

Calf circumference measurement of rural elderly people in southern Brazil

Abstract

The measurements of calf circumference (CC) indicate important nutritional and muscular characteristics in the assessment of physiological aspects of aging. This article aims to present data regarding the CC measurement of active elderly rural workers in southern Brazil. It is a cross-sectional population study conducted with 632 elderly individuals aged ≥ 60 years, comprising 46.8% (n=296) women and 53.2% (n=336) men, selected by clusters. The instrument used for data collection was the CC. The average CC found was 37.1 cm, exceeding cutoff values found in other population studies. Women (n=296 - 46.8%) had an average CC of 37.6 cm, which was higher than that of men (n=336 - 53.2%), who had an average of 36.7 cm. This difference is statistically significant ($p=0.010$), challenging the common notion that men have greater muscle mass. Regarding age, younger elderly individuals (60 to 69 years) have a calf circumference (CC) of 37.6 cm, while older individuals (80+) have a CC of 35.5 cm, indicating a significant reduction with advancing age ($p<0.001$). Similarly, regional differences reveal higher CC values in the southern region of the state (39.17 cm) and significantly lower values in other regions ($p=0.001$). The CC data provide insights into the biological characteristics of aging in the population. However, the results indicate the need for further research on the specificities of the group, especially concerning values that exceed the cutoff points in the literature and the significant reversal between men and women. This difference may be linked to body fat distribution, hormonal or genetic factors that affect mass accumulation. Therefore, a deeper analysis is essential to understand the causes of this difference and its implications for the health of each gender, also considering other contextual factors.

Keywords: rural population, health of the elderly, rural health, anthropometry, calf circumference

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Jorge Luiz de Andrade Trindade,¹ Marielly de Moraes,² Vanessa Giendruczak da Silva,¹ Alexandre Simões Dias¹

¹Universidade Federal do Rio Grande do Sul, Brazil

²Universidade Federal de Santa Catarina, Brazil

Correspondence: Jorge Luiz de Andrade Trindade, Universidade Federal do Rio Grande do Sul – UFRGS, Porto Alegre, Rio Grande do Sul, Brazil

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Abbreviations: CC, calf circumference; FETAGRS, federation of rural workers of rio grande do sul; STR, rural workers union of rio grande do sul; RS, rio grande do sul

Introduction

Population aging is becoming more consolidated and accelerating demographic changes across the world.¹ In Latin America, as in Brazil, social differences make it essential to recognize and understand these distinct characteristics, considering the demands of public policies.² From a population point of view, Rio Grande do Sul (RS), located in the extreme south of Brazil, has stood out as a state with an accelerated aging process, presenting a significant concentration of elderly people in the country.³ On the other hand, we observe that research related to the elderly population living in the countryside is scarce, which makes this character little known, therefore, it is necessary to study in depth and comprehensively ways for this public to have quality aging.³⁻⁵

During aging, several factors can affect the quality of life of the elderly, and nutritional status is one of the most important.⁶ Studies show that nutritional disorders are related to the risk of morbidity.^{6,7}

Anthropometric measurements are essential data in the assessment of elderly people, as they serve as an important tool to indicate their nutritional status.⁸ In addition to providing basic information on physical variations and body composition, these measurements represent a non-invasive method that is easy and quick to perform.

One of the most sensitive anthropometric indicators of muscle mass is calf circumference (CC), as it indicates changes in lean mass that occur with age and decreased physical activity. Measuring CC is

a simple, inexpensive and non-invasive procedure and is relevant in diagnosing nutritional status, functional capacity and health.⁷⁻¹⁰

In rural areas, the loss of functionality not only impacts daily life activities, but also the family's financial situation, as many elderly people, even retired ones, earn a living from their daily work.⁵ Especially if we consider that this work activity uses the body as a work tool.^{5,11} Therefore, the study of the prevalence of calf circumference measurements becomes extremely relevant, as it is an easily measured data that can be useful in recognizing the anthropometric measurement of this population. Therefore, this study aims to present the calf circumference measurements of the active elderly population of a state in the extreme south of Brazil.

Material and methods

Population research, cross-sectional and exploratory in nature. The setting was the state of RS, located in the extreme south of Brazil.

It was carried out in conglomerates, organized based on the identification of the regional offices (n=24) of the Federation of Rural Workers of Rio Grande do Sul (FETAGRS) and the respective 348 Sindicato dos Trabalhadores Rurais do Rio Grande do Sul (STR) distributed across the 497 municipalities of the state.

The data found were systematized, transposed and analyzed according to the state's microregions (North, South, Metropolitan, Serra, Missioneira, Valleys, Central-West), used by the state's Health Department in the distribution of the 19 Health Coordinators, responsible for managing local Public Health Care (Figure 1).

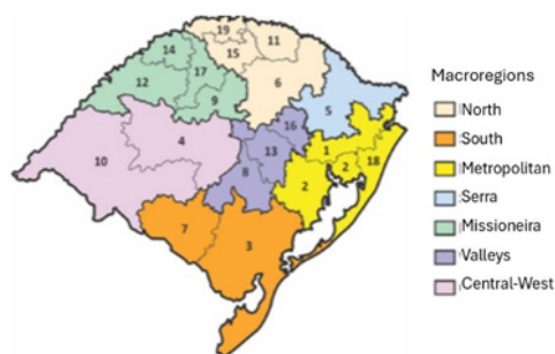


Figure 1 Distribution of regions of the state of Rio Grande do Sul, Brazil. (North, South, Metropolitan, Serra, Missioneira, Valleys, Central-West).

Source Adapted from the Health Department of the State of Rio Grande do Sul.

The rural elderly population studied was identified from the strata of the conglomerates considering the dispersion in the regions of the state and the population density where they were randomly and proportionally researched.

Individuals of both sexes, over 60 years of age on the date of the total population survey in the rural union records and identified in the union records and elected by drawing lots were included.

The study carried out in 2018, followed Resolution No. 466/201216 and was approved by the Research Ethics Committee of the Federal University of Rio Grande do Sul, under No. 1,716,579 on September 8, 2016. The instrument used to prepare this study was the Calf circumference.

CC was measured using a non-elastic measuring tape with the individual sitting (thigh parallel to the floor and leg vertical, with the knee at 90°). To measure the calf circumference, the evaluator measured the largest perimeter of the leg of the non-dominant limb, testing in 3 or more different locations on the calf.

The measuring tape remained across the leg (it could not be inclined). The measurement was taken 3 times and the values of the 3 measurements were recorded. And the CC taken into consideration was the average of the 3 measurements.

Results

A total of 632 people were evaluated, 295 women (53.2%) and 337 men (46.8%), aged between 60 and 93 years old and with a total average of 69.6 ± 7.1 years. (Table 01) The elderly people surveyed maintained a small difference between genders, with a male prevalence, young elderly people and a higher demographic density in the northern region, considering the distribution proportion of the sample chosen.

When analyzing the sample's CC, we identified an average of 37.1 cm with values between 26.5 and 50 cm (+3.7). In the association of gender and age group (Table 1), we can observe significant differences in CC measurements between genders ($p = 0.010$) and between age groups so that the measurement is smaller with advancing age ($p < 0.001$), mainly in the age group of "80 years or more" with the other groups and smaller in the male gender.

When comparing the regions of the state, we can observe a significant difference between the prevalent CC values. Highlighting the "South" region, with higher values in relation to the "North"

(Figure 2) and "Missioneira". And the North region, showing a lower average in relation to the others.

Table 1 Distribution of the rural population studied in relation to gender, age group and regions, in the extreme south of Brazil. (n=632)

Variables	Categories	n	%
Gender	Male	337	53,3
	Female	295	46,7
Age group	60 – 69	310	49,1
	70 – 79	228	36,1
	80 +	94	14,8
Region	Norte	227	35,9
	Metropolitana	108	17,1
	Missioneira	100	15,8
	Centro-Oeste	65	10,3
	Vales	59	9,3
	Serra	43	6,8
	Sul	30	4,7

Table 2 Distribution of CC measurements in the rural population studied in relation to gender and age group in the extreme south of Brazil. (n=632)

Variables	Categories	CC (cm)		p
		md	dp	
Gender	Male	36,7	3,3	**0,010
	Female	37,6	4,0	
Age group	60 – 69 a	37,6	3,5	**<0,001
	70 – 79 b	37,1	3,8	
	80+a,b	35,5	3,7	

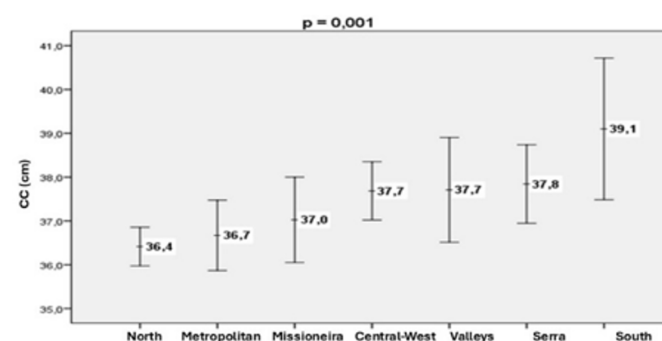


Figure 2 Distribution of CC measurements in the rural population studied in relation to the regions of the state of RS, in the extreme south of Brazil.

Discussion

The state of RS stands out as the Brazilian state with the highest percentage of elderly people, representing 20.2% of its total population. When examining the demographics of the population over 60 years old in the southernmost part of the country, especially in rural areas, we notice that the northern region of the state houses a significant concentration of this age group, reflecting the proportional distribution observed in the sample.^{3,13}

The distribution of the rural elderly population by gender, the identification of the sample within its proportionality maintained the characteristics indicated in other studies that indicate male predominance in the rural population, as found during the construction period of this research project.^{13,15} The masculinization of the countryside observed up to the age of 75, the exodus of younger people and the aging population have been identified as non-isolated

processes and deserve their own investigations to understand the contemporary situation and their implications are fundamental, so that actions can be developed to modify, alleviate or adapt this new rural demographic dynamic to the future desired by the region. In this research, this phenomenon was also observed in relation to the process of male aging. This situation can be partly explained by the fact that it is common for women to migrate to urban centers with their relatives, while men tend to remain working in the fields to supplement the family income.¹⁶

Regarding the physical condition of elderly people, we can observe a growing interest of researchers, with the development of evaluation methods, with the aim of identifying parameters for the promotion of healthy aging. Several population studies have indicated, in this sense, CC as a good nutritional and sarcopenia predictor in elderly people. Therefore, cutoff values such as 31 to 35 cm in women and 33 to 34 cm in men,¹⁷ have been indicated to predict decreased muscle mass in several European and Asian studies.^{9,19} In Brazil, a clinical validation study to assess muscle mass in the elderly found 34 cm for men and 33 cm for women.¹⁷ In any case, the values of this study were different from the current literature on these values. Although we can infer about the reduction in values at more advanced ages^{8,9,18,19} indicative of nutritional status and other factors such as obesity and cardiovascular changes, they deserve to be considered in a more in-depth analysis.^{2,20,23}

A higher waist circumference (CC) in elderly women living in rural areas of RS, compared to elderly men in the same condition, can be justified by various factors, including biological, behavioral, and social differences. Studies on female body composition during the aging process, for example, could explain the fact that women presented a higher CC value than men in this research; such as a greater proportion of subcutaneous fat, especially in the leg regions, which may contribute to a larger circumference.^{25,26} However, other factors deserve consideration regarding the nature of the lifestyle in the countryside, such as labor practices that require routine physical activities.²⁷ In some rural communities, women may have more active roles in daily physical activities, while men may be more involved in activities that do not require as much physical effort, especially at older ages. They may also be more engaged in activities that require the use of their legs, such as tending to gardens or performing household tasks, which can result in greater development of calf muscles. A study conducted in the interior of the state of RS observed a higher prevalence of physical activity in the rural population related to work and commuting.²⁸ In any case, no specific studies were found regarding the physical condition of elderly individuals living in rural areas of RS that could be directly related to the findings of this study. The scores found in different regions of the state territory, we can infer hypotheses of associations with factors related to characteristics and variables pertinent to the geographic condition and other sociocultural factors that deserve appropriate investigation. In any case, the cutouts found, considering the sample size, describe characteristics pertinent to the population researched.

Conclusion

The prevalent values of calf circumference indicate an adequate pattern of nutritional and musculoskeletal conditions of the population studied. However, we observed that in the indicator evaluated, women present higher values than men and inversely proportional to age and important regional relationships in the context of the findings found. These measures provide us with better knowledge about this portion of the population in relation to their biological aging characteristics.

And they make us reflect on the living conditions and demands for approaches in public policies considering the promotion of healthy aging of elderly rural workers, projecting the need for future studies in the search for understanding the physical dimension of the findings of this research. Furthermore, it is essential to investigate how socioeconomic factors, access to health services and physical activity practices influence the musculoskeletal and nutritional conditions of this population. The relationship between calf circumference and other health measures, such as muscular strength and mobility, also deserves attention, as does the analysis of regional and cultural differences that may impact these outcomes.

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Ethics approval

None.

Conflicts of interest

The authors declare no conflicts of interest of any nature.

References

1. Mrejen M, Nunes L, Giacomin K. Envelhecimento populacional e saúde dos idosos: O Brasil está preparado? Estudo Institucional n. 10. São Paulo: Instituto de Estudos para Políticas de Saúde 2023.
2. United nations department of economic and social affairs, population division. World Population Ageing: Challenges and opportunities of population ageing in the least developed countries 2023.
3. Rio grande do sul. Caderno RS no Censo. população. Porto alegre: secretaria de planejamento, Governança e Gestão. 2024;17p: il.
4. Lisboa MC, Bagolin IP. Evolução da distribuição geográfica da população gaúcha, 1970-2000. In: Encontro de Economia Gaúcha, 4; Porto Alegre. 2009;1-25.
5. Trindade JDA, Moraes MD, Dias AS. The elderly, work and health present and future challenges in the aging of rural family population in the south of Brazil. *Int J Fam Commun Med*. 2020;5(2):60-61.
6. Dent E, Olivia R, Jean W, et al. Malnutrition in older adults. *The Lancet*. 401;(10380):951-966.
7. Wei J, Jing J, chan LC, et al. The association between low calf circumference and mortality: a systematic review and meta-analysis. *European geriatric medicine*. 2022;13(3):597-609.
8. Pagotto V, Santos KF dos, Malaquias SG, et al. Calf circumference: clinical validation for evaluation of muscle mass in the elderly. *Rev Bras Enferm*. 2018;71(2):322-328.
9. Gonzalez MC, Ali M, Nariman R, et al. Calf circumference: cutoff values from the NHANES 1999-2006. *The American journal of clinical nutrition*. 2021;113(6):1679-1687.
10. Costa JP, Carala M, Maria CG, et al. New insights on the use of mini nutritional assessment: impact of alternative calf circumference cutoffs. *Clinical Nutrition*. 2025;48(1):60-69.
11. Ferraz L, Alves J, Ferretti F. A vulnerabilidade ocupacional do idoso no meio rural. *Saúde & Transformação Social/Health & Social Change*. 2017;8(1):47-60.
12. Instituto Brasileiro de Geografia e Estatística – IBGE. Censo Agropecuário 2017- Resultados Definitivos. Brasil. Rio de Janeiro: IBGE, 2019.

13. da Silva Arrais SC, Prat BV, Cambraia RP. Análise dos censos agropecuários brasileiros dos anos de 2006 e 2017 para identificação de características da população agrícola. *Cerrados*. 2019;17(2):228–246.
14. Instituto brasileiro de geografia e estatística – ibge. censo demográfico 2022. dados nacionais. fundação instituto brasileiro de geografia e estatística. brasil. rio de janeiro: IBGE, 2023.
15. Froehlich JM, Rauber CC, Carpes RH, et al. Êxodo seletivo, masculinização e envelhecimento da população rural na região central do RS. *Ciência Rural*. 2011;41(9):1674–1680.
16. Ferraz L et al. Homem idoso que trabalha no campo: vulnerabilidades individuais, sociais e programáticas. *Revista Gênero e Direito*. 2018;7(1):1–19.
17. Kawakami R, Haruka M, Kiyoshi S, et al. Calf circumference as a surrogate marker of muscle mass for diagnosing sarcopenia in Japanese men and women. *Geriatr Gerontol Int*. 2015;15(8):969–876.
18. Bolaji OF. Association between calf circumference, its change, and health outcomes in community-dwelling older adults from southern Brazil. *Pelotas*, 2024;83.
19. Pagotto V, Silveira EA. Methods, diagnostic criteria, cutoff points, and prevalence of sarcopenia among older people. *The Scientific World Journal*. 2014;(1):231–312.
20. Álvarez BA, Jose AC, Helio CJ, et al. Diagnostic and prognostic value of calf circumference for sarcopenia in community-dwelling older adults. *The Journal of nutrition, health and aging*. 2024;28(8):100–290.
21. Prado CM, Francese L, Samuel THC, et al. Advances in muscle health and nutrition: a toolkit for healthcare professionals. *Clinical Nutrition*. 2022;41(10):2244–2263.
22. Hsiang CH, Chen JW, Tung WK, et al. Calf circumference and risk of cardiovascular disease. *Geriatrics & Gerontology International*. 2020;20(12):1133–1137.
23. Hansen SS, Munk T, Knudsen AW, et al. Concordance between changes in calf circumference and muscle mass exists: A narrative literature review. *Clinical Nutrition ESPEN*. 2024;59(1):171–175.
24. Smith JA, Brown LM. Gender differences in body composition and muscle distribution: a comprehensive review. *Journal of Human Physiology*. 2022; 45(3): 215–230.
25. Garcia RF, Lee TH. The role of genetics in body fat distribution: implications for health and fitness. *International Journal of Obesity*. 2023; 47(1):12–25.
26. Johnson T, Su J, Andres J, et al. Sex Differences in fat distribution and muscle fat infiltration in the lower extremity: a retrospective diverse-ethnicity 7T MRI study in a research institute setting in the USA. *Diagnostics*. 2024; 14(20): 2260.
27. Martinez PA, Silva JR. Physical activity and its impact on muscle development in women: a longitudinal study. *Journal of Sports Science and Medicine*. 2024;23(2):100–110.
28. Nogueira JAD. Atividade física em populações rurais do Brasil: uma revisão da literatura. *Revista Brasileira de Ciência e Movimento*. 2019;27(4): 228–240.