epidemiological scenario in Aiquara, as abdominal obesity combined with dyslipidemia exacerbates comorbidities, raising the risk of hemodynamic and metabolic disorders like hypertension and diabetes mellitus, which can damage key organs (e.g., brain, kidneys, heart) and increase mortality risk[4,5,19,29].

Another notable finding was the association between HW and female sex. Similarly, Fagundes *et al*.[6] found that older women in Lafaiete Coutinho were 3.85 (95% CI: 2.16-6.87) times more likely to have HW than older men. The higher occurrence of HW in older women likely stems from a greater prevalence of abdominal obesity, driven by physiological changes following menopause[29-31]. Specifically, decreased estrogen levels during the climacteric period reduce resting energy expenditure and increase caloric intake, promoting fat accumulation. Moreover, fat redistribution from the hip to the abdominal region post-menopause contributes to both abdominal obesity and dyslipidemia[32-34].

In Aiquara, Bahia, Brazil, marital status was positively associated with HW, with divorced or separated older adults more likely to present this outcome. Studies suggest that older adults without partners tend to have higher rates of abdominal obesity and an unfavorable lipid profile[35-37]. Conversely, those living with a spouse generally benefit from more balanced diets and fewer high-risk behaviors, such as poor nutrition and sedentary lifestyles[10].

Conversely, underweight older adults were less likely to exhibit HW. This nutritional status, often marked by low muscle mass and low abdominal and overall fat levels, is frequently associated with malnutrition. Unintentional weight loss may result from various factors, including comorbidities, polypharmacy, and inadequate nutrient intake[8,30,38].

This study has certain limitations, such as the indirect measurement of physical activity and sedentary behavior. However, a notable strength lies in the biochemical and hormonal assessment methods, as well as in the census-based approach, which allowed for the investigation of a large number of older adults in a municipality with low socioeconomic indicators. These findings may inform health surveillance strategies for older adults in Aiquara, Bahia, Brazil, and similar communities, facilitating early identification of individuals with a greater likelihood of HW and guiding targeted health interventions based on the factors identified in this study.

CONCLUSION

The findings indicate a high prevalence of hypertriglyceridemic waist , which was positively associated with female sex, elevated non-HDL cholesterol, marital status (separated or divorced), and low HDL cholesterol. Furthermore, an inverse association was observed between HW and low weight.

ACKNOWLEDGEMENTS

The authors are grateful to the Research Program for the Brazilian Unified Health System (PPSUS), the National Council for Scientific and Technological Development (CNPq), the State University of Southwest Bahia (UESB), the Foundation for Research Support of the State of Bahia (FAPESB), the Municipal Health Department of Aiquara, and the older adults who participated in this study.

AUTHOR CONTRIBUTIONS

YSS: Writing - review & editing, Writing - original draft, Visualization, Validation, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. LS: Writing - review & editing, Writing - original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. DJS: Writing - review & editing, Writing - original draft, Visualization, Validation, Resources, Methodology, Investigation, Formal analysis, Conceptualization. RSB: Writing - review & editing, Writing - original draft, Visualization, Validation, Resources, Methodology, Investigation, Formal analysis, Conceptualization. LLTP: Writing - review & editing, Writing - original draft, Visualization, Validation, Resources, Methodology, Investigation, Formal analysis, Conceptualization. PFVN: Writing - review & editing, Writing - original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. CAC: Writing - review & editing, Writing - original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

REFERENCES

1. Jura M, Kozak LP. Obesity and related consequences to ageing. Age (Dordr). 2016;38(1):23. http://doi.org/10.1007/s11357-016-9884-3. PMid:26846415.

2. Fernández-García JC, Muñoz-Garach A, Martínez-González MÁ, Salas-Salvado J, Corella D, Hernáez Á, et al. Association Between Lifestyle and Hypertriglyceridemic Waist Phenotype in the PREDIMED-Plus Study. Obesity (Silver Spring). 2020;28(3):537-43. http://doi.org/10.1002/oby.22728. PMid:32090511.

3. Lemieux I, Pascot A, Couillard C, Lamarche B, Tchernof A, Alméras N, et al. Hypertriglyceridemic waist: a marker of the atherogenic metabolic triad (hyperinsulinemia; hyperapolipoprotein B; small, dense LDL) in men? Circulation. 2000;102(2):179-84. http://doi.org/10.1161/01.CIR.102.2.179. PMid:10889128.

4. Rocha ALC, Pereira PF, Pessoa MC. Hypertriglyceridemic waist phenotype and cardiometabolic alterations in Brazilian adults. Nutr Hosp. 2015;32(3):1099-106. PMid:26319826.

5. Ely BR, Clayton ZS, McCurdy CE, Pfeiffer J, Minson CT. Meta-inflammation and cardiometabolic disease in obesity: Can heat therapy help? Temperature. 2017;5(1):9-21. http://doi.org/10.1080/23328940.2017.1384089. PMid:29687041.

6. Fagundes LC, Fernandes MH, Brito TA, Coqueiro RDS, Carneiro JAO. Prevalence and factors associated with hypertriglyceridemic waist in the elderly: a population-based study. Cien Saude Colet. 2018;23(2):607-16. http://doi.org/10.1590/1413-81232018232.02862016. PMid:29412418.

7. Zeng J, Liu M, Wu L, Wang J, Yang S, Wang Y, et al. The association of hypertriglyceridemic waist phenotype with chronic kidney disease and its sex difference: a cross-sectional study in an urban Chinese elderly population. Int J Environ Res Public Health. 2016;13(12):1233. http://doi.org/10.3390/ijerph13121233. PMid:27983610.

8. Andrade JR, Velasquez-Melendez G, Barreto SM, Pereira TSS, Mill JG, Molina MDCB. Fenótipo da cintura hipertrigliceridêmica e fatores nutricionais: um estudo com participantes do ELSA-Brasil. Rev Bras Epidemiol. 2017;20(3):382-93. http://doi.org/10.1590/1980-5497201700030003. PMid:29160432.

9. Blackburn P, Lemieux I, Alméras N, Bergeron J, Côté M, Tremblay A, et al. The hypertriglyceridemic waist phenotype versus the National Cholesterol Education Program–Adult Treatment Panel III and International Diabetes Federation clinical criteria to identify high-risk men with an altered cardiometabolic risk profile. Metabolism. 2009;58(8):1123-30. http://doi.org/10.1016/j.metabol.2009.03.012. PMid:19481769.

10. Freitas RS, Fonseca MJMD, Schmidt MI, Molina MDCB, Almeida MDCC. Fenótipo cintura hipertrigliceridêmica: fatores associados e comparação com outros indicadores de risco cardiovascular e metabólico no ELSA-Brasil. Cad Saude Publica. 2018;34(4):e00067617. http://doi.org/10.1590/0102-311x00067617. PMid:29617485.

11. Prince MJ, Wu F, Guo Y, Gutierrez Robledo LM, O'Donnell M, Sullivan R, et al. The burden of disease in older people and implications for health policy and practice. Lancet. 2015;385(9967):549-62. http://doi.org/10.1016/S0140-6736(14)61347-7. PMid:25468153.

12. Casotti CA, de Almeida CB, dos Santos L, Valença Neto PF, do Carmo TB. Condições de saúde e estilo de vida de idosos: métodos e desenvolvimento do estudo. PC-RESC. 2021;2:e12643.

13. Instituto Brasileiro de Geografia e Estatísica. Aiquara [Internet]. 2020 [cited 2021 Mar 14]. Available from: https://cidades.ibge.gov.br/brasil/ba/aiquara/panorama

14. Melo DMD, Barbosa AJG. O uso do Mini-Exame do Estado Mental em pesquisas com idosos no Brasil: uma revisão sistemática. Cien Saude Colet. 2015;20(12):3865-76. http://doi.org/10.1590/1413-812320152012.06032015. PMid:26691810.

15. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 2003;35(8):1381-95. http://doi.org/10.1249/01.MSS.0000078924.61453.FB. PMid:12900694.

16. Benedetti TRB, Antunes PC, Rodriguez-Añez CR, Mazo GZ, Petroski ÉL. Reprodutibilidade e validade do Questionário Internacional de Atividade Física (IPAQ) em homens idosos. Rev Bras Med Esporte. 2007;13(1):11-6. http://doi.org/10.1590/S1517-86922007000100004.

17. Benedetti T, Mazo G, Barros M. Aplicação do questionário internacional de atividades físicas para avaliação de mulheres idosas: validade concorrente e reprodutibilidade teste-reteste. Revista Brasileira de Ciência e Movimeto. 2004;12(1):25-34.

18. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020;54(24):1451-62. http://doi.org/10.1136/bjsports-2020-102955. PMid:33239350.

19. Barroso WKS, Rodrigues CIS, Bortolotto LA, Mota-Gomes MA, Brandão AA, Feitosa ADM, et al. Diretrizes Brasileiras de Hipertensão Arterial–2020. Arq Bras Cardiol. 2021;116(3):516-658. http://doi.org/10.36660/abc.20201238. PMid:33909761.

20. Frisancho AR. New standards of weight and body composition by frame size and height for assessment of nutritional status of adults and the elderly. Am J Clin Nutr. 1984;40(4):808-19. http://doi.org/10.1093/ajcn/40.4.808. PMid:6486088.

21. World Health Organization. Waist circumference and waist-hip ratio: report of a WHO expert consultation. Geneva: WHO; 2011.

22. Andriolo A MA, Ballarati C, Barbosa I, Mendes M, Melo M, et al. Recomendações da Sociedade Brasileira de Patologia Clínica/Medicina Laboratorial para coleta de sangue venoso. Rio de Janeiro: ControlLab; 2009 [cited 2021 Mar. 20]. Available from: https://controllab.com/ensino/livros/recomendacoes-da-sbpc-ml-para-coleta-de-sangue-venoso/.

23. Sociedade Brasileira de Diabetes. Diretrizes da Sociedade Brasileira sobre Diabetes: 2019-2020 [Internet]. São Paulo: Clannad; 2019 [cited 2021 Mar. 20]. Available from: https://www.saude.ba.gov.br/wp-content/uploads/2020/02/Diretrizes-Sociedade-Brasileira-de-Diabetes-2019-2020.pdf.

24. Faludi AA, Izar MCO, Saraiva JFK, Chacra APM, Bianco HT, Afiune A No, et al. Atualização da diretriz brasileira de dislipidemias e prevenção da aterosclerose–2017. Arq Bras Cardiol. 2017;109(Supl 1):1-76. http://doi.org/10.5935/abc.20170121.

25. Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP, et al. Evaluation, treatment, and prevention of vitamin D deficiency: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011;96(7):1911-30. http://doi.org/10.1210/jc.2011-0385. PMid:21646368.

26. Carvalho GA, Perez CLS, Ward LS. Utilização dos testes de função tireoidiana na prática clínica. Arq Bras Endocrinol Metabol. 2013;57(3):193-204. http://doi.org/10.1590/S0004-27302013000300005. PMid:23681265.

27. Lemieux I, Poirier P, Bergeron J, Alméras N, Lamarche B, Cantin B, et al. Hypertriglyceridemic waist: a useful screening phenotype in preventive cardiology? Can J Cardiol. 2007;23(Suppl B):23B-31B. http://doi.org/10.1016/S0828-282X(07)71007-3. PMid:17932584.

28. Kahn HS, Valdez R. Metabolic risks identified by the combination of enlarged waist and elevated triacylglycerol concentration. Am J Clin Nutr. 2003;78(5):928-34. http://doi.org/10.1093/ajcn/78.5.928. PMid:14594778.

29. Confortin SC, Bittencourt B, Ono LM, Marques LP, Schneider IJC, Orsi E. Fatores associados ao estado nutricional em idosos participantes do Estudo "EpiFloripa Idoso". DEMETRA: Alimentação. Nutrição & Saúde. 2016;11(Suppl Supl.):1333-50.

30. Silveira EA, Vieira LL, Souza JD. Elevada prevalência de obesidade abdominal em idosos e associação com diabetes, hipertensão e doenças respiratórias. Cien Saude Colet. 2018;23(3):903-12. http://doi.org/10.1590/1413-81232018233.01612016. PMid:29538570.

31. Lima PV, Lopes AOS, Duarte SFP, Oliveira AS, Correa GTB, Reis LAD. Profile of the body mass index and associated factors in active elderlies. Rev Bras Enferm. 2018;71(Supl 2):876-83. http://doi.org/10.1590/0034-7167-2016-0683. PMid:29791622.

32. López M, Tena-Sempere M. Estradiol effects on hypothalamic AMPK and BAT thermogenesis: a gateway for obesity treatment? Pharmacol Ther. 2017;178:109-22. http://doi.org/10.1016/j.pharmthera.2017.03.014. PMid:28351720.

33. Greendale GA, Sternfeld B, Huang M, Han W, Karvonen-Gutierrez C, Ruppert K, et al. Changes in body composition and weight during the menopause transition. JCI Insight. 2019;4(5):e124865. http://doi.org/10.1172/jci.insight.124865. PMid:30843880.

34. Xu Y, López M. Central regulation of energy metabolism by estrogens. Mol Metab. 2018;15:104-15. http://doi.org/10.1016/j.molmet.2018.05.012. PMid:29886181.

35. Andrade FBD, Caldas ADF Jr, Kitoko PM, Batista JEM, Andrade TBD. Prevalência de sobrepeso e obesidade em idosos da cidade de Vitória-ES, Brasil. Cien Saude Colet. 2012;17:749-56. http://doi.org/10.1590/S1413-81232012000300022.

36. Costa CD, Schneider BC, Cesar JA. Obesidade geral e abdominal em idosos do Sul do Brasil: resultados do estudo COMO VAI? Cien Saude Colet. 2016;21(11):3585-96. http://doi.org/10.1590/1413-812320152111.02492016. PMid:27828591.

37. Gama A, Marques P, Madeira T, Rosado-Marques V. Excesso de peso ou obesidade e fatores do estilo de vida em idosos do concelho de Lisboa. Antropol Port. 2020;(37):131-57. http://doi.org/10.14195/2182-7982_37_6.

38. Gaddey HL, Holder KK. Unintentional weight loss in older adults. Am Fam Physician. 2021;104(1):34-40. PMid:34264616.