

Association between cognitive commitment and calf circumference in elderly: a transversal study

Associação entre comprometimento cognitivo e circunferência da panturrilha em idosos: um estudo transversal

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ABSTRACT | BACKGROUND: Cognitive impairment is correlated with left calf circumference (LCC), which corresponds to an indirect marker of sarcopenia. LCC is a simple and quick measure to be collected in outpatient clinics. However, the magnitude of this correlation seems to be different between the different degrees of frailty in the elderly. **OBJECTIVE:** Verify the correlation between LCC and cognitive impairment at different levels of frailty in the elderly. **MATERIALS AND METHODS:** Cross-sectional study with secondary data from medical records of elderly people diagnosed with dementia registered at the State Reference Center for Health Care for the Elderly (CREASI). Data were collected from the Mini-Mental State Examination (MMSE), and the left calf circumference (LCC) was obtained from the comprehensive geriatric assessment carried out on admission of the elderly to CREASI. In addition, the elderly's sociodemographic data were recorded to characterize the sample, divided into gender and degree of frailty. In each group, Pearson's test was applied to verify the correlation between MMSE and LCC, considering a p-value of 0.05. **RESULTS:** 470 medical records were evaluated, 342 women and 128 men. The frail elderly showed a weak correlation between the sexes. **CONCLUSION:** Cognitive impairment and LCC are only weakly correlated in frail older adults. Gender did not modify the correlation between cognitive impairment and LCC.

KEYWORDS: Aging. Cognitive Dysfunction. Frail Elderly. Fragility. Sarcopenia.

RESUMO | INTRODUÇÃO: O Comprometimento cognitivo está correlacionado com circunferência da panturrilha esquerda (CPE) que corresponde a um marcador indireto de sarcopenia. A CPE é uma medida simples e rápida de ser coletada em ambulatórios. Contudo, a magnitude desta correlação parece ser distinta entre os diferentes graus de fragilidade do idoso. **OBJETIVO:** Verificar a correlação entre a CPE e comprometimento cognitivo nos diferentes níveis de fragilidade do idoso. **MATERIAIS E MÉTODOS:** Estudo transversal com dados secundários provenientes dos prontuários dos idosos com diagnóstico de demência cadastrados no Centro de Referência Estadual de Atenção à Saúde do Idoso (CREASI). Dados do Mini Exame do estado mental (MEEM) e da CPE foram obtidos da avaliação geriátrica ampla realizada no ingresso ao CREASI. Os dados sociodemográficos dos idosos foram registrados para caracterização da amostra, divididos quanto ao sexo e ao grau de fragilidade. Em cada grupo foi aplicado o teste de Pearson para verificar a correlação entre MEEM e CPE considerando p valor de 0,05. **RESULTADOS:** Foram avaliados 470 prontuários, 342 mulheres e 128 homens. Os idosos frágeis demonstraram fraca correlação entre os sexos. **CONCLUSÃO:** Comprometimento cognitivo e CPE estão fracamente correlacionados nos idosos frágeis. O sexo não modificou a correlação entre comprometimento cognitivo e CPE.

PALAVRAS-CHAVE: Disfunção Cognitiva. Envelhecimento. Idoso Fragilizado. Fragilidade. Sarcopenia.

Introduction

Left leg circumference (LPC) is an easily collected indicator of muscle mass loss in healthcare services. The LPC associated with other indicators such as low muscle strength and physical performance may indicate sarcopenia frame in elderly.¹ Scientific evidence indicates that cognitive impairment (CI) is correlated with sarcopenia¹, emotional changes², and frailty.³ This is supported by the fact that elderly people diagnosed with dementia commonly present sarcopenia.^{4,5} As there is already evidence of the association between sarcopenia and cognitive impairment^{6,7}, it is plausible to assume that the measures used to diagnose sarcopenia as LPC also have some level of association with cognitive impairment. Given this, there is a need to identify a possible association between LPC and CI to analyze the clinical implications of this possible association.

Clinical conditions such as systemic inflammation, oxidative stress⁸, insulin resistance, and a sedentary lifestyle seem to reduce muscle mass and affect both LPC and CI.⁹ It was also found that inflammatory markers have been associated with lower levels of muscle mass and strength and physical performance¹⁰ and dementias, especially Alzheimer's.¹¹ Therefore, subjects with dementia may have reduced LPC and have a moderate or strong association with CI.

LPC is a low-cost procedure that is easily replicable in health services.^{13,14} This is the measurement of the circumference of the left calf, having as cutoff points 34cm for men and 33cm for women. Although the exclusive use of this measure for the diagnosis of sarcopenia is not recommended, this measure has been used as a screening method to identify probable sarcopenia among the elderly.¹²

Just as the LPC represents a practical and objective measure to screen for possible cases of sarcopenia, the Mini-Mental State Examination (MMSE) corresponds to the most applied test to identify CI.¹⁴ The MMSE has internationally accepted accuracy levels, is commonly applied in specialized services in the health of the elderly.¹⁵ As both tests are performed during the Comprehensive Geriatric Assessment (CGA) in health services, the analysis of possible correlations between them becomes possible with secondary data. Previous studies report the association between CI and sarcopenia.^{16,17} However, they do not correlate this association with the different degrees of frailty.

Frail elderly people with higher levels of sarcopenia may have higher degrees of CI, but this statement still needs further investigation. Therefore, the association between LPC and CI can occur among the elderly registered in a reference center. This study aimed to verify the correlation between LPC and cognitive impairment at different levels of frailty in the elderly.

Materials and methods

Study scope

This is an observational, cross-sectional study of secondary data from medical records of elderly people with active registration at the State Reference Center for Health Care for the Elderly (CREASI). Data collection was carried out from February to November 2019. The initial CGA assessment form was analyzed in each medical record, which is filled out upon admission of the elderly person.

In the CGA, MMSE data were collected, which is a valid instrument to assess cognitive impairment.¹⁹ The MMSE checks orientation, memory, and attention, naming ability, obedience to a verbal and written command²⁰ with scores from 0 to 30 points, and having the cutoff adjusted to education.²¹ Another measure collected in the CGA was the LPC, an indirect indicator of muscle mass loss and sarcopenia in the elderly. Cutoff values of 34 cm for men and 33 cm for women were considered.^{13,14} Sample characterization variables were collected together, such as age, body mass index (BMI), education, clinical, functional statement, ambulation, amount of medication ingested, Timed Up and Go (TUG), and the number of falls.

This study followed the recommendations of Resolution 466/12 of the National Health Council, being approved by the Ethics Committee for Research on Human Beings of the Health Secretariat of the State of Bahia under number 2.581.226. Data confidentiality, protection of the research subject's information, and respect for the privacy and individuality of the elderly were guaranteed by restricting access to the database to the main researchers. The use of data for analysis did not contain information that would identify the subjects.

Sample

Elderly people with a diagnosis of dementia registered in the CGA participated in this study. Frailty levels were identified by the Clinical Functional Vulnerability Index (IVCF-20) proposed by Moraes et al.²² The IVCF-20 was developed to identify frail elderly people quickly. This questionnaire includes multidimensional aspects of elderly health, comprising 20 questions related to age, self-perception of health, functional disabilities, cognition, mood, mobility, aerobic capacity, gait, sphincter incontinence, communication, and multiple comorbidities. The result of the IVCF-20 is expressed on a scale of 1 to 10, being considered robust elderly (1 to 3), elderly at risk of frailty (4 and 5), and frail elderly (6 to 10).²²

Procedures

Data collection was conducted by 13 researchers' employees distributed in five shifts collection. All received prior training and performed the collection using an electronic form on the computer. To minimize duplicate collections and team rework, a supervising researcher was included who performed weekly database reviews.

Data collection was conducted in a restricted room of the Education and Research Center (ERC) of CREASI. Environment properly equipped for this purpose with four computers available. Doubts about the data contained in the medical record could be discussed with the responsible researchers who knew the CGA in depth. The collected data were electronically stored in an ERC virtual folder. An external researcher reviewed the database to check for inconsistencies and collection errors to be later released for data analysis. Therefore, the database was considered safe and reliable for statistical analysis. In addition, a registered copy with identification data of the elderly replaced by alphanumeric codes was released for statistical analysis.

Data Analysis

A descriptive analysis of clinical and functional data was performed to characterize the sample. To characterize the sample in this study, a descriptive

analysis of the identification data of the subjects was performed. Quantitative data were presented with measures of central tendency (means or medians) and their dispersive measures. Ordinary measurements were presented as frequencies. The Kolmogorov-Smirnov test was applied to verify adherence to the normality curve, considering $p \leq 0.05$. The elderly were divided into 2 groups: 1) frail elderly, 2) very frail elderly, 3) elderly at risk of frailty, and 4) elderly at risk of frailty. The correlation between MMSE and LPC through the Pearson test was performed in each group separately, considering $p \leq 0.05$. Statistical analyzes were performed using Statistical Package for Social Sciences version 20.0 for Windows (SPSS Inc, Chicago, IL, USA).

Results

3282 records were identified in CREASI, and 1092 had some dementia. After applying the exclusion criteria, 470 elderly were selected, 342 women and 128 men distributed in the four study groups, 22 men at risk of frailty, 106 frail men, 44 women at risk of frailty, and 298 frail women (Figure 1). Most of the elderly in the four groups had between 1 and 7 years of study with free walking and were similar in age ($F=2.605$; $p=0.101$) and BMI ($F=1.191$; $p=0.206$). The number of falls in the last year was similar between the four groups ($F=0.577$; $p=0.448$), and the amount of medication in use differed between the groups ($F=6.507$; $p=0.011$), being higher among frail women. It was also observed that the mean TUG time differed between groups ($F=3.302$; $p=0.051$), being higher in frail individuals, regardless of gender. The other data that characterize the individuals in the study are described in Table 1.

The correlation between MMSE and LPC was analyzed in each group and indicated a low degree of correlation in all. However, the correlation was significant in the frail elderly groups. Women at risk of frailty had the lowest degree of correlation without statistical significance ($r=-0.115$, $p=0.458$), and frail men had the highest correlation index ($r=0.345$, $p=0.000$). The distribution of correlations in each group is described in Figure 2.

Table 1. Characteristics of elderly people with dementia at the State Reference Center for Elderly Care in Salvador, Bahia

	In risk of frail		Frail		Test T	p
	Men (n = 22)	Women (n = 44)	Men (n = 106)	Women (n = 298)		
Age (mean ± SD)	76,6 ± 8,77	74,5 ± 6,97	76,2 ± 11,33	79,2 ± 8,29	0,567	0,330
Education (n (%))						
Unlettered	1 (4,8)	15 (34,9)	21 (17,9)	88 (26,8)		
1 to 7 years	13 (61,9)	19 (44,2)	64 (54,7)	176 (53,7)		
8 years or more	7 (33,3)	9 (20,9)	32 (27,4)	64 (19,5)		
BMI (mean ± SD)	24,4 ± 3,7	25,5 ± 5,3	24,5 ± 3,5	24,9 ± 5,1	1,56	0,089
Amount of medication (mean ± SD)	4,8 ± 2,8	4,8 ± 3,1	4,38 ± 2,6	5,2 ± 3,0	1,09	0,13
Functional clinical extract (mean ± SD)	4,8 ± 0,91	5,2 ± 1,1	7,8 ± 1,1	7,6 ± 1,1	0,893	0,243
Calf Circunference (mean ± SD)	34,47 ± 3,4	34,1 ± 3,5	33,4 ± 3,6	32,4 ± 3,8	1,752	0,092
MMSE (mean ± SD)	20,0 ± 6,2	16,3 ± 6,3	14,1 ± 6,6	13,0 ± 6,1	0,374	0,879
Walk (n (%))						
Without help	15 (71,4)	31 (72,1)	60 (51,3)	194 (59,1)		
Walking Stick	1 (4,8)	3 (7)	4 (3,4)	18 (5,5)		
Aided by people	0 (0)	1 (2,3)	6 (5,1)	14 (4,3)		
Wheelchair	0 (0)	1 (2,3)	14 (12,0)	31 (9,5)		
Crutch	1 (4,8)	0 (0)	4 (3,4)	1 (0,3)		
Walker	0 (0)	0 (0)	1 (0,9)	6 (1,8)		
Others	0 (0)	0 (0)	2 (1,7)	3 (0,9)		
Not filled	4 (19,0)	7 (16,3)	7 (16,3)	61 (18,6)		
TUG (mean ± SD)	10,2 ± 1,58	13,4 ± 4,36	21,5 ± 24,69	18,8 ± 10,9	1,273	0,845
Number of falls in the last year (mean ± SD)	0,55 ± 0,98	1,0 ± 1,8	0,8 ± 1,6	1,0 ± 1,6	0,324	0,754

Figure 1. Flowchart for the selection of medical records for the elderly with active registration at CREASI

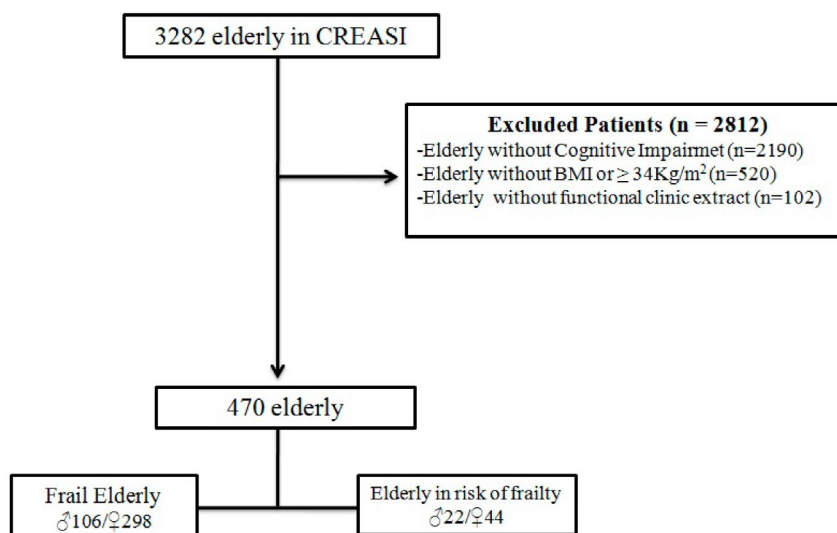
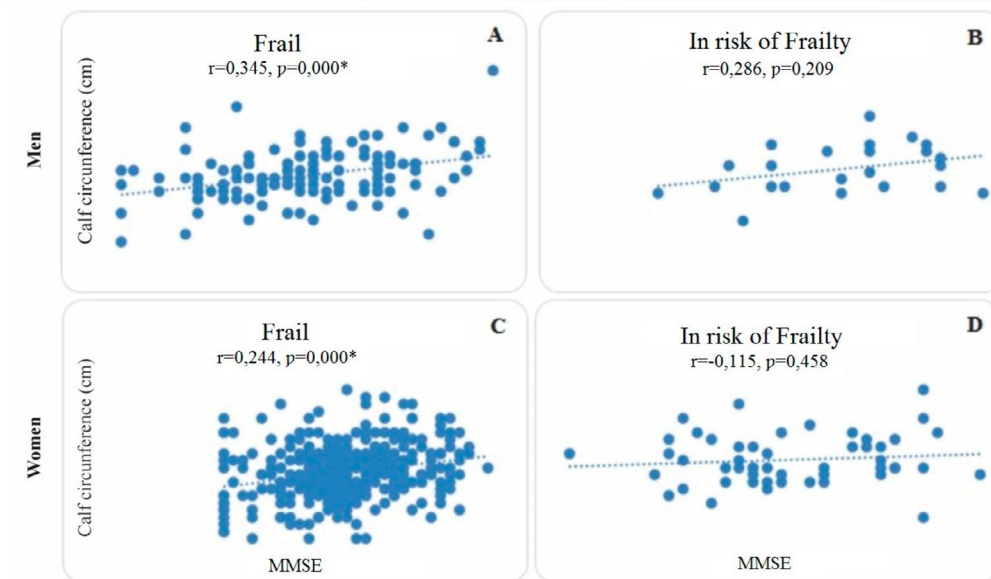


Figure 2. Correlation between Minimal and left calf circumference (cm) according to sex and clinical-functional extract. Figure 2A corresponds to frail elderly men with a correlation of $r = 0.345$ and $p = 0.000^*$, figure 2B corresponds to elderly men at risk of frailty with a correlation of $r = 0.286$ and $p = 0.209$. Figure 2C shows the correlation in frail elderly women having $r = 0.244$ and $p = 0.000^*$ and figure 2D shows the correlation of elderly women at risk of frailty with $r = -0.115$ and $p = 0.458$.



Discussion

Left calf circumference was weakly correlated with cognitive impairment in frail older adults regardless of gender. Although systematic reviews indicate a moderate to strong correlation between these variables²³, the present study showed a weak correlation only in frail elderly. Different studies claim that the female sex tends to have a greater magnitude of this correlation.¹ The justification corresponds to the tendency of females to have more neurological deficits and lower physical performance compared to males. These findings were not reproduced in the present study, revealing that gender did not modify the magnitude of the correlation between MMSE and LPC.

Despite this, sarcopenia was correlated with cognitive impairment, and depressive symptoms in elderly men living in the community²⁴, as well as this correlation, was also evidenced when different sarcopenia assessment parameters were used.²⁵ However, the present study was one of the few that used LPC to correlate with MMSE. This fact does not preclude the analysis but allows analyzes that justify the divergence of the findings.

Although the literature robustly demonstrates the association between sarcopenia and cognitive impairment, our findings contradict the main systematic reviews on this subject and demonstrate that gender does not influence this correlation.^{1,26,27} The justification for analyzing it separately by sex lies in identifying risk factors for sarcopenia inherent to men and women. Therefore, understanding the role of sex in this correlation allows further studies on physiological, behavioral, and social factors adopted by elderly men or women.

The inclusion of LPC in the present study is due to its ease of clinical use, low cost, and practicality in collecting information. It is an indirect measure considered valid to monitor sarcopenia.^{13,14} The presence of adipose tissue can influence calf circumference, and for this reason, patients with a BMI greater than 34kg/m² were excluded.

Frailty is the added factor that induces higher levels of muscle weakness in elderly people of both sexes.²³ The present study showed a greater correlation between LPC and MMSE in frail elderly, demonstrating that frailty increases the chances of this correlation occurring. Thus, the importance of early diagnosis of frailty lies in the possibility of preventing disabilities and providing opportunities for the elderly to remain healthy and independent for longer.^{23,26}

The results found in this study do not support previous findings of a strong association between sarcopenia and cognitive impairment^{16,29,30}, but they support the idea that there is a relationship between these variables. The cross-sectional methodological design adopted in this study differs from prospective articles included in systematic reviews.³¹ Despite this, the different methodological designs did not prevent the comparative analysis between studies. This study has robust data collected by geriatricians in a referral center specializing in elderly health, ensuring the quality of the information collected. Together, the sample size is sufficient to guarantee study power for the implemented statistical analyzes.

LPC, together with the measurement of muscle strength and physical capacity, should be used in health services to identify sarcopenia, but extrapolating the use of LPC to investigate changes in cognitive impairment should be viewed with caution. New prospective studies that address the relationship between LPC and CI can help understand this relationship in depth, whose study showed evidence of its existence. However, the relationship between these measures is incipient for clinical use, and it is necessary to further investigate together with the pathophysiological mechanisms that support this association with more robustness.

The present study has limitations in using secondary data that health professionals recorded during their work activities. Such data may contain measurement biases that the researchers did not identify. To minimize this, a high sample was included, able to alleviate this bias. The absence of more detailed information about sarcopenia prevented a direct correlation between sarcopenia and CI. For this reason, the analysis was carried out only with the LPC.

Conclusion

The CI and LPC are weakly correlated only in the frail elderly of both sexes. This association was not found in the elderly at risk of frailty. The weak correlation between EPC and WC indicates that these measures together have low clinical relevance, and it is not possible to state that changes in LPC will influence CI even in frail elderly people.

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Authors' contributions

Rates TSR participated in research data collection, interpretation, conception, design, statistical analysis of research data, and scientific article writing. Noronha DO participated in participant recruitment, research project planning, and design. Silva MFC, Silva AR, and Mota ER participated in the study's data collection. Santos KOB participated in the planning of the research project and design. Luz-Santos C participated in the recruitment of participants, planning the research project, conception, design, statistical analysis of research data, and writing the scientific article.

Competing interest

No financial, legal, or political conflicts involving third parties (government, companies, and private foundations, etc.) have been declared for any aspect of the submitted work (including, but not limited to grants and funding, advisory board participation, study design, preparation manuscript, statistical analysis, etc.).

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