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Neck circumference in community-dwelling older adults: prevalence and associated factors—a cross-sectional study

Circunferência do pescoço em pessoas idosas da comunidade: prevalência e fatores associados - um estudo transversal

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Abstract

Objective: To evaluate the prevalence of inadequate nutritional status, as assessed by neck circumference (NC), and its associated factors in older adults living in a municipality in Southern Brazil.

Methods: This was a cross-sectional study of older adults living in the municipality of Coxilha, Rio Grande do Sul. Participants were assessed for demographic and socioeconomic characteristics and presence of chronic noncommunicable diseases (NCDs). NC was measured at the midpoint of the neck, just below the upper border of the laryngeal prominence, and categorized based on the following cutoff points: ≥ 40.5 cm for men and ≥ 35.7 cm for women.

Results: A total of 517 older adults (mean age 69.74 years) were assessed. The sample was predominantly female. A high prevalence of inadequate NC was identified in both men (39.8%) and women (48.7%). In men, inadequate NC was associated with living with a partner, having a household income more than five times the minimum wage, and presence of NCDs. In women, it was associated with living in urban areas and the presence of NCDs.

Conclusions: This study found a high prevalence of large NC in older adults in a small municipality in Rio Grande do Sul, Brazil, This finding was associated with NCDs and other factors.

Keywords: neck; chronic noncommunicable diseases; anthropometry; aged.

Resumo

Objetivo: Este estudo avaliou a prevalência do estado nutricional inadequado por meio da circunferência do pescoço (CP) e seus fatores associados em pessoas idosas que residem em um município do Sul do Brasil.

Metodologia: Trata-se de um estudo observacional transversal com pessoas idosas que moram no município de Coxilha-RS. Foram analisadas características demográficas, socioeconômicas e a presença de DCNTs. A CP foi medida no ponto médio do pescoço, logo abaixo da borda superior da proeminência da laringe, e categorizada com base nos pontos de corte: ≥ 40,5 cm para homens e ≥ 35,7 cm para mulheres.

Resultados: Foram avaliadas 517 pessoas idosas, com média de idade de 69,74 anos, sendo a maioria do sexo feminino. Identificou-se alta prevalência de CP inadequada em homens (39,8%) e mulheres (48,7%). Nos homens, a CP inadequada associou-se a viver com companheiro, ter renda familiar acima de cinco salários-mínimos e à presença de DCNTs. Nas mulheres, associou-se a residir na zona urbana e ter DCNTs.

Conclusões: O estudo constatou alta prevalência de CP elevada em idosos de uma pequena cidade do RS e sua associação com DCNTs e outros fatores.

Palavras-chave: pescoço; doenças crônicas não transmissíveis; antropometria; idosos.

INTRODUCTION

The years 2020–2030 have been defined as the decade of healthy aging. The number of older adults worldwide is expected to rise from 1 billion in 2019 to 1.4 billion by 2030.[1] In 2020, life expectancy at birth in the Brazilian state of Rio Grande do Sul reached 77.45 years, representing an increase of 0.19 years compared to year-end data for 2019, when it was 77.26 years.[2]

As life expectancy has increased, so has the prevalence of chronic noncommunicable diseases (NCDs), such as malignancies, diabetes mellitus (DM), cardiovascular disease (CVD), and chronic respiratory diseases.[3,4] These conditions pose a major public health challenge worldwide, accounting for 73.6% of all deaths in 2019.[5] In Brazil, also in 2019, NCDs caused 41.8% of all premature deaths (between the ages of 30 and 69 years).[6] Leading risk factors include inadequate diet, excess alcohol intake, smoking, sedentary lifestyle, and obesity.[6]

Early detection of obesity can prevent the impact of its adverse outcomes, such as CVD.[7] Therefore, many indicators have been used to assess nutritional status, with the body mass index (BMI) being most widely accepted by researchers.

However, new indicators are being pursued, including neck circumference (NC), an easily accessible, practical, non-invasive, low-cost anthropometric measurement that, under normal conditions, does not vary during the day. It is considered an indirect indicator of the upper-body subcutaneous fat depot.[8,9] Due to its strong correlation with abdominal obesity, it has also been considered more accurate than BMI.[10]

As suggested by some studies, NC can be used as a screening tool to detect overweight/obesity in older adults, and increased NC values may be associated with an increased risk of cardiovascular disease.[11] However, despite its potential as a good anthropometric indicator for several diseases, health outcomes, and lifestyle, NC has rarely been studied, especially in older populations.[12,13]

Within this context, the present study sought to evaluate the prevalence of inadequate nutritional status (as assessed through NC measurements) and associated factors in older adults living in a municipality in southern Brazil.

METHODS

A cross-sectional, quantitative, observational study was conducted with people aged 60 years or older living in the municipality of Coxilha, Rio Grande do Sul. This study is part of a larger project, *Censo das condições de vida e saúde de idosos no município de Coxilha (RS)* [Census of living and health conditions of older adults in the municipality of Coxilha (RS)], conducted by the Graduate Program in Human Aging at Universidade de Passo Fundo. The data present in the Census database were collected from August to December 2021.

For the present study, a sample size of 385 subjects was calculated to estimate a proportion of occurrence of the outcome of interest within 10% range for the prevalence of inadequate nutritional status assessed by NC in older adults. The sample size calculation considered 95% confidence levels and a 50% expected proportion of the outcome of interest.[14] This calculation was performed using the online version of the *PSS Health* tool.[15]

Data were collected in the participants' own homes, using a standardized instrument. As this was a census, the sample included all adults aged 60 or older who had lived within Coxilha (RS) municipal limits, whether in urban or rural areas, for at least 6 months and who agreed to participate in the study. Those who did not meet these conditions were not eligible to participate in the study.

Neck circumference, the outcome measure of interest, was assessed at the midpoint of the neck, below the laryngeal prominence. Measurement was performed with the participant in the orthostatic position, facing forward and shoulders relaxed. An inelastic measuring tape was placed on the upper edge of the laryngeal prominence, perpendicular to the long axis of the neck, in the midpoint region, below the epiglottis. In men with a visible laryngeal prominence (Adam's apple), the measurement was obtained just below it.[16] For classification of overweight/excess weight using NC, the following cutoff points were considered: NC ≥ 40.5 cm for men and NC ≥ 35.7 cm for women.[11]

The exposure variables were collected through standardized, pre-coded questionnaires administered during in-person interviews with the participants. These variables were: age group (60 to 69 years, 70 to 79 years, and 80 years or older), sex (female, male), marital status (with or without a partner), years of schooling (0 to 3 years, 4 to 11 years, 12 years or more), skin color (white or non-white), setting of residence (urban or rural), household income (up to 1 minimum wage, 1 to 2 times the minimum wage, 3 to 5 times the minimum wage, or >5 times the minimum wage), and presence of NCDs (yes or no). The NCDs considered for the purposes of this study were emphysema, diabetes mellitus, rheumatism, hypertension, arthritis, stroke/cerebral ischemia, cancer, heart disease, Parkinson's disease, and Alzheimer's disease.

This study may include some sources of bias, such as a lack of information on calibration of the equipment used to measure neck circumference and the lack of information on the participants' lifestyle habits and physical activity, which could impact our findings regarding the prevalence of inadequate nutritional status.

Data were analyzed in the SPSS version 22.0 statistical package. Descriptive analyses were carried out, and the χ^2 and Fisher's exact tests were used to verify associations. The level of significance was set at 5%.

This study was approved by the Research Ethics Committee of Universidade de Passo Fundo with opinion no. 4.586.122. Furthermore, written informed consent was obtained from all study participants.

RESULTS

Of the 560 older adults residing in the municipality at the time of data collection, 517 were evaluated, with a mean age of 69.74 years (SD = 7.77). Most were 60 to 69 years old (57.3%), female (51.7%), white (74.8%), lived with a partner (67.5%), lived in urban areas (66.0%), had a household income of 1 to 5 times the minimum wage (76.0%), and 4 to 11 years of formal education (71.6%). The presence of NCDs was reported by 78.9% of respondents (Table 1).

The overall prevalence of inadequate NC was 44.4% in men, whose mean NC was 39.77 cm (SD = 3.50), while in women the mean NC was 35.75 cm (SD = 3.34). The prevalence of large NC was 39.8% among men and 48.7% among women (Table 1).

In men, living with a partner (p = 0.027), having a household income more than 5 times the minimum wage (p = 0.008), and presence of NCDs (p < 0.001) were associated with large NC (Table 2).

In women, living in urban areas (p = 0.009) and having NCDs (p < 0.001) were associated with large NC (Table 3).

DISCUSSION

The present study found an overall prevalence of inadequate NC of 44.4% and a high prevalence of NC associated with cardiovascular diseases, in both men (39.8%) and women (48.7%). In men, this outcome was associated with living with a partner, having a household income more than five times the minimum wage, and having NCDs; in women, the associated variables were living in an urban area and having NCDs.

A prior study with older adults found that the mean NC was 38.2 cm (SD = 3.4) in men with adequate weight and 35.2 cm (SD = 3) in overweight women.[17] In the present sample, the mean NC was 39.77 cm (SD = 3.50) among men and 35.75 cm among women (similar to the values found in the previous study), regardless of nutritional status as assessed by BMI.

Furthermore, another recent study with older adults identified mean NC values very similar to those of our sample: 39.6 cm (SD = 3.40) among men and 35.6 cm (SD = 3.50) among women.[18] A longitudinal study conducted in urban communities in China also found similar NC averages. Older adults in this Chinese study had a mean NC of 37.8 cm and 34.3 cm for men and women, respectively.[14] Taken together, these findings suggest that men have a larger mean NC.

The difference in NC between men and women is biologically based on the distribution of body fat, as influenced by hormonal and cardiovascular factors. While adipose tissue

TABLE 1. Characteristics of exposure and outcome variables in the study population (n = 517).

Variable/Category	n	%
Age range (years)		
60 to 69	296	57.3
70 to 79	159	30.8
80 or older	62	12.0
Sex*		
Male	249	48.3
Female	267	51.7
Skin color*		
White	386	74.8
Non-white	130	25.2
Marital status		
No partner	168	32.5
Living with partner	349	67.5
Setting of residence		
Rural	176	34.0
Urban	341	66.0
Years of schooling†		
0-3	116	22.9
4 to 11	363	71.6
12+	28	5.5
Household income (× minimum wage)		
≤1‡	48	9.5
1 to 2	197	39.0
3 to 5	187	37.0
>5	73	14.5
Presence of NCDs		
No	109	21.1
Yes	408	78.9
NC (men)		
< 40.5 cm	150	60.2
≥ 40.5 cm	99	39.8
NC (women)		
< 35.7 cm	137	51.3
≥ 35.7 cm	130	48.7

n: sample size; NCDs: chronic noncommunicable diseases; NC: neck circumference.

*sex, skin color, NC (men), NC (women): valid n = 516; †years of schooling: valid n = 507; ‡household income: valid n = 505.

TABLE 2. Description of the association between neck circumference in men and exposure variables in the study sample (n = 517).

Variable/Category	NC (men)				p-value
	< 40.5 cm		≥ 40.5 cm		
	n	%	n	%	
Age range (years)					
60 to 69	84	62.2	51	37.8	
70 to 79	49	57.0	37	43.0	0.738*
80 or older	17	60.7	11	39.3	
Skin color					
White	108	57.8	79	42.2	0.106†
Non-white	42	67.7	20	32.3	
Marital status					
Without a partner	41	71.9	16	28.1	0.027†
With a partner	109	56.8	83	43.2	
Setting of residence					
Rural	58	63.0	34	37.0	0.289†
Urban	92	58.6	65	41.4	
Years of schooling					
0-3	36	66.7	18	33.3	
4 to 11	101	57.4	75	42.6	0.449*
12 or older	9	64.3	5	35.7	
Household income (× minimum wage)					
up to 1	20	83.3	4	16.7	
1 to 2	47	61.0	30	39.0	0.008†
3 to 5	60	62.5	36	37.5	
>5	21	42.9	28	57.1	
Presence of NCDs					
No	56	78.9	15	21.1	< 0.001*
Yes	94	52.8	84	47.2	

*χ^2 test; †Fisher's exact test.

NC: neck circumference; NCDs: chronic noncommunicable diseases.

accumulates more in the neck region in men, in women it predominates in the retrosacral area. This disparity is reflected in the ratio of adipose tissue thickness between the two regions, which is greater in the neck in men. These variations highlight the differences in adiposity distribution patterns between the sexes, and help distinguish cutoff points for anthropometric assessment.[19]

Regarding NCDs, we found a higher prevalence of these conditions in older adults with larger NC. A systematic review with meta-analysis found positive associations of NC with waist circumference (WC), BMI, and blood pressure, both systolic and diastolic.[20] Still regarding the relationship between NC and cardiovascular diseases, a study of older adults found that NC is associated with CVD and chronic metabolic diseases. Men and women with an NC of 40.6 cm and 34.2 cm, respectively, had 4.36-fold greater odds of having a heart attack and 2.42-fold odds of developing high blood pressure.[21]

A longitudinal study carried out in Brazil evaluated NC and cardiovascular risk over 10 years at the baseline of the Longitudinal Study of Adult Health (ELSA-Brazil), and found an independent, positive correlation between CVD risk and NC. It found that NC could be a useful predictor of cardiovascular risk beyond the data provided by traditional anthropometric measures.[22] Further regarding the association between NCDs and NC, a cross-sectional study conducted in 2015 with 435 older adults in the municipality of Poá, state of São Paulo, found that NC was associated with presence of high blood pressure and type 2 diabetes mellitus.[11]

In the Republic of Korea, the risk of cardiovascular disease for older adults with a large neck circumference was 3.645-fold higher than in those with a normal neck circumference.[18] Another study, conducted in Thailand, found that participants with a large neck circumference—whether measured as a continuous or categorical (≥ 37.5 in men, ≥ 32.5 in women) variable—were more likely to have high blood pressure.[23] These findings further highlight the relationship between NCDs, such as CVDs, and a large neck circumference.

TABLE 3. Description of the association between NC in women and exposure variables in the study sample (n = 517).

Variable/Category	NC (women)				p-value
	< 35.7 cm		≥ 35.7 cm		
	n	%	n	%	
Age range (years)					
60 to 69	82	51.3	78	48.8	0.976*
70 to 79	37	50.7	36	49.3	
80 or older	18	52.9	16	47.1	
Skin color					
White	101	51.0	97	49.0	0.530†
Non-white	35	51.5	33	48.5	
Marital status					
Without a partner	59	53.6	51	46.4	0.304†
With a partner	78	49.7	79	50.3	
Setting of residence					
Rural	52	62.7	31	37.3	0.009†
Urban	85	46.2	99	53.8	
Years of schooling					
0-3	31	50.0	31	50.0	0.951*
4 to 11	97	52.2	89	47.8	
12 or older	7	50.0	7	50.0	
Household income (× minimum wage)					
up to 1	13	54.2	11	45.8	0.867*
1 to 2	64	53.8	55	46.2	
3 to 5	44	48.4	47	51.6	
>5	13	48.4	11	45.8	
Presence of NCDs					
No	30	81.1	7	18.9	<0.001†
Yes	107	46.5	123	53.5	

*Fisher's exact test; †χ^2 test.

NC: neck circumference; NCDs: chronic noncommunicable diseases.

Among the NCDs, the relationship of obesity with NC is worth mentioning, as suggested by a cross-sectional study carried out in the Southeast Region of Brazil. Its results indicated a significant correlation between NC and traditional anthropometric indicators of obesity, such as waist circumference and BMI. The findings also demonstrate that NC can predict insulin resistance, a marker of cardiovascular risk.[24] Furthermore, Oliveira et al.[25] found that NC can be used to identify overweight/obesity in young adults.

This relationship between NC and other anthropometric parameters had already been reported. A study of older adults aged 60 to 93 living in the Greater Vitória region (state of Espírito Santo), found a positive correlation between NC and the body adiposity index.[26]

This study has some limitations. Due to the cross-sectional design, there is a possibility of reverse causality; however, it is based on census data from the older-adult population of a small municipality. The state of Rio Grande do Sul has an estimated population of 11 million across 497 municipalities, of which 452 have a 50,000 inhabitants or fewer. Coxilha is one of these municipalities,[27] and is thus representative of a significant portion of towns in the state. The study of simple, low-cost anthropometric measurements which may facilitate early identification of nutritional abnormalities is essential.

Neck circumference measurement has proven to be a valid screening method to detect overweight and obesity in older adults. Large NC values may also be associated with risk factors for CVD and other NCDs.[11]

NC corresponded strongly with indices of adiposity and can also be a useful supplemental parameter for clinical screening of the metabolic syndrome.[18]

CONCLUSION

We identified a high prevalence of inadequate NC among older adults living in a small municipality in Rio Grande do Sul, Brazil, as well as a correlation of NC with NCDs, regardless of sex. Furthermore, among men, large NC was

associated with living with a partner, having a household income more than five times the minimum wage, and presence of NCDs. Among women, the associated variables were living in an urban area and having NCDs. Such findings may be useful for evaluating, monitoring, and planning health actions at the municipal level, and should also contribute to greater knowledge and use of this affordable anthropometric parameter with the ability to predict NCDs, especially CVD.

DECLARATIONS

Conflict of interest
The authors report no conflicts of interest.

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Author contributions
Bruna Dalla Cort: project administration, formal analysis, conceptualization, data curation, writing – original draft, writing – review & editing, investigation, methodology, resources, software, supervision, visualization. Marilene Rodrigues Portella: project administration, conceptualization, writing – original draft, writing – review & editing, methodology, resources, supervision. Ana Luisa Sant'Anna Alves: formal analysis, conceptualization, data curation, writing – original draft, writing – review & editing, methodology, resources, software, visualization. Andréia Mascarelo: project administration, conceptualization, writing – original draft, writing – review & editing, investigation, methodology, resources, supervision. Danieli Cristina Pasqualotto Torella: writing – original draft, writing – review & editing, resources, visualization.

Ethical approval and informed consent
This study was approved by the Research Ethics Committee of Universidade de Passo Fundo under opinion no. 4.586.122. Written informed consent was obtained from all study participants.

Data availability statement
Within ethical and privacy limitations, data are available upon reasonable request. The data supporting the findings of this study are available upon request from the corresponding author, B.D.C. These data are not publicly available because they contain information that could compromise the privacy of research participants.

Reporting standards guidelines
The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline was followed.

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