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Dissertação de Mestrado

COMPARABILIDADE DA MEDIDA DE CIRCUNFERÊNCIA DA PANTURRILHA EM PACIENTES HOSPITALIZADOS POR MEIO DE MEDIDAS REPETIDAS EM DIFERENTES POSIÇÕES

Ana Carolina Vaz Benet

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Ana Carolina Vaz Benet

Comparabilidade da medida de circunferência da panturrilha em pacientes hospitalizados por meio de medidas repetidas em diferentes posições

Dissertação apresentada ao Programa de Pós-Graduação em Nutrição e Alimentos da Universidade Federal de Pelotas, como requisito parcial à obtenção do título de Mestre em Nutrição e Alimentos.

Orientadora: Profª Drª Maria Cristina Gonzalez
Coorientadora: Drª Silvana Paiva Orlandi

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Banca Examinadora:

Profª Drª Maria Cristina Gonzalez (orientadora)
Doutora em Epidemiologia pela Universidade Federal de Pelotas

Drª Ana Paula Fayh
Doutora em Ciências Médicas: Endocrinologia pela Universidade Federal do Rio Grande do Sul

Dr Leonardo Pozza Santos
Doutor em Epidemiologia pela Universidade Federal

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A educação não muda o mundo, a educação muda as pessoas e as pessoas mudam o mundo.

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RESUMO

BENET, Ana Carolina Vaz. **COMPARABILIDADE DA MEDIDA DE CIRCUNFERÊNCIA DA PANTURRILHA EM PACIENTES HOSPITALIZADOS POR MEIO DE MEDIDAS REPETIDAS EM DIFERENTES POSIÇÕES.** Dissertação (Mestrado em Nutrição e Alimentos) – Programa de Pós-Graduação em Nutrição e Alimentos, Faculdade de Nutrição, Universidade Federal de Pelotas, 2025.

A circunferência da panturrilha (CP) é uma medida antropométrica reconhecida como marcador de massa muscular. No entanto, existem discrepâncias na literatura em relação à posição do indivíduo (ortostática, sentada ou decúbito dorsal) durante a medição. O objetivo deste estudo foi avaliar a concordância entre as medidas de CP em diferentes posições e sugerir ajustes caso fossem observadas variações. Este estudo transversal foi realizado com pacientes hospitalizados (≥ 18 anos). A CP foi medida na maior circunferência da panturrilha direita nas posições ortostática (em pé) (CP_{ort}), sentada (CP_{sent}) e em decúbito dorsal (CP_{dec}). Foram aplicados os testes *post hoc* de Análise de Variância de Medidas Repetidas (RM-ANOVA) e Diferença Honestamente Significativa de Tukey. Também foram utilizados gráficos de Bland-Altman e regressão linear ajustada por sexo, índice de massa corporal e idade, tendo CP_{ort} como variável dependente e as demais posições como variáveis independentes. Foram avaliados 193 pacientes com média de idade de 57,7 ± 15,0 anos (52,8% do sexo feminino). O CP_{sent} (34,4 ± 4,8 cm) apresentou os maiores valores médios, com diferenças estatisticamente significativas em relação a CP_{ort} (+0,39 cm; $p < 0,05$) e CP_{dec} (+0,33 cm; $p < 0,05$). O CP_{sent} foi maior que o CP_{ort} em ambos os sexos, enquanto o CP_{dec} foi maior apenas no sexo feminino. Como os valores de corte para nossa população foram obtidos a partir de CP_{ort} (≤ 33,3 cm e ≤ 34,3 cm, para mulheres e homens, respectivamente), as regressões lineares geraram valores equivalentes de CP quando as medidas foram obtidas de outras posições. Para $CP_{sent,}$ os pontos de corte equivalentes seriam ≤ 33,3 cm e ≤ 34,3 cm para mulheres e homens, respectivamente. Para CP_{dec}, os pontos de corte correspondentes seriam ≤33,2 cm e ≤ 34,0 cm para mulheres e homens, respectivamente. As medidas do CP feitas em pé, sentado e decúbito dorsal não são intercambiáveis, e valores significativamente mais altos foram obtidos na posição sentada. Esses resultados sugerem que valores de corte equivalentes devem ser usados quando o CP é medido em posição diferente daquela em que o ponto de corte foi originalmente estabelecido.

Palavras-chaves: circunferência da panturrilha, massa muscular, antropometria, sarcopenia, avaliação nutricional, composição corporal.

Abstract

BENET, Ana Carolina Vaz. **COMPARABILITY OF CALF CIRCUMFERENCE MEASURES IN HOSPITALIZED PATIENTS USING REPEATED MEASUREMENTS IN DIFFERENT POSITIONS.** Dissertation (master's degree in nutrition and food) - Postgraduate Program in Nutrition and Food, Faculty of Nutrition, Federal University of Pelotas, 2025.

Calf circumference (CC) is an anthropometric measure recognized as a muscle mass marker. However, discrepancies exist in the literature regarding the individual`s position (orthostatic, sitting, or supine) during measurement. This study aimed to evaluate agreement among CC measurements in different positions and suggest adjustments if we observed variations. This cross-sectional study was conducted with hospitalized patients (≥ 18 years). CC was measured at the largest circumference of the right calf in orthostatic (standing) (CC_{ort}), sitting (CC_{sit}), and supine (CC_{sup}) positions. The repeated-measures Analysis of Variance (RM-ANOVA) and the Tukey Honestly Significant Difference post hoc tests were applied. Bland–Altman plots and linear regression adjusted for sex, body mass index, and age were also used, with CC_{ort} as the dependent variable and the other positions as independent variables. A total of 193 patients were evaluated with a mean age of 57.7 ± 15.0 years (52.8% females). CC_{sit} (34.4 ± 4.8 cm) had the highest mean values, with statistically significant differences from CC_{ort} (+0.39 cm; $p < 0.05$) and CC_{sup} (+0.33 cm; $p < 0.05$). CC_{sit} was higher than CC_{ort} in both sexes, while CC_{sup} was higher only in females. As the cutoff values for our population were obtained from CC_{ort} (≤ 33.3 cm and ≤ 34.3 cm, for females and males, respectively), linear regressions generated equivalent CC values when the measurements were obtained from other positions. For CC_{sit}, the equivalent cutoffs would be ≤ 33.3 cm and ≤ 34.3 cm for females and males, respectively. For CC_{sup}, the corresponding cutoffs would be ≤33.2 cm and ≤ 34.0 cm for females and males, respectively. The CC measurement taken at standing, sitting, and supine position are not interchangeable, and significant higher values were obtained in the sitting position. These results suggest that equivalent cutoff values should be used when CC is measured in different position from the one the cutoff was originally established.

Keywords: calf circumference, muscle mass, anthropometry, sarcopenia, nutritional assessment, body composition.

Sumário

1-PROJETO DE PESQUISA

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Programa de Pós-Graduação em Nutrição e Alimentos

PROJETO DE PESQUISA

COMPARABILIDADE DA MEDIDA DE CIRCUNFERÊNCIA DA PANTURRILHA EM PACIENTES HOSPITALIZADOS POR MEIO DE MEDIDAS REPETIDAS EM DIFERENTES POSIÇÕES

Ana Carolina Vaz Benet

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Ana Carolina Vaz Benet

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Projeto de qualificação apresentado ao Programa de Pós-Graduação em Nutrição e Alimentos da Faculdade de Nutrição da Universidade Federal de Pelotas como requisito parcial à obtenção do título de Mestre em Nutrição e Alimentos.

Orientadora: Profª Drª Maria Cristina Gonzalez
Coorientadora (es): Drª Silvana Paiva Orlandi

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Banca Examinadora:

Profª Drª Maria Cristina Gonzalez (orientadora)
Doutora em Epidemiologia pela Universidade Federal de Pelotas

Drª Renata Moraes Bielemann
Doutora em Epidemiologia pela Universidade Federal de Pelotas

Dr Leonardo Pozza Santos
Doutor em Epidemiologia pela Universidade Federal de Pelotas

SUMÁRIO

1 Introdução

O músculo esquelético tem funções físicas muito bem conhecidas, sendo cada vez mais reconhecido o seu papel crucial no metabolismo energético e proteico(CRUZ-JENTOFT; GONZALEZ; PRADO, 2023; DEUTZ et al., 2019). Condições que afetam a ingestão alimentar e as necessidades nutricionais estão associadas ao catabolismo do músculo esquelético (ARGILÉS et al., 2016). Desse modo, observamos a massa e a função do músculo esquelético como indicadores importantes do estado nutricional, estando associados a vários desfechos clínicos, incluindo morbidade e mortalidade (CRUZ-JENTOFT; GONZALEZ; PRADO, 2023; DEUTZ et al., 2019).

A Iniciativa de Liderança Global sobre Desnutrição (*Global Leadership Initiative on Malnutrition* - GLIM) é uma iniciativa recente das principais sociedades globais de nutrição clínica, com o objetivo de fornecer critérios e orientações para uma abordagem baseada em consenso para o diagnóstico de desnutrição em adultos, aplicável em diversos ambientes clínicos globais. A massa muscular reduzida foi incluída como um critério fenotípico nas recomendações de consenso do GLIM para o diagnóstico de desnutrição (CEDERHOLM et al., 2019; JENSEN et al., 2019).

A perda de massa, força e função muscular tem consequências adversas, como lentidão na cicatrização de feridas e na recuperação de doenças, incapacidade física, quedas (ARGILÉS et al., 2016), pior qualidade de vida, custos mais elevados com cuidados de saúde (CRUZ-JENTOFT et al., 2019) e são encontradas em condições clínicas como a sarcopenia e suas variantes, como a obesidade sarcopênica (DONINI et al., 2020).

Avaliar a massa e a função muscular esquelética é de suma importância, visto que a perda de massa muscular esquelética é um componente central na desnutrição, sarcopenia, e caquexia (CEDERHOLM et al., 2019; CRUZ-JENTOFT et al., 2019; FEARON et al., 2011). Porém, ainda não há consenso sobre a melhor forma de medir e definir a massa muscular reduzida, particularmente em ambientes clínicos (BARAZZONI et al., 2022; CEDERHOLM et al., 2019; COMPHER et al., 2022)

Atualmente, técnicas como análise de tomografia computadorizada (TC), ressonância magnética, impedância bioelétrica (BE) e absorciometria de raios X de dupla energia (DXA) são recomendadas quando os métodos e o acesso à análise especializada são disponíveis (BARAZZONI et al., 2022; COMPHER et al., 2022; CRUZ-JENTOFT et al., 2019; HEYMSFIELD et al., 2015). No entanto, a disponibilidade limitada de técnicas avançadas em países de média e baixa renda, como o Brasil, é realmente um desafio. O alto custo e a complexidade desses métodos podem dificultar sua implementação na prática clínica, tanto em serviços de atenção primária, quanto secundária (PAGOTTO et al., 2018). As medidas antropométricas, por outro lado, são uma alternativa mais acessível, não-invasiva e prática de serem aplicadas. Sendo assim, as medidas antropométricas são aceitas para a avaliação do critério fenotípico massa muscular para diagnóstico de desnutrição (BARAZZONI et al., 2022; COMPHER et al., 2022).

Vários estudos sugeriram correlações positivas entre a circunferência da panturrilha (CP) e a massa muscular esquelética apendicular medida por DXA, o que abre a possibilidade de usar medições da CP como uma ferramenta de triagem para identificar risco de baixa massa muscular em indivíduos de comunidades locais (KAWAKAMI et al., 2020; ROLLAND et al., 2003; SANTOS et al., 2019).

A CP é reconhecida pelo Consenso do Grupo de Trabalho Asiático para Sarcopenia 2019 (*Asian Working Group for Sarcopenia* - AWGS'19) (CHEN et al., 2020b) e pela Organização Mundial da Saúde (OMS) como um marcador de massa muscular em indivíduos adultos idosos (WHO, 1995). A confirmação através dos resultados de diferentes estudos fortalece a utilização da CP como um marcador substituto para avaliação da massa muscular (HWANG et al., 2018; KIM et al., 2018). Esta medida se torna significativa para a prática clínica, permitindo uma avaliação mais ampla e acessível em diversas populações e ambientes.

Contudo, até o momento não existe uma padronização na forma de medir a CP. Embora o AWGS'19 recomende medir o valor máximo de ambas as panturrilhas usando uma fita não elástica, ele não oferece orientação específica sobre a posição (em pé vs. sentada) e lateralidade (esquerda vs. direita) para medição (PIODENA-APORTADERA et al., 2022). Em termos de posição, diferentes estudos adotaram variadas posturas para suas análises. A posição ortostática foi empregada em diversas pesquisas (BARBOSA-SILVA et al., 2016a; KAWAKAMI et al., 2015; PAGOTTO et al., 2018), consistente com as recomendações da Sociedade Internacional para o Avanço da Cineantropometria (STEWART, 2011) Alguns estudos optaram pela posição sentada (LIM et al., 2020; PÉREZ-ZEPEDA; GUTIÉRREZ-ROBLEDO, 2016; SANTOS et al., 2019). Outros estudos preferiram a posição em decúbito dorsal com o joelho dobrado e apoiado na cama, formando um ângulo de 90 graus (BORGES et al., 2022; MAEDA et al., 2017) e, mesmo em posição em decúbito, estudos utilizaram o decúbito ventral (KINOSHITA et al., 2022).

Além das variações na posição para medir a circunferência da panturrilha, sabe-se que o método, como toda medida antropométrica, possui uma margem de erro. A variabilidade nas medidas antropométricas, causada por diferenças na execução da técnica, contribui significativamente para essa margem de erro. O erro técnico de medição (ETM) é um índice que reflete a precisão da medida e serve como um indicador de controle de qualidade para essas avaliações (PERINI et al., 2005). Representado pelo desvio-padrão entre medidas repetidas, o ETM é utilizado para calcular a variabilidade intra-avaliador (variação das medidas repetidas em uma mesma pessoa ou grupo de pessoas pelo mesmo antropometrista) e inter-avaliador (variação das medidas realizadas por diferentes antropometristas em um mesmo grupo de pessoas). Assim como em qualquer outro método de medição, a confiabilidade intra e inter-avaliadores e a mudança mínima detectável (MMD) são cruciais para estudos longitudinais e de grande importância na prática clínica para identificar verdadeiras mudanças (CADILHA et al., 2017).

Padronizar os métodos de medição e estabelecer diretrizes claras sobre a posição do indivíduo e a técnica utilizada pode permitir a comparabilidade entre estudos e facilitar a implementação prática em ambientes clínicos, especialmente em contextos com recursos limitados. Assim, será possível utilizar estratégias de intervenção mais eficazes, resultando em melhores desfechos clínicos.

2 Marco teórico

Serão apresentados os fundamentos teóricos do estudo. As medidas da CP serão analisadas quanto à precisão e confiabilidade, avaliando repetibilidade e reprodutibilidade. As medições serão repetidas em dias diferentes e por diferentes entrevistadores para identificar erros técnicos.

2.1 Precisão

Na avaliação da composição corporal, o termo 'precisão' é utilizado para indicar o nível de consistência entre resultados obtidos em medições repetidas com o mesmo método, refletindo a capacidade do método de reproduzir o mesmo resultado em diversas ocasiões. Em estudos longitudinais, a precisão é fundamental para identificar e interpretar mudanças ao longo do tempo. Se as medições não forem precisas, as mudanças observadas podem não refletir alterações reais, comprometendo a validade do estudo.

2.2 Confiabilidade

Refere-se à capacidade de um método de medição produzir resultados consistentes e precisos. Um método é considerado confiável quando demonstra alta repetibilidade, ou seja, produz resultados consistentes sob as mesmas condições, e alta reprodutibilidade, indicando que mantém essa consistência mesmo quando aplicado em diferentes condições ou por diferentes operadores. Erros aleatórios podem afetar tanto a precisão quanto a confiabilidade de um método.

2.3 Repetibilidade

Descreve a consistência das medições de uma variável específica, quando realizadas repetidamente pelo mesmo operador ou observador, usando o mesmo equipamento, no mesmo indivíduo e sob condições idênticas.

2.4 Reprodutibilidade

Refere-se à capacidade de um dispositivo específico de produzir resultados consistentes ao medir uma variável, mesmo quando operado por diferentes observadores, seja na mesma situação ou em situações distintas.

2.5 Erro interobservador

O erro de medição interobservador descreve a variabilidade nos resultados de uma variável específica quando diferentes operadores realizam medições usando o mesmo método.

2.6 Erro intraobservador

O erro de medição intraobservador refere-se à variabilidade nos resultados de uma variável específica, obtida pelo mesmo método, quando um operador realiza múltiplas medições consecutivas.

2.7 Erro aleatório

O erro aleatório é um tipo de erro que ocorre de maneira imprevisível durante a coleta de dados de medições em geral, são causados por diversos fatores que variam de uma medição para outra, tornando esses erros imprevisíveis e, geralmente, impossíveis de eliminar completamente. Os principais fatores que contribuem para o erro aleatório são: variabilidade biológica, desvios de protocolo, erro aleatório do instrumento, erro do operador e ambiente. O impacto dos erros aleatórios pode ser minimizado através do aumento do número de medições.

3 Revisão bibliográfica

3.1 Estratégia de busca

Foram incluídos, na presente revisão de literatura, artigos com delineamento transversal, longitudinal e de coorte que usaram a medida da CP como marcador de massa muscular e triagem/diagnóstico de sarcopenia.

A busca foi realizada na base de dados da *PubMed* (figura 1). A estratégia de busca foi realizada utilizando as palavras-chaves “calf circunference AND (muscle mass or sarcopenia)”.

A seleção dos artigos ocorreu, primeiramente, através da leitura dos títulos e, posteriormente, pela leitura dos resumos. Os artigos que foram selecionados após a leitura dos resumos, foram lidos na íntegra.

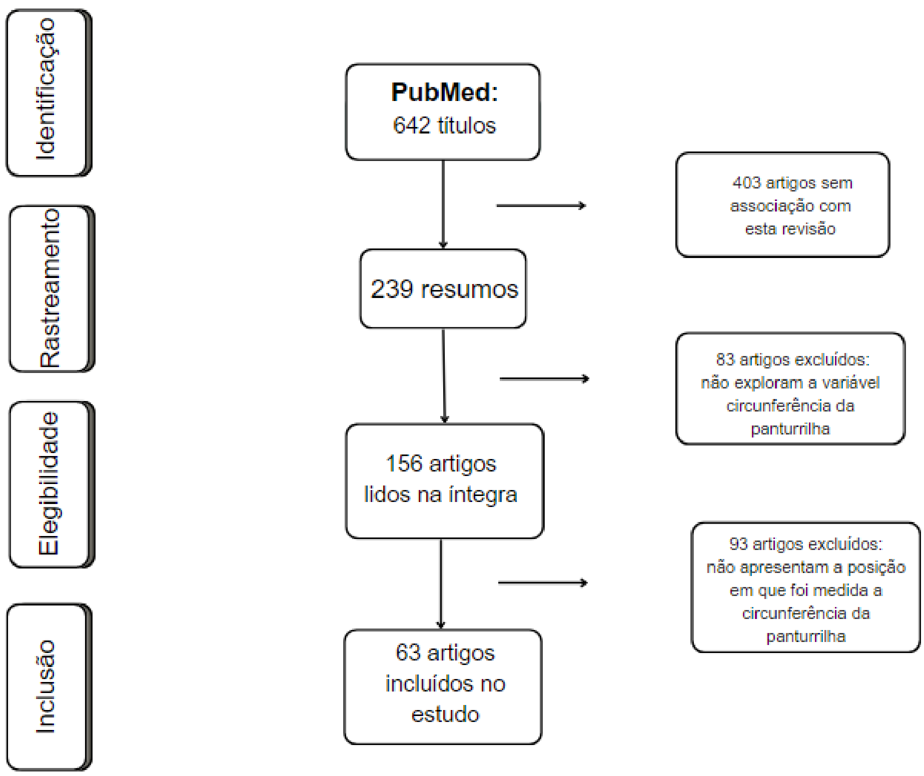
Os critérios de exclusão incluíram: estudos que não apresentassem resultados das medições da CP, a posição em que o indivíduo se encontrava durante a medição ou pacientes críticos que só poderiam ser medidos na posição em decúbito.

3.2 Artigos incluídos na revisão

No processo de revisão da literatura realizado na base de dados PubMed, foram inicialmente identificados 642 estudos relevantes. Destes, 239 foram selecionados para a leitura dos resumos, e 156 artigos foram escolhidos para a leitura completa. Ao final do processo de seleção, 63 artigos foram incluídos nesta revisão, conforme ilustrado na Figura 1.

Dos artigos selecionados, 59 estudos identificaram a posição em que o indivíduo se encontrava durante a medição da CP (Quadro 1). No entanto, quatro estudos tiveram suas principais características detalhadamente apresentadas no Quadro 2 devido à sua maior relevância para este estudo. Desses, três estudos compararam a posição ortostática e sentada, e um estudo analisou a precisão da medição da CP.

Figura 1. Fluxograma do processo de seleção dos artigos incluídos na revisão de literatura.



Fonte: Elaborada pelo autor (2024).

3.3 Principais resultados

Os artigos listados no Quadro 1 foram mencionados nesta revisão para identificar as posições dos indivíduos durante a medição da CP e destacar as divergências na utilização desta ferramenta. Observa-se que 26 estudos usaram a posição sentada, 23 estudos utilizaram a posição ortostática, 7 estudos adotaram a posição em decúbito, e 3 estudos permitiram tanto a posição em decúbito quanto a sentada.

No Quadro 2, foram apresentados três estudos sobre a comparabilidade das posições para medição de CP. O estudo de (PIODENA-APORTADERA et al., 2022), considerado uma referência na literatura, destaca-se por comparar as posições ortostática e sentada com a massa esquelética apendicular relativa usando análise de BE. A massa corporal magra livre de gordura nos quatro membros foi somada e padronizada pelo quadrado da altura para obter a massa esquelética apendicular relativa. Segundo os resultados, as medidas obtidas na posição sentada apresentaram valores mais altos, e a medida em posição ortostática foi recomendada por apresentar maior concordância com a estimativa de sarcopenia pela BE. Em um estudo posterior por (JEONG; KIM; WON, 2020), também houve comparação entre as medidas de CP ortostática e sentada, e os resultados sugeriram a posição ortostática para a triagem de sarcopenia.

No entanto, o estudo mais recente de (PIODENA-APORTADERA et al., 2024) em que aplicou o teste de Yubi-wakka circundando a parte mais larga da panturrilha não dominante com os dedos indicadores e polegares de ambas as mãos e comparou com as medidas da CP ortostática e sentado, mostrou uma concordância moderada apenas nas medidas de CP em posição sentada na perna não dominante, essa concordância provavelmente ocorreu pelo teste de Yubi-wakka ser aplicado com o indivíduo em posição sentada.

O último estudo incluído nesta revisão, e o único identificado na literatura sobre a precisão diagnóstica da CP, foi o de Pribadi et al. (2022). Incluído para discutir a repetibilidade da CP, alinhando-se a um dos objetivos desta revisão, o estudo avaliou o papel de cinco métodos, incluindo a CP, como modalidades diagnósticas de sarcopenia em pacientes com doença inflamatória intestinal, utilizando o DXA como referência para avaliar a massa muscular. Os resultados indicaram que, na prática clínica, a medição da CP será precisa em 82 de 100 pacientes. Quando a CP é medida repetidamente em 100 pacientes, o valor correto é obtido em 69 a 95 pacientes. No entanto, a forma como os autores descreveram a precisão é confusa, sugerindo inconsistências no uso do termo 'precisão'. Isso levanta dúvidas sobre a ampla faixa de resultados (69 a 95), bem como sobre a confiabilidade e possíveis erros na técnica de medição (PRIBADI et al., 2022).

Após revisar a literatura, torna-se evidente a falta de padronização na medição da CP, bem como a escassez de estudos que abordem sua precisão, repetibilidade e potenciais fontes de erro associadas a essa técnica.

Quadro 1. Características dos estudos incluídos na revisão de literatura sobre a posição do indivíduo para medição da circunferência da panturrilha.

POSIÇÃO	AUTOR (ANO/ PAÍS)	TIPO DE ESTUDO	AMOSTRA (N/FAIXA ETÁRIA)
POSIÇÃO DECÚBITO OU SENTADA	Kiss CM et al. / 2024 / Suiça	Transversal	305 participantes com idade entre 50 e 99 anos
	Sobestiansky S et al. / 2021 / Suecia	Transversal	56 participantes com idade ≥ 65 anos
	Yao R et al. / 2022 / China	Transversal	364 participantes com idade entre 18 e 80 anos
POSIÇÃO DECÚBITO	Asai C et al. / 2019 / Japão	Transversal	124 participantes com idade ≥60 anos
	Borges K et al./ 2022 / Espanha	Transversal	90 participantes com idade >65 anos
	Kinoshita H et al. / 2022 / Japão	Transversal	43 participantes com idade média de 20 anos
	Kusaka S et al. / 2017 / Japão	Transversal	116 participantes com idade ≥ 65 anos
	Maeda et al. / 2017 / Japão	Transversal	1164 participantes com idade ≥ 65 anos
	Yalcin A et al. / 2016 / Turquía	Coorte	141 participantes com idade >65 anos
	Yang M et al. / 2018/ China	Transversal	384 participantes com idade ≥60 anos
POSIÇÃO SENTADA	Álvarez-Bustos A et al / 2024 / Espanha	Coorte	1531 participantes com idade > 65 anos
	Aliberti MJR et al. / 2020 / Brasil	Coorte	203 participantes com idade ≥ 60 anos
	Chen CY et al. / 2020 / Taiwan	Transversal	177 participantes com idade >65 anos
	de Luna JRG et al. / 2023 / Brasil	Transversal	124 participantes com idade ≥40 anos
	do Nascimento MK et al. / 2024 / Brasil	Coorte	206 participantes com idade ≥60 anos
	Gonzalez MC, et al. / 2021 / Estados unidos	Transversal	17.789 participantes com idade > 18 anos
	Ito A et al. / 2021 / japão	Transversal	139 participantes com idade ≥65 anos
	Ishii S et al. / 2014 / Japão	Coorte	1971 participantes com idade ≥ 65 anos
	Kandinata SG et al. / 2023 / Indonésia	Transversal	266 participantes com idade ≥ 60 anos
	Kim GM et al. / 2022 / Coreia	Transversal	85 participantes com idade média de 59 anos
	Ko CH et al. / 2022 / Taiwan	Transversal	606 participantes com idade média de 63 anos
	Lee ST et al. / 2024	Transversal	230 participantes com idade >50 anos
	Lim JY et al / 2020 / Singapura	Transversal	75 participantes com idade ≥65 anos
	Luo S et al. / 2023 / China	Transversal	4177 participantes com idade ≥ 50 anos
	Merchant RA et al. 2021 / Cingapura	Transversal	191 participantes com idade ≥ 65 anos
	Nishioka S et al. / 2021 / Japão	Coorte	628 participantes com idade >20 anos
	Sato R et al. / 2024 / Japão	Transversal	88 participantes com idade ≥65 anos
	Sato R et a. / 2023 / Japão	Coorte	118 participantes com idade ≥65 anos
	Santos LP et al. / 2019 / Estados unidos	Transversal	17.789 participantes com idade > 18 anos
	Sousa IM et al. / 2020 / Brasil	Longitudinal	250 pessoas idade ≥20 anos
	Sousa IM et al. / 2022 / Brasil	Transversal	219 participantes com idade >20 anos

(Continuação) Quadro 1. Características dos estudos incluídos na revisão de literatura sobre a posição do indivíduo para medição da circunferência da panturrilha.

POSIÇÃO	AUTOR (ANO/ PAÍS)	TIPO DE ESTUDO	AMOSTRA (N/FAIXA ETÁRIA)
POSIÇÃO SENTADA	Sousa IM et al. / 2023/ Brasil	Coorte	554 participantes com idade ≥ 18 anos
	Sousa IM et al. / 2024 / Brasil	Coorte	1272 participantes com idade média de 54 anos
	Trussardi Fayh AP et al. / 2021 / Brasil	Transversal	208 participantes com idade ≥ 60 anos
	Vidal-Cuellar CL et al. / 2022 / Peru	Transversal	206 participantes com idade ≥ 60 anos
	Wu SE, Chen WL. / 2022 / Taiwan	Transversal	2.532 participantes com idade entre 50 e 85 anos
POSIÇÃO ORTOSTÁTICA	Alves VA et al. / 2023 / Brasil	Transversal	177 participantes com idade >20 anos
	Araújo MPD et al / 2021 / Brasil	Transversal	250 participantes com idade > 60 anos
	Bahat G et al / 2016 / Turquia	Transversal	301 participantes com idade entre 18 e 39 anos
	Bahat G et al. / 2018 / Turquia	Transversal	207 participantes com idade ≥ 65 anos.
	Barbosa-Silva TG et al. 2016 / Brasil	Transversal	179 participantes com idade ≥ 60 anos
	Bohannon RW et al. / 2016 / República Tcheca	Transversal	38 participantes com idade entre 72 e 98 anos
	Camargo Pereira C et al. / 2022 / Brasil	Coorte	418 participantes com idade ≥ 60 anos
	Du X et al. / 2022 / China	Transversal	589 participantes com idade entre 22 e 88 anos
	Erdoğan et al. / 2022 / Turquia	Transversal	164 participantes com idade entre 18 e 39 anos
	González-Correa, et al. / 2020 / Colombia	Transversal	213 participantes com idade >65 anos
	Hwang AC et al. / 2018 / Taiwan	Transversal	1839 participantes com idade ≥ 50 anos
	Hadzivukovic N et al. / 2023 / Bósnia e Herzegovina	Transversal	446 participantes com idade ≥ 65 anos
	Kawakami R et al. / 2021 / Japão	Transversal	1262 participantes com idade ≥ 40 anos
	Kawakami et al. / 2020 / Turquia	Transversal	164 participantes com idade entre 18 e 39 anos
	Kawakami et al. / 2015 / Japão	Transversal	526 participantes com idade entre 40 e 89 anos
	Kim M, Won C / 2019 / Corea	Coorte	2.123 participantes com idade entre 70 e 84 anos
	Kim S et al. / 2018 / Corea	Coorte	657 participantes com idade entre 70 e 84 anos
	Lin YH et al. / 2023 / Taiwan	Estudo transversal	209 participantes com idade >65 anos
	Lin YL et al. / 2022 / Taiwan	Transversal	186 participantes com idade ≥ 20 anos
	Lu JL et al. / 2022 / China	Coorte	263 participantes com idade ≥18 anos
	Ozkayar N et al. / 2014 / Turquia	Transversal	166 participantes com idade > 18 anos
	Pagotto V et al / 2018 / Brasil	Transversal	132 participantes com idade média de 70 anos
	Zhou J et al. / 2022 / China	Transversal	401 participantes com idade ≥ 60 anos

Quadro 2. Características dos estudos incluídos na revisão de literatura sobre a comparabilidade da medida de circunferência da panturrilha por meio de medidas em diferentes posições e sua precisão.

AUTOR (ANO/TÍTULO/ PAÍS)	TIPO DE ESTUDO	AMOSTRA (N/FAIXA ETÁRIA)	METODOLOGIA DE AVALIAÇÃO	PRINCIPAIS RESULTADOS
Piodena-Aportadera M, et al. (2022). Calf Circumference Measurement Protocols for Sarcopenia Screening: Differences in Agreement, Convergent Validity and Diagnostic Performance. Singapura	Transversal	176 indivíduos com idade entre 50 e 99 anos	O estudo comparou as diferentes posições (sentado e em pé) para medir a CP, incluindo as medições nas pernas direita e esquerda, com a massa esquelética apendicular relativa usando análise de BE para rastreamento da sarcopenia.	• Foi constatado que as medidas de CP em pé e sentada não são equivalentes; • A CP sentada foi maior do que em pé, independentemente da lateralidade (direita 35,31±2,95 cm vs. 34,61±2,74 cm; esquerda 35,37±2,96 cm vs. 34,70±2,83 cm; ambos p<0,001); • Observando uma superestimação das medidas sentadas em relação às de pé (viés direito=0,70 cm; IC de 95%, 0,48–1,88; viés esquerdo=0,67 cm, IC 95%, 0,35–1,68). • A posição em pé foi recomendada para rastreamento de sarcopenia.
Jeong E, et al. (2020). Effect of posture, side and dominant hand on calf circumference measurement in community-dwelling older adults. Coréia	Coorte	1439 participantes com idade entre 70 e 84 anos	O estudo investigou as associações entre variáveis, como a postura, o lado do corpo e a mão dominante, em relação à medida da CP em idosos que vivem na comunidade. A CP foi medida, usando uma fita, em ambos os lados nas posições em pé e sentado.	• A média da CP no lado esquerdo foi menor que no lado direito nas posições em pé (direita: 33,82 cm, esquerda: 33,76 cm, P = 0,006) e sentado (direita: 34,29 cm, esquerda: 34,21 cm, P = 0,005). • Entre os destros, independentemente da postura, a CP esquerda foi menor que a direita. Nos canhotos, a diferença não foi significativa. • A análise da curva ROC indicou que a CP do lado direito na posição de pé apresentou a maior precisão para o diagnóstico de sarcopenia, conforme o AWGS'19.

(Continuação) Quadro 2. Características dos estudos incluídos na revisão de literatura sobre a comparabilidade da medida de circunferência da panturrilha por meio de medidas em diferentes posições e sua precisão.

AUTOR (ANO/TÍTULO/ PAÍS)	TIPO DE ESTUDO	AMOSTRA (N/FAIXA ETÁRIA)	METODOLOGIA DE AVALIAÇÃO	PRINCIPAIS RESULTADOS
Piodena-Aportadera M, et al. (2024). Yubi-Wakka Test for Sarcopenia Screening in the Community: Comparative Agreement, Diagnostic Performance and Validity with Calf Circumference Measurements. Singapura	Transversal	187 adultos entre 50 e 99	O estudo comparou a concordância, o desempenho diagnóstico e a validade do teste Yubi-Wakka para triagem de sarcopenia, com as medições de CP, que foram medidas em ambas as panturrilhas nas posições sentada e em pé e o teste de Yubi-wakka circundando a parte mais grossa da panturrilha não dominante com os dedos indicadores e polegares de ambas as mãos.	• O Yubi-wakka identificou 16,6% dos participantes como positivos no rastreio de massa muscular reduzida ("menores"). • Mostrou concordância moderada apenas com as medições de CP sentada no lado não dominante (k=0,421, p<0,001). • Seu desempenho diagnóstico foi inferior tanto para detectar baixa massa muscular (AUC=0,591 vs 0,855–0,870, p<0,001) quanto para o diagnóstico de sarcopenia (AUC=0,581 vs 0,788–0,818, p<0,001) em comparação às medições de CP.
Pribadi RR, et al. (2022). Role of thigh circumference, calf circumference, subjective global assessment, and handgrip strength as diagnostic modalities of sarcopenia in women inflammatory bowel disease patients. Indonésia	Transversal	85 indivíduos com idade entre 18 e 59 anos	O objetivo deste estudo foi explorar o ponto de corte e a precisão diagnóstica de circunferência da coxa, CP, avaliação global subjetiva e força de preensão manual para identificar sarcopenia em pacientes com doença inflamatória intestinal, utilizando o DXA como referência para avaliar a massa muscular.	• Usando o ponto de corte de CP ≤31 cm, a sensibilidade, especificidade, valor preditivo positivo, valor preditivo negativo, razão de verossimilhança positiva e razão de verossimilhança negativa foram 100%, 60,38%, 25%, 100%, 2,52 e 0, respectivamente. • A AUC da CP é de 82,5% (IC 95% 69,2–95,7), com valor de p = 0,006. Na prática clínica, a CP medirá com precisão em 82 de 100 pacientes com DII. Quando medida repetidamente em 100 pacientes, o valor correto será obtido em 69 a 95 pacientes.

4 Justificativa

A avaliação da composição corporal é fundamental para a identificação de anormalidades musculares e, consequentemente, estado nutricional (PRADO et al., 2023). Embora a compreensão da importância da saúde muscular e do estado nutricional como alvos terapêuticos tenha aumentado, essas condições ainda são frequentemente subestimadas (PRADO et al., 2022).

Existem diversas técnicas de composição corporal para medir ou estimar a massa muscular (BARAZZONI et al., 2022; COMPHER et al., 2022). No entanto, ainda não há consenso sobre o melhor método, que seja objetivo e confiável, para avaliar a massa muscular ou sua perda à beira do leito (EARTHMAN, 2015).

A ressonância magnética e a TC são técnicas de imagem objetivas, precisas e acuradas. No entanto, elas não podem ser realizadas à beira do leito e exigem mobilização do paciente, profissionais especializados, são de alto custo, e impossíveis de serem aplicados em larga escala. Além disso, a TC envolve exposição à radiação, sendo considerado um método de conveniência para a avaliação da composição corporal quando realizada por razões clínicas, especialmente em pacientes com câncer (LOOIJAARD; MOLINGER; WEIJS, 2018; MOURTZAKIS et al., 2017). O DXA, embora envolva menor exposição à radiação, é restrito principalmente a ambientes de pesquisa ou hospitais (MUNDI; PATEL; MARTINDALE, 2019; SHEEAN et al., 2020). A BE é prática e portátil, mas tem limitações quando aplicada a indivíduos com doenças agudas, crônicas, distúrbios hídricos e obesidade (MULASI et al., 2015; SHEEAN et al., 2020), além de sua acurácia estar associada ao emprego de equações preditivas específicas para a população avaliada (GONZALEZ; BARBOSA-SILVA; HEYMSFIELD, 2018). Já a ultrassonografia (US) é amplamente disponível e tem ganhado ênfase o seu uso, mas ainda necessita de protocolos padronizados e validados antes de sua implementação na prática clínica (EARTHMAN, 2015; LIMA et al., 2024).

Apesar de tantas técnicas, há uma demanda por ferramentas simples que possam ser aplicadas na rotina clínica e que melhorem a avaliação do estado nutricional dos pacientes, independentemente das restrições financeiras

(BARAZZONI et al., 2022; BISTRIAN; MOGENSEN; CHRISTOPHER, 2020; COMPHER et al., 2022). Apesar de não mensurar objetivamente os compartimentos corporais, a antropometria pode ser considerada útil em ambientes clínicos como marcador de massa muscular (PRADO et al., 2022).

A CP é uma medida antropométrica altamente correlacionada com medidas diretas e indiretas da massa muscular esquelética (BARAZZONI et al., 2022; COMPHER et al., 2022; JONATHAN et al., 2013; SANTOS et al., 2019), além de ser uma abordagem simples, acessível e de baixo custo (PRADO et al., 2023). Embora essa ferramenta seja valiosa em ambientes hospitalares e ambulatoriais, uma variedade de fatores de confusão pode afetar a medição e sua interpretação, como idade, IMC, etnia, edema (PRADO et al., 2022).

O estudo de Gonzalez et al. (2021) realizado com população adulta saudável de diferentes características, sugeriu fatores de ajustes aos valores de CP em indivíduos com IMC fora dos limites da normalidade (18,5 a 24,9 kg/m^2)(GONZALEZ et al., 2021). No entanto, quando aplicado em situações em que existe a possibilidade de perda de peso ou massa muscular, estes ajustes não seriam aplicados a indivíduos com IMC < 18,5 kg/m^2. Os pontos de corte foram definidos em <34 cm para homens e <33 cm para mulheres como marcadores de CP moderadamente baixa e <32 cm para homens e <31 cm para mulheres como marcadores de CP gravemente baixa. De forma semelhante, o estudo de Barbosa-Silva et al. (2016) com idosos comunitários utilizou a circunferência da panturrilha para estimar a massa muscular (BARBOSA-SILVA et al., 2016). Os pontos de corte foram baseados em valores de DXA de uma subamostra do índice de massa muscular esquelética apendicular, comparando-os com os valores de uma população adulta jovem da mesma cidade. Assim, foram estabelecidos pontos de corte de ≤34 cm para homens e ≤33 cm para mulheres, visando identificar a perda de massa magra e refletir com maior precisão a realidade da população estudada.

Contudo, as medidas antropométricas apresentam a limitação de baixa confiabilidade devido à variabilidade interobservador e intraobservador. Programas de treinamento intensivos e padronizados podem minimizar essa variabilidade, mas o potencial de erro permanece alto (EARTHMAN, 2015). Portanto, investigar a técnica correta para medir a CP é de alta relevância para a prática clínica.

5 Objetivos

5.1 Objetivo Geral

Comparar as medidas da CP em diferentes posições (ortostática, sentado e decúbito dorsal) para avaliar a concordância entre elas.

5.2 Objetivos específicos

- Verificar a confiabilidade intra e interavaliador;
- Determinar o ETM das medidas da CP;
- Determinar a MMD das medidas da CP;
- Definir se as técnicas apresentadas para a medição da CP são equivalentes entre si.

6 Hipóteses

- As medidas da CP variarão conforme a posição, com a posição sentada apresentando, em média, os maiores valores em comparação com a posição ortostática;
- Espera-se que o ETM para a repetibilidade seja em torno de 1,35 e para a reprodutibilidade, em torno de 0,90;
- Não há valores descritos na literatura para a MMD da CP, impossibilitando a sugestão de uma hipótese específica;
- A posição ortostática será a posição menos influenciada pela atividade muscular e, consequentemente menos sujeita a erros intra- e inter-avaliadores.

7 Metodologia

7.1 Delineamento

Trata-se de um estudo de validação, realizado na cidade de Pelotas, no sul do Brasil, com indivíduos hospitalizados.

7.2 População alvo

Participantes adultos e idosos hospitalizados no Hospital Escola da Universidade Federal de Pelotas.

7.3 Cálculo de tamanho de amostra

O tamanho amostral foi calculado para estudos de confiabilidade e repetibilidade, baseados na avaliação dos coeficientes de correlação intraclasse (CCI). Foi realizada a estimativa baseada na abordagem de estimativa (precisão) e de teste de hipóteses de confiabilidade mínima (BORG et al., 2022). Para a abordagem de estimativa, foi assumido um real CCI de 0,85, amplitude do intervalo de confiança (IC) de 0,10 e 80% de probabilidade de precisão, sendo necessária uma amostra de 149 pares de medidas. Para a abordagem de teste de hipóteses, foi considerado um CCI mínimo de 0,85, um CCI verdadeiro de 0,90, sendo necessário uma amostra de 170 pares de medidas. Além disto, estimou-se a amostra necessária para estudos de precisão, nível de confiança de 10%, sendo a amostra necessária 192 pares de medidas (MCALINDEN; KHADKA; PESUDOVS, 2015). Sendo assim, será necessário avaliar pelo menos 192 indivíduos.

7.4 Critérios de inclusão e exclusão

7.4.1 Critérios de inclusão

- Indivíduos com idade igual ou superior a 18 anos;
- Indivíduos hospitalizados clínicos ou pré-operatório de pacientes cirúrgicos.

7.4.2 Critérios de exclusão

- Indivíduos acamados, sem condições de ficarem na posição ortostática ou sentados fora da cama;
- Indivíduos edemaciados;
- Indivíduos com um dos membros inferiores amputados;
- Gestantes.

7.5 Coleta de dados

A coleta de dados será realizada por dois entrevistadores separadamente, a fim de garantir que a atuação de um não exerça influência sobre as medições realizadas pelo outro. Os entrevistadores serão previamente treinados e padronizados para assegurar a qualidade do estudo e minimizar erros.

A padronização seguirá a metodologia de Habicht, que envolve a aplicação das técnicas de precisão e exatidão. Cada entrevistador medirá a CP de dez indivíduos duas vezes, com um intervalo entre as medições para evitar que a lembrança da primeira medição influencie a segunda. As medições dos entrevistadores serão comparadas com as realizadas por um supervisor padrão ouro, que também medirá cada indivíduo duas vezes. Na avaliação dos entrevistadores, a precisão será considerada adequada se a somatória das diferenças entre suas medições não ultrapassar o dobro da somatória das diferenças do supervisor padrão ouro. A exatidão será avaliada com base na somatória das diferenças entre as medidas dos entrevistadores e as do supervisor, os entrevistadores serão aprovados se essa somatória não exceder o triplo da somatória das diferenças observadas nas medições do supervisor.

O processo de coleta será dividido em dois momentos distintos. No primeiro contato com o participante, será realizada a entrevista para a obtenção de dados sociodemográficos e clínicos, seguida pela primeira medição da CP. No segundo contato, que ocorrerá com um intervalo de 24h entre as medições, será realizada a segunda medição da CP, este intervalo tem como objetivo avaliar a repetibilidade das medições. Todas as informações coletadas serão registradas em formulário impresso na presença do entrevistado.

7.6 Instrumentos avaliação da circunferência da panturrilha

Para a medida da CP, será utilizada uma fita inelástica métrica centimétrica da marca BodyMetrix®, com a realização das aferições do entrevistado, sendo realizada na panturrilha direita. No momento da entrevista, o participante será informado a respeito da coleta da medida da CP e, após, receberá instruções necessárias para a medição. A CP será medida no maior perímetro da panturrilha utilizando uma fita métrica inelástica. Será medida três vezes a perna direita, sendo considerada a maior medida entre as três, nas seguintes posições:

- Posição ortostática: o participante com os pés afastados na largura dos ombros e o peso corporal distribuído uniformemente entre as duas pernas;
- Posição sentado: o participante sentado com os joelhos dobrados em um ângulo de 90°, ambas as pernas no chão e relaxado;
- Posição decúbito dorsal: o participante deitado no leito com o joelho num ângulo reto entre a coxa e a panturrilha.

As medidas serão coletadas de forma aleatória (entre 4 combinações: decúbito dorsal /sentado /ortostática, decúbito dorsal /ortostática /sentado, sentado /ortostática /decúbito dorsal, ortostática /sentado /decúbito dorsal), definidas a partir de sorteio. As medidas sempre iniciarão ou terminarão com o paciente em decúbito dorsal para evitar que se mobilize da cama mais de uma vez.

Para avaliar a repetibilidade, será aplicado a medida conforme citado anteriormente, porém realizado de forma consecutiva por dois dias na semana.

As variáveis sociodemográficas, como data de nascimento, sexo, estado civil e cor da pele, serão coletadas por meio de um questionário padronizado. As informações sobre as condições clínicas atuais dos participantes serão obtidas a partir dos prontuários médicos existentes. O questionário também incluirá a data da entrevista.

7.7 Variáveis

A variável principal do estudo será a circunferência da panturrilha, medida por diferentes observadores e em diferentes dias.

Além da variável principal, serão coletadas variáveis sociodemográficas (como sexo, idade, estado civil e cor da pele) e variáveis antropométricas (peso, altura e IMC) para a descrição detalhada da amostra.

Quadro 3. Variáveis

Variáveis	Tipo de Variável	Definição
Características sociodemográficas		
Sexo	Categórica dicotômica	Masculino / Feminino
Idade	Numérica discreta, categorizada em politômica ordinal	18-29 anos 30-39 anos 40-49 anos 50-59 anos 60-69 anos 70-79 anos >80 anos
Estado civil	Categórica nominal	Casado(a) ou com companheiro(a) / Solteiro(a), separado(a) ou divorciado(a) / Viúvo(a)
Cor da pele	Categórica nominal	Branca / Preta ou parda / Outras
Características antropométricas		
Peso	Numérica contínua	Contínua: kg
Altura	Numérica contínua	Contínua: m
IMC	Numérica contínua, transformada em categórica politômica ordinal	Contínua: kg/m² Categórica: Magreza, Eutrofia, Excesso de Peso
Circunferência da panturrilha	Numérica contínua	Contínua: cm

7.8 Avaliação das variáveis

As variáveis "sexo" e "cor da pele" serão autorreferidas pelo entrevistado, as opções para sexo serão “masculino” e “feminino”, e para cor de pele, o entrevistador classificou os entrevistados em “branco”, “preto”, “pardo” ou “outra”. A idade será questionada aos entrevistados e registrada em anos completos. O entrevistado será questionado quanto à sua situação conjugal através da pergunta “Qual é a sua situação conjugal?”, e receberá como opções de resposta as afirmativas “casado(a) ou com companheira(o)” ou “solteiro(a) ou viúvo (a) ou sem companheira (o)”.

Para o cálculo do IMC serão obtidas as medidas de peso e altura dos participantes. Será avaliado a partir do cálculo proposto por Quételet: peso/altura² (peso corporal em kg dividido pelo quadrado da altura em metros), classificando os de acordo com o proposto por Lipschitz, a saber: < 22 kg/m² = magreza, 22 a 27 kg/m² = eutrofia e > 27 kg/m² = excesso de peso (LIPSCHITZ, 1994). Para adultos, a OMS define as seguintes categorias de IMC: < 18,5 kg/m² = magreza, 18,5 a 24,9 kg/m² = eutrofia, 25 a 29,9 kg/m² = sobrepeso e ≥ 30 kg/m² = obesidade (WHO, 2021).

7.9 Análise estatística

As análises estatísticas serão realizadas utilizando o software Stata versão 17.1 (College Station, TX: StataCorp LP). Primeiramente será realizada uma descrição da amostra conforme características sociodemográficas coletadas no questionário formalizado por meio impresso através de valores absolutos e relativos para as variáveis categóricas e média e desvio padrão para as variáveis contínuas. Os valores da medida da CP serão apresentados como média e desvio padrão, de acordo com os 3 métodos utilizados, observador (1 e 2) e tempo de medida (medida 1 e medida 2). A diferença média entre os pares de medidas será estimada através de teste t de Student´s para medidas pareadas. A concordância entre as medidas de CP realizadas nas diferentes posições será avaliada através do coeficiente de correlação de concordância de Lin e gráficos de Bland-Altman. Também será verificado o CCI para as medidas realizadas pelo mesmo observador no mesmo dia (confiabilidade intraobservador), entre os dois observadores (confiabilidade interobservador) e pelo mesmo observador em dias diferentes (repetibilidade).

O erro técnico será avaliado para medir a precisão das medidas, os valores de ETM serão obtidos utilizando-se da fórmula: ETM =DP x √ (1 – CCI), onde DP representa do desvio padrão agrupado da primeira e da segunda avaliação e o nível de confiança é 95% (FLEISS, 1999).

Além disto, será calculado a MMD para identificar valores mínimos esperados para serem usados em estudos longitudinais, utilizando-se a fórmula MMD_{95} = 1,96 x ETM x √ 2 (TIGHE et al., 2010)

Para todos os testes estatísticos, serão considerados um IC 95% e um valor de p < 0,05 como critérios para significância estatística.

7.10 Aspectos Éticos

O presente trabalho atenderá a todos os aspectos éticos especificados na Resolução 466/12 do Conselho Nacional de Saúde. Além disso, o termo de consentimento livre e esclarecido será fornecido para o participante. Os dados utilizados para análise serão anonimizados e irão incluir apenas números de identificação. Os nomes dos participantes e informações confidenciais irão ser omitidos para proteger os dados pessoais.

O projeto de pesquisa será submetido ao Comitê de Ética em Pesquisa (
da Faculdade de Medicina UFPel / FAMED e do setor de educação do HE UFPE

8 Financiamento

Todos os custos associados ao projeto serão integralmente financiados pelo pesquisador.

Quadro 4. Quadro de financiamento para a pesquisa.

Descrição	Quantidade	Valor unitário	Total
Impressão questionário	260	R$ 0,50	R$ 130,00
Caneta	5	R$ 2,00	R$ 10,00
Prancheta	2	R$ 10,00	R$ 20,00
Deslocamento	50	R$ 6,00	R$ 300,00
Fita centimétrica BodyMetrix®	4	R$ 107,00	R$ 428,00
Total			**R$ 868,00**

9 Divulgação dos resultados

O artigo resultante do presente projeto será publicado em uma revista científica nacional ou internacional, preferencialmente Qualis A1 ou A2.

10 Cronograma

O cronograma das atividades a serem desenvolvidas encontra-se descrito no Quadro 4, logo abaixo.

Quadro 4. Cronograma de atividades.

Atividades	2023					2024												2025						
	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7
Revisão Bibliográfica																								
Elaboração do projeto																								
Qualificação do projeto																								
Aprovação do conselho de ética																								
Coleta de dados																								
Análise de dados																								
Escrita do Artigo																								

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Apêndices

Apêndice A - Questionário

Universidade Federal de Pelotas

Programa de Pós-graduação em Nutrição e Alimentos

Estudo de validação do teste de círculo dos dedos - PPGNA

Nome:____

Data da entrevista: _______/_______/_______________

Data de nascimento - Qual a sua data de nascimento? _______/_______/_______________

Estado civil: Qual é a sua situação conjugal?”

- ☐ Solteiro (a)
- ☐ Casado (a) ou com companheiro (a)
- ☐ Separado (a) ou divorciado (a)
- ☐ Viúvo (a)

Qual a cor da pele do entrevistado?

- ☐ Branca
- ☐ Negra
- ☐ Parda
- ☐ Outras

Hist de internação - Esteve internado nos últimos 30 dias?

- ☐ Sim
- ☐ Não

Peso (kg): _______________

Altura (m): _________________

Valor do IMC (kg/m²): _____________________

Medida da circunferência da panturrilha ortostática (cm):______________________

Medida da circunferência da panturrilha sentado (cm):______________________

Medida da circunferência da panturrilha decúbito dorsal (cm):______________________

Apêndice B – Termo de consentimento livre e esclarecido

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Prezado paciente Sr. (a)____

A avaliação da massa muscular é muito importante para todos os pacientes hospitalizados. Uma das maneiras mais simples de avaliar sua massa muscular é através da medida da circunferência da panturrilha, o músculo da "batata da perna". É uma medida bastante simples, feita com uma fita métrica.

Estamos realizando um estudo que tem como título: "Comparabilidade da medida de circunferência da panturrilha em pacientes hospitalizados por meio de medidas repetidas em diferentes posições". O objetivo do estudo é comparar as medidas da circunferência da panturrilha feitas em três posições: de pé, sentada e deitada, avaliando se as medidas são iguais ou diferentes. Também queremos saber se esta medida pode variar quando feita por entrevistadores diferentes ou quando repetida em dias diferentes. Isto é muito importante para saber se podemos confiar nestas medidas para verificar como você está evoluindo.

Sua participação no estudo será responder algumas perguntas, além de fazer as medidas de circunferência da panturrilha nas diferentes posições (sentado, de pé e deitado) por dois entrevistadores treinados. Estas medidas serão repetidas no dia seguinte por um dos entrevistadores.

Esses procedimentos oferecem um risco mínimo e não irão interferir no seu tratamento, bem como não irão gerar qualquer tipo de custo. Em qualquer momento do estudo o Sr.(a) terá acesso aos responsáveis pela pesquisa para esclarecimento de dúvidas. Caso queira deixar de participar, é garantida a liberdade de retirada de consentimento sem qualquer prejuízo ou necessidade de oferecer justificativa. Como benefício, você e a equipe que cuida de você informada se você apresenta baixa massa muscular, para que você receba uma orientação especial.

Todas as informações coletadas serão utilizadas apenas para fins de estudo e sua identidade será sempre preservada. Caso tenha entendido todos os aspectos do estudo e aceite participar, solicito sua assinatura no campo abaixo.

____________________________	____________________________
Ana Carolina Benet Nutricionista – CRN2 15358 Tel.: (53) 984268584	Nome: Tel.: (_ _) _ _ _ _ _ _ _ _

Pelotas, ___ de _________ de 2024.

Sua participação é muito importante! Desde já, agradecemos. O Comitê de Ética em Pesquisa da Faculdade de Medicina (FAMED) da UFPel se situa na Av Duque de Caxias, 250- 96030-000 – Fragata – Pelotas/RS, podendo ser contato pelo contato (53) 3284-4100 ou pelo e-mail cep.famed@gmail.com.

2 - ALTERAÇÕES EM RELAÇÃO AO PROJETO DE PESQUISA

Em relação ao projeto aprovado em banca de qualificação, foram realizadas as seguintes alterações:

- O projeto resultará na elaboração de dois artigos. O primeiro, apresentado nesta dissertação, tem como objetivo comparar as medidas repetidas da circunferência da panturrilha (CP) obtidas em diferentes posições corporais, avaliando a concordância entre elas. Esse artigo será utilizado para a defesa do mestrado. O segundo artigo, a ser desenvolvido posteriormente, terá foco na avaliação da precisão, repetibilidade e fontes de erro associadas à técnica, incluindo a determinação do erro técnico de medição (ETM), da mudança mínima detectável (MMD) e da confiabilidade intra e interavaliador.

- Diferentemente do previsto inicialmente, os dados não foram registrados em formulários impressos, mas sim na plataforma REDCap, garantindo maior organização, segurança e eficiência no armazenamento das informações.

3 - ARTIGO ORIGINAL

Este artigo será submetido para a revista Clinical Nutrition

Comparability of calf circumference measures in hospitalized patients using repeated measurements in different positions

Ana Carolina Vaz Benet - M.Sc. – Postgraduate Program in Nutrition and Food. Federal University of Pelotas, Pelotas, RS, Brazil

Silvana Paiva Orlandi - Ph.D. - Postgraduate Program in Nutrition and Food. Federal University of Pelotas, Pelotas, RS, Brazil

Leonardo Siefert Rocha - M.Sc. – Postgraduate Program in Nutrition and Food. Federal University of Pelotas, Pelotas, RS, Brazil

Maria Cristina Gonzalez* - Ph.D. - Postgraduate Program in Nutrition and Food. Federal University of Pelotas, Pelotas, RS, Brazil

***Corresponding author:** Maria Cristina Gonzalez

E-mail: cristinagbs@hotmail.com

Postgraduate Program in Nutrition and Food

Gomes Carneiro St, block A, room 227, Pelotas, RS, Brazil.

ABSTRACT

Introduction and objective: Calf circumference (CC) is an anthropometric measure recognized as a muscle mass marker. However, discrepancies exist in the literature regarding the individual`s position (orthostatic, sitting, or supine) during measurement. This study aimed to evaluate agreement among CC measurements in different positions and suggest adjustments if we observed variations.

Methods: This cross-sectional study was conducted with hospitalized patients (≥ 18 years). CC was measured at the largest circumference of the right calf in orthostatic (standing) (CC_{ort}), sitting (CC_{sit}), and supine (CC_{sup}) positions. The repeated-measures Analysis of Variance (RM-ANOVA) and the Tukey Honestly Significant Difference post hoc tests were applied. Bland–Altman plots and linear regression adjusted for sex, body mass index, and age were also used, with CC_{ort} as the dependent variable and the other positions as independent variables.

Results: A total of 193 patients were evaluated with a mean age of 57.7 ± 15.0 years (52.8% females). CC_{sit} (34.4 ± 4.8 cm) had the highest mean values, with statistically significant differences from CC_{ort} (+0.39 cm; $p < 0.05$) and CC_{sup} (+0.33 cm; $p < 0.05$). CC_{sit} was higher than CC_{ort} in both sexes, while CC_{sup} was higher only in females. As the cutoff values for our population were obtained from CC_{ort} (≤ 33.3 cm and ≤ 34.3 cm, for females and males, respectively), linear regressions generated equivalent CC values when the measurements were obtained from other positions. For CC_{sit}, the equivalent cutoffs would be ≤ 33.3 cm and ≤ 34.3 cm for females and males, respectively. For CC_{sup}, the corresponding cutoffs would be ≤33.2 cm and ≤ 34.0 cm for females and males, respectively.

Conclusion: The CC measurement taken at standing, sitting, and supine position are not interchangeable, and significant higher values were obtained in the sitting position. These results suggest that equivalent cutoff values should be used when CC is measured in different positions from the one the cutoff was originally established.

Keywords: calf circumference, muscle mass, anthropometry, sarcopenia, nutritional assessment, body composition

Introduction

Skeletal muscle mass and function are important indicators of nutritional status and sarcopenia [1, 2]. Assessment of skeletal muscle mass is paramount because its loss is a key component in the diagnosis of malnutrition, cachexia, sarcopenia, and sarcopenic obesity [1-4]. In addition, low muscle mass is associated with several adverse clinical outcomes, such as higher morbidity and mortality [5, 6].

Although several techniques are available to assess/estimate muscle mass, there is no consensus on the best method. The choice depends on several factors, including the purpose (diagnostic or follow-up) and location of the assessment (bedside, out-of-hospital, or epidemiological studies) [7-10]. When available, techniques such as computed tomography analysis, magnetic resonance imaging, bioelectrical impedance (BIA), and dual-energy X-ray absorptiometry are recommended [2, 7, 8, 11]. However, the limited availability of advanced techniques, particularly in middle- and low-income countries like Brazil, poses a challenge. The cost and complexity of these methods hinder their implementation in primary and secondary care practices.

Calf circumference (CC) is an anthropometric measure that correlates strongly with both direct and indirect measurements of skeletal muscle mass, though it does not directly measure body compartments [12, 13]. Consequently, it is recognized by the Asian Working Group for Sarcopenia (AWGS 2019) and the World Health Organization (WHO) as a marker of muscle mass in older adults [14, 15]. The Global Leadership Initiative on Malnutrition also includes CC as a phenotypic criterion for diagnosing adult malnutrition [1, 7, 8, 10, 13, 16]. This measure is particularly valuable in low-resource clinical settings due to its simplicity, accessibility, noninvasiveness, practicality, and low cost [7, 8, 17].

Despite the widespread use of CC, there is no standardized protocol for CC measurement. AWGS 2019 recommends measuring the maximum calf value using a nonelastic tape but does not specify the measurement position (standing vs. sitting) [14]. Studies have employed different positions, with several, including the one that generates the cutoff values for our population [18], following the orthostatic position (i.e., standing) recommended by the International Society for the Advancement of Kineanthropometry (ISAK) [19, 20], while others have used the sitting position [13, 21-27]. In clinical settings, however, CC is often measured in the supine position, particularly in bedridden patients or those unable to stand. Some studies have therefore adopted this approach [28, 29].

Although some research has compared sitting vs. standing and standing vs. supine positions [30-32], no robust studies have evaluated all three positions simultaneously. Therefore, the main objective of this study was to compare CC measurements across different body positions (orthostatic, sitting, and supine), assess their agreement, and propose conversion equations to generate equivalent values for measurements in positions showing discrepancies.

Materials and methods

Participants

This cross-sectional study was conducted in Pelotas, southern Brazil, in patients hospitalized at the *Hospital Escola da Universidade Federal de Pelotas* (HE UFPel). The target population (inclusion criteria) included patients aged ≥ 18 years admitted to clinical departments or in the preoperative phase of elective surgeries between November 2024 and January 2025. Patients who were exclusively bedridden or had one of their lower limbs amputated were excluded from the study. A trained researcher assessed edema by visual inspection and palpation, considering the presence of evident swelling or persistent depression on digital compression.

The sample size was calculated for reliability and repeatability by evaluating intraclass correlation coefficients (ICC). The estimation used a precision-based approach and minimum reliability hypothesis testing [33]. For the estimation approach, an ICC of 0.85, a confidence interval (CI) of 0.10, and an 80% probability of accuracy were assumed, requiring a sample of 149 measurement pairs. For the hypothesis testing approach, a minimum ICC of 0.85 was considered, with a true ICC of 0.90, requiring a sample of 170 measurement pairs. In addition, the sample needed for the precision studies to evaluate the consistency and reproducibility involving repeated measurements was estimated, resulting in 192 measurement pairs [34]. Therefore, it was necessary to study at least 192 individuals.

This study complied with all ethical aspects stipulated in Resolution 466/12 of Brazilian's National Health Council. This study was approved by the Research Ethics Committee of the School of Medicine at UFPEL and the Education Sector of HE UFPEL (no. 7.118.983). Informed consent was obtained from all participants.

Standardization and training

Data were collected by a single, previously trained, and standardized interviewer using the Habicht method, which evaluates precision and accuracy [35]. For standardization, the interviewer measured CC in the orthostatic position, following the ISAK recommendation of 10 individuals twice, with an interval between measurements to avoid the influence of the first measurement [20]. These measurements were compared with the supervisor's, which was considered the gold standard, and each individual was measured twice. Precision was considered adequate if the differences in the measurements of the interviewer did not exceed twice the differences in the measurements of the supervisor. Accuracy was confirmed if the differences between the measurements of the interviewer and supervisor did not exceed three times the differences in the measurements of the supervisor.

Data collection

Sociodemographic information, such as sex, self-reported ethnicity, marital status, and hospitalizations in the last 30 days, was collected through interviews. Data on weight, height, and date of birth were obtained from medical records. Data were recorded in a specific form using the REDCap software. Body mass index (BMI) was calculated using Quételet's formula (weight [kg] divided by the square of height [m^2]) and classified according to the WHO criteria [15].

Calf circumference measurement

CC was measured using an inelastic BodyMetrix® tape measure at the largest right calf circumference as defined by the ISAK recommendations [20]. For each position, the participant was measured three times in a single moment, and the highest value was considered. Measurements were performed at the following positions:

- Orthostatic position (CC_{ort}): the participant was standing with the feet shoulder-width apart and the body weight evenly distributed.
- Sitting position (CC_{sit}): The participant sat with the knees bent at 90°, both feet flat on the floor, and legs relaxed.
- Supine position (CC_{sup}): The participant was lying down, with the knee flexed at a right angle between the thigh and calf and the foot forming a 90º angle with the leg. While the sole was suspended, only the heel region was in contact with the bed (Figure 1). As there was no standardization for the supine position, we used the same technique recommended for measuring the height of bedridden patients based on the knee height measurement [36, 37]. This position allowed for better visualization of the calf, making it easier to identify the point of the greatest circumference.

Positions were randomly assigned in four possible combinations: supine-sitting-orthostatic, supine-orthostatic-sitting, orthostatic-sitting-supine, and sitting-orthostatic-supine.

Statistical analysis

Statistical analyses were performed using Stata software, version 17.1 (College Station, TX, StataCorp LP). Quantitative or continuous variables were expressed as mean ± standard deviation. Categorical variables were expressed as absolute and relative frequencies with their respective 95% CI. The significance level was set at 5%.

Repeated measures ANOVA with Tukey Honestly Significant Difference (HSD) tests for post hoc comparisons were performed to evaluate agreement among positions. Comparisons were also made according to sex and BMI. Concordance correlation coefficient (CCC) was assessed and interpreted according to McBride et al.: > 0.99, almost perfect; 0.95 to 0.99, substantial; 0.90 to 0.95, moderate; and < 0.90, weak [38]. All statistical analyses considered the CC_{ort} as the reference. Bland–Altman plots were constructed to determine the mean difference and 95% limits of agreement between measurements made at different positions. Multiple linear regressions included CC measurements in different positions, sex, age, and BMI as independent variables, retaining only those with $p < 0.05$. Beta coefficients from these models enabled the generation of equivalent values among the measurements taken in different positions. Instead of converting each measurement in a position other than the one used to develop the cutoff point, we suggest converting the cutoff instead. As an example for clinical practice, we generate the equivalent to cutoff values for our population when the CC is taken in a different position, based on the previous study by Barbosa-Silva et al. (≤ 33 cm for females and ≤ 34 cm for males), which used the orthostatic position [18].

Results

A total of 193 individuals were included (52.8% females; 64.3% white). Sociodemographic characteristics are shown in Table 1. The mean age was 57.7 ± 15.0 years, and 52.3% were older than 60. A total of 11.9% of the participants reported being hospitalized 30 days before the data collection. Anthropometric measures are presented in Table 2. CC measurements were significantly higher in females than males at the three positions.

Comparison of CC measurements between the three positions revealed a statistically significant difference, and post hoc comparisons identified this difference between several combinations of measurements (Table 3). CC_{sit} showed significantly higher mean values than CC_{ort} (+0.39 cm) and CC_{sup} (+0.33 cm). Figure 2 shows the analyses based on sex and BMI. CC_{sit} was found to be significantly higher than CC_{ort} for males and females. CC_{sup} was not significantly different from CC_{ort} in males but was significantly higher in females. CC_{sit} was significantly higher than other positions in both BMI categories, and there was no significant difference between CC_{ort} and CC_{sup} in either category.

Lin's CCC indicated an almost perfect agreement between CC_{ort} and CC_{sit} (CCC = 0.993) and CC_{ort} and CC_{sup} (CCC = 0.992). Bland–Altman graphs (Figure 3) showed a mean difference of -0.39 cm when comparing CC_{ort} and CC_{sit}, with limits of agreement between -1.19 and 0.41 cm. When comparing CC_{ort} and CC_{sup}, the mean difference was smaller (-0.06 cm) but with slightly higher limits of agreement (between -1.20 and 1.09 cm).

Based on these results, two equations were developed (using linear regression analysis) to convert CC measurements obtained in the sitting and supine positions (independent variables) into equivalents to those taken in the orthostatic position (dependent variable) when we need to use population-specific cutoff points generated from CC_{ort}. For CC_{sit}, no other variable was significant; therefore, a single equation was developed for conversion: CC_{ort} =

$1.05 + 0.96 \times CC_{sit}$. For CC_{sup}, sex was significant, resulting in the following equation: $CC_{ort} = 0.5 + 0.98 \times CC_{sup}$ (for females) and $CC_{ort} = 0.67 + 0.98 \times CC_{sup}$ (for males). Based on these equations, we suggest the conversion of the usual cutoff instead of converting every measurement taken if position other than orthostatic. Table 4 presents the equivalent values to the cutoff values established for the orthostatic position in our population (≤ 33.0 cm for females and ≤ 34.0 cm for males) when CC measurements were taken in the sitting and supine positions. When we applied the equation in the sitting position, the equivalent cutoff values were ≤ 33.3 cm for females and ≤ 34.4 cm for males. In the supine position, the equivalent cutoff value was ≤ 33.2 cm for females, while for males, it remained ≤ 34.0 cm.

Discussion

Understanding the variability of CC measurements across different body positions is crucial for ensuring accurate nutritional and clinical assessments. This study highlights statistically significant differences between measurements in the orthostatic, sitting, and supine positions, emphasizing that body position influences CC values. CC_{sit} had significantly higher mean values than CC_{ort} and CC_{sup}, whereas CC_{sup} differed from CC_{ort} only in females. These differences may be related to changes in hydrostatic pressure and fluid displacement during the transition from a sitting to an orthostatic position [39]. In addition, the reduced influence of orthostatic muscle activity might have reduced adhesion between the muscle and superficial adipose tissue, resulting in lower circumference values in the orthostatic position [39]. These findings directly impact clinical practice, research, and the development of position-specific cutoff values, ensuring that CC remains a reliable tool for evaluating health and disease risk.

Our findings from comparing CC_{ort} and CC_{sit} measurements are aligned with the literature. Piodena et al. compared orthostatic and sitting positions in relation to the estimated relative appendicular skeletal muscle mass using BIA analysis [31]. Their results showed that measurements taken in the sitting position yielded higher values. In contrast, the orthostatic position was recommended for sarcopenia screening, as it showed greater agreement with muscle assessment using BIA. Similar results were observed by Jeong et al., who indicated CC_{ort} as an ideal method for sarcopenia screening in community-dwelling older adults [30]. However, our study demonstrated that the cutoff values were specific to the position for which they were developed. Our equations allowed for their modification when measurements were taken in a different position from the one where the cutoff value was originally established.

Regarding measurements in orthostatic and supine positions, Sousa et al. evaluated the effect of posture on body circumferences, including CC, in hospitalized older adults [32]. In contrast to our findings, they found differences between positions, with measurements in the orthostatic position being systematically higher than those in the supine position. However, the measurement method in the supine position differed from that used in our study. In Sousa et al.'s study, patients were completely relaxed with their legs extended on the bed. While well-established protocols exist for measuring CC in orthostatic and sitting positions, there is no standardized method in the supine position. These methodological differences may explain the divergent results between studies.

Another key finding of our study was that, although CC measurements differed between positions, no significant differences were observed when stratified by BMI. We compared individuals to themselves, which may explain why BMI did not affect the measurements. In addition to variations in muscle contraction across different positions, subcutaneous fat distribution likely changes with posture.

Patients often cannot change positions in clinical practice due to various restrictions. Therefore, it is essential to adapt measurement techniques to individual patient needs [32]. Our findings indicate that CC measurements performed in sitting and supine positions are viable alternatives when orthostatic measurement is not possible. However, this study suggests the need for position-specific cutoff values. Using a cutoff value developed for CC_{ort} to interpret CC_{sit} could lead to underestimating low CC values. For example, a man with a CC_{sit} of 34.1 cm would be classified as having normal CC using the CC_{ort} cutoff (≤ 34 cm). However, the equivalent cutoff value for CC_{sit} is 34.4 cm, meaning this individual should be considered as having low CC. Furthermore, the lack of standardization of CC_{sup} highlights the need for a consistent measurement protocol, as different techniques may influence results.

This is the first study to assess CC measurements in all three positions simultaneously, using a single trained interviewer, ensuring comparability. Although conducted in a hospitalized population, no biological rationale prevents its applicability to the general population. Another strength is the development of conversion equations to generate equivalent values for CC measurements taken across different positions, reinforcing that cutoff values should be position specific. Furthermore, a single interviewer, who had previously trained and standardized, collected all the data. We also carefully measured CC in the three positions in a random order so as not to influence the results. The CC measurement for the supine position was also standardized according to a previous protocol used for the knee height measurement. However, limitations should be noted. First, the equivalent cutoff values were based on an earlier study rather than derived prospectively. This approach assumes consistency across populations and measurement conditions, which may introduce bias and reduce generalizability. The equivalent cutpoints may not fully capture position-specific variability or clinical relevance without direct validation. A prospective study would enable real-time data collection, allowing for the derivation and validation of cutpoints within the study population, thereby enhancing their reliability and applicability. Second, as with any study involving anthropometric measurements, minor variations in technique may introduce a margin of error. Nevertheless, our findings emphasize the importance of standardizing CC measurement techniques to ensure accuracy across different positions with appropriate cutoff points.

Conclusion

This study demonstrated variability in CC measurements across different body positions, with CC_{sit} yielding higher values on average than CC_{ort} and CC_{sup}. While CC_{sup} did not significantly differ from CC_{ort} in males, females exhibited significantly higher CC_{sup} values than CC_{ort}. Based on these results, this study proposes equations to generate equivalent cutoff values when CC is measured in a position different from the one for which the original cutoff was established. These findings emphasize the need for a standardized CC measurement protocol to ensure comparability across research contexts. Establishing clear guidelines for position-specific cut-off values is essential for accurately identifying individuals with low CC, particularly in high-risk populations. Standardization minimizes diagnostic errors, enabling more effective interventions and improved clinical outcomes, even in resource-limited settings.

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Table 1: Sociodemographic and anthropometric characteristics of the study participants (n = 193).

Variable	**n (%)**
Sex	
Female	102 (52,8)
Male	91 (47,2)
Skin color	
White	124 (64.3)
Other	69 (35.7)
Age	
< 60 years	101 (52.3)
≥ 60 years	92 (47.7)
Marital status	
Without partner	72 (37.3)
With partner	96 (49.7)
Widow	25 (13.0)
Hospitalization in the last 30 days	
Yes	23 (11.9)
No	170 (88.1)

Table 2: Anthropometric measurements (n = 193).

Variable	Total	Male	Female	p-value[a]
Weight (kg)*	70.1 ± 17.3	69.2 ± 16.1	70.9 ± 18.3	0.497
Height (cm)*	164.6 ± 8.9	170.1 ± 6.7	159.8 ± 7.5	<0.001
BMI (kg/m^2) *	25.9 ± 6.2	23.9 ± 5.1	27.7 ± 6.7	<0.001
Calf circumference (cm)				
Orthostatic	34.0 ± 4.6	32.9 ± 3.9	35.0 ± 5.0	0.002
Sitting	34.4 ± 4.8	33.2 ± 4.2	35.4 ± 5.1	0.001
Dorsal decubitus	34.1 ± 4.7	32.8 ± 3.9	35.1 ± 5.1	<0.001

BMI: body mass index. [a]t-test by sex.

Table 3: Comparison of the calf circumference mean values according to position.

Position	Orthostatic	Sitting	Supine	Mean difference
Orthostatic vs. Sitting	34.0 cm	34.4 cm		- 0.39 cm[a]
Orthostatic vs. Supine	34.0 cm		34.1 cm	- 0.06 cm
Sitting vs. Supine		34.4 cm	34.1 cm	0.33 cm[a]

[a]p<0,05 according to Tukey HSD test for post hoc comparisons

Table 4: Suggested equivalent values to the cutoffs ≤34 cm and ≤33 cm (orthostatic position) for calf circumference measurements taken at the sitting and supine positions.

Position	Males	Females
Sitting[a]	≤ 34.4 cm	≤ 33.3 cm
Supine[b]	≤ 34.0 cm	≤ 33.2 cm

These values were obtained according to the regression equations considering the cutoff values of CC_{ort} ≤33.0 cm and 34.0 cm [17]:

[a]When CC was measured in a sitting position: $CC_{ort} = 1.05 + 0.96 \text{ X } CC_{sit}$

Males: $34.0 = 1.05 + 0.96 \text{ X } CC_{sit}$, then $CC_{sit} = (34/0.96) – 1.05 = 34.37 \approx 34.4$cm

Females: $33.0 = 1.05 + 0.96 \text{ X } CC_{sit}$, then $CC_{sit} = (33/0.96) – 1.05 = 33.33 \approx 33.3$ cm

[b]When CP is measured in a supine position:

Males: $CC_{ort} = 0.67 + 0.98 \text{ X } CC_{sup} \rightarrow 34.0 = 0.67 + 0.98 \text{ X } CC_{sup}$, then $CC_{sup} = 34/0.98 – 0.67 = 34.02 \approx 34.0$

Females: $CC_{ort} = 0.5 + 0.98 \text{ X } CC_{sup} \rightarrow 33.0 = 0.5 + 0.98 \text{ X } CC_{sup}$, then $CC_{sup} = 33/0.98 – 0.5 = 33.17 \approx 33.2$

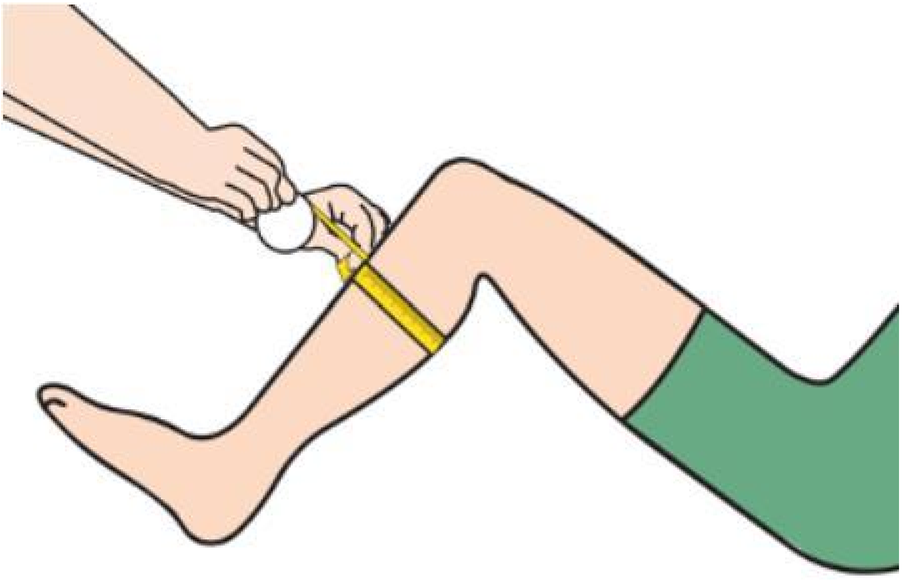

Figure 1 – Position supine

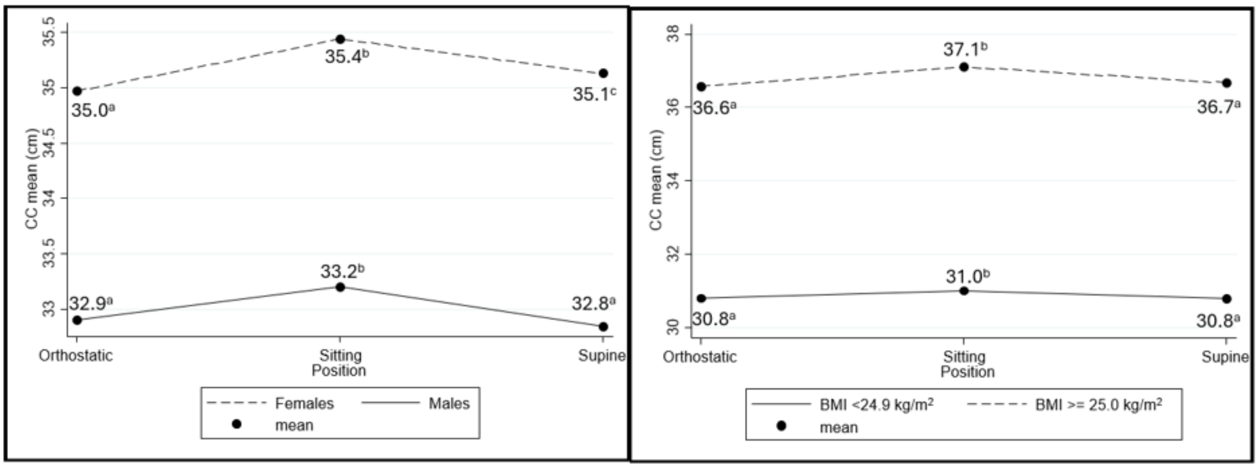

Figure 2 – Calf circumference measurements in different positions according to sex (left) and body max index (right). Different letters: p<0,05 according to Tukey HSD test for *post hoc* comparisons.

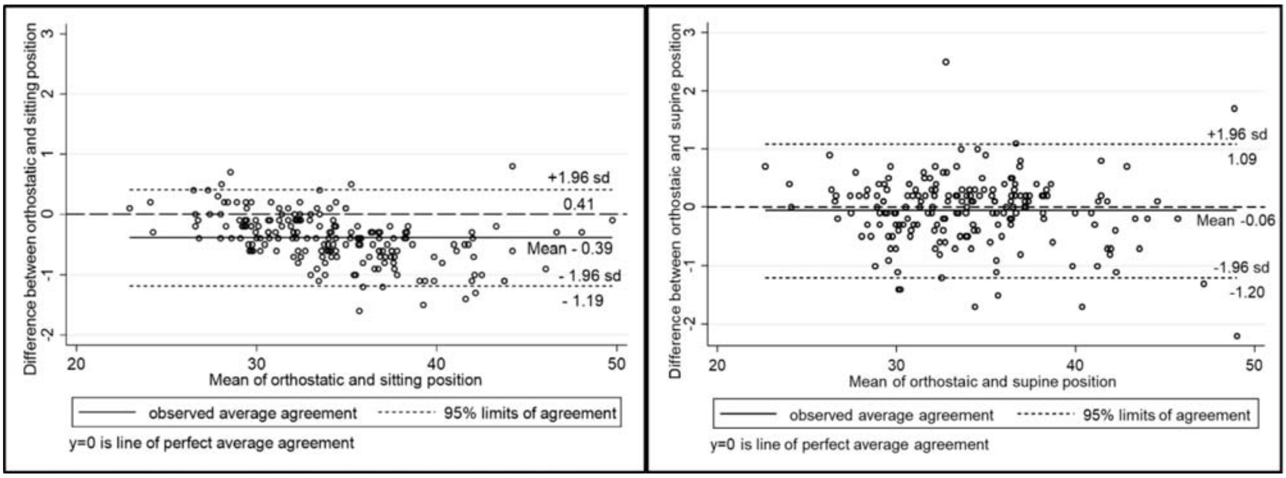

Figure 3: Bland-Altman plots comparing the agreement between calf circumference measurements in different positions: orthostatic vs. sitting position (left) and orthostatic vs. dorsal decubitus position (right).

Anexos

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1. McLaren D S, Meguid M M. Nutrition and its disorders, 4th edn. Edinburgh: Churchill Livingstone, 1988.

Chapter in a book

1. Goodwin S C, Liu S. Radiologic techniques for enteral access. In: Rombeau J L, Rolandelli R H, Eds. Enteral and tube feeding, 3rd edn. Philadelphia: W B Saunders, 1997: 193-206.

Website

1. U.S. positions on selected issues at the third negotiating session of the Framework Convention on Tobacco Control. Washington, D.C.: Committee on Government Reform, 2002. (Accessed March 4, 2002, at http://www.house.gov/reform/min/inves_tobacco/index_accord.htm.)

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