Universidade de Lisboa

Faculdade de Motricidade Humana

FENÓTIPO DA SÍNDROME SARCOPÊNICA EM PESSOAS IDOSAS DO AMAZONAS, BRASIL

ALEX BARRETO DE LIMA

Orientador(es): Prof. Doutora Maria de Fátima Marcelina Baptista
Prof. Doutor Élvio Rúbio Quintal Gouveia

Tese especialmente elaborada para obtenção do grau de Doutor em Motricidade Humana na Especialidade de Atividade e Saúde

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Sumário

Tabelas

CAPÍTULO 3

CAPÍTULO 4

CAPÍTULO 5

CAPÍTULO 6

Figuras

CAPÍTULO 3

CAPÍTULO 4

CAPÍTULO 5

CAPÍTULO 6

Abreviaturas

6MWT	6-min walk test
ABEP	Associação brasileira de empresas de pesquisa
ACT	30-s arm curl test
ADL	Activities of daily living
BIA	Bioimpedância elétrica
BM	Body Mass
BMI	Body mass index
BST	Back-scratch test
CAAE	Certificado de Apresentação de Apreciação Ética
CSAR	chair sit-and-reach test
CST	30-s Chair Stand Test
DCNT	Doenças Crônicas Não Transmissíveis
DXA	Dual X-Ray Absorptiometry
EWGSOP	European Working Group on Sarcopenia in Older People
FAB	Fullerton Advanced Balance scale
FFM	Fat Free Mass
FM	Fat mass
FPM	Força de Preensão Manual
FUG	8-foot up-and-go test
IBGE	Instituto Brasileiro de Geografia e Estatística
IMME	Índice de massa muscular esquelética
ISAK	The International Society for the Advancement of Kinathropometry

METs	Metabolic equivalent of task
MM	Muscle mass
MMSE	Mini-Mental State Examination
MMT	Massa Muscular Total
OMS	Organização Mundial da Saúde
RNM	Ressonância nuclear magnética
ROC	Receiver operator characteristic
SARC-F	Strength, Assistance in walking, Rise from a chair, Climb stairs e Falls
SD	Standard deviation
SDOC	Sarcopenia Definitions and Outomes Consortion
SFT	Senior Fitness Test
SMMI	Skeletal muscle mass index
SPPB	Short Physical Performance Battery
SPSS	Statistical Package for the Social Sciences
TC	Tomografia computadorizada
TUG	Timed Up and Go
UEA	Universidade do Estado do Amazonas
VPN	valor preditivo negativo
VPP	valor preditivo positivo

Resumo

A sarcopenia é uma doença caracterizada por força muscular e massa muscular diminuída cuja prevalência aumenta com o envelhecimento. Trata-se de uma condição que interfere com a saúde em geral, com a competência funcional diária em particular, mas também com a expectativa de vida, uma vez que a fragilidade, ou seja, a vulnerabilidade a um evento stressor, encontra-se frequentemente associada á sarcopenia. Apesar da caracterização da sarcopenia, as abordagens para a sua avaliação constituem motivo de investigação. Esta dissertação teve como objetivo identificar um fenótipo de risco para sarcopenia em pessoas idosas de Novo Aripuanã, Amazonas, Brasil, considerando diversos tipos de marcadores: marcadores da sintomatologia da sarcopenia, da função muscular, do desempenho físico, da massa muscular, da atividade física e da competência funcional diária (funcionalidade). Para o efeito procedeu-se previamente a diversos trabalhos para analisar separadamente alguns marcadores, nomeadamente: o desempenho de instrumentos para o rastreamento de sarcopenia em pessoas idosas (SARC-F vs. SARC-Calf); a prevalência de sarcopenia na amostra em estudo, de acordo com a fraqueza muscular ou a lentidão na marcha e a concordância entre estes marcadores; e a relevância do *Senior Fitness Test* (SFT), uma bateria muito utilizada para a avaliação da aptidão física de pessoas idosas, para o rastreio da sarcopenia.

Os resultados evidenciam: o SARC-CalF (sintomatologia), o índice de massa muscular e a potência de membros inferiores (função muscular) como os marcadores mais determinantes do risco para sarcopenia em pessoas idosas de ambos os sexos, e adicionalmente a velocidade de marcha e o funcionamento físico para as mulheres idosas no Amazonas, Brasil; uma relevância maior da potência muscular dos membros inferiores comparativamente á força de preensão palmar em ambos os sexos no âmbito da identificação de um fenótipo de sarcopenia.

Os resultados mostram ainda que: a lentidão na marcha é mais prevalente em mulheres do que em homens idosos, enquanto a fraqueza muscular é mais prevalente em homens; a prevalência de fraqueza muscular parece ser maior na população idosa estudada, do que em outras regiões do Brasil; apesar da fraca concordância, a lentidão da marcha esteve mais de acordo com a fraqueza muscular em ambos os sexos quando utilizado o critério europeu (EWGSOP2) para identificação de fraqueza muscular; o SFT, especificamente o teste de flexão de braço de 30 segundos e o teste de caminhada de 6 minutos da bateria Senior Fitness Test apresentaram capacidade de discriminar entre pessoas idosas de Novo Aripuanã, Amazonas, Brasil, com e sem sintomas suspeitos de sarcopenia.

Concluindo, a dissertação apresenta evidência científica sobre o fenótipo de risco para sarcopenia em pessoas idosas de Novo Aripuanã, Amazonas, realçando assim os marcadores mais relevantes a serem avaliados, tendo em vista a prevenção da sarcopenia em pessoas idosas desta região do Brasil.

Palavras-chave: Aptidão Física, Fraqueza Muscular, Função muscular, SARC-CalF, Sarcopenia

Abstract

Sarcopenia is a disease characterized by muscle strength and decreased muscle mass whose prevalence increases with aging. It is a condition that interferes with health in general, with daily functional competence in particular, but also with life expectancy, since frailty, that is, vulnerability to a stressful event, is often found associated with sarcopenia. Despite the characterization of sarcopenia, the approaches to its evaluation are subject to investigation. This dissertation aimed to identify a risk phenotype for sarcopenia in elderly people in Novo Aripuanã, Amazonas, Brazil, considering several types of markers: markers of sarcopenia symptomatology, muscle function, physical performance, muscle mass, physical activity and daily functional competence (functionality). For this purpose, several works were previously carried out to separately analyze some markers, namely: the performance of instruments for screening sarcopenia in elderly people (SARC-F vs. SARC-Calf); the prevalence of sarcopenia in the study sample, according to muscle weakness or slowness in walking and the agreement between these markers; and the relevance of the Senior Fitness Test (SFT), a battery widely used to assess the physical fitness of elderly people, for sarcopenia screening.

The results show: the SARC-CalF (symptomology), the muscle mass index and the power of the lower limbs (muscle function) as the most determinant markers of the risk for sarcopenia in elderly people of both genders, and additionally the gait speed and physical functioning for elderly women in Amazonas, Brazil; a greater relevance of lower limb muscle power compared to handgrip strength in both sexes in the context of identifying a sarcopenia phenotype.

The results also show that: slow gait is more prevalent in women than in elderly men, while muscle weakness is more prevalent in men; the prevalence of muscle weakness seems to be higher in the elderly population studied than in other regions of Brazil; despite the poor agreement, slow gait was more in line with muscle weakness in both genders when the European criteria (EWGSOP2) was used to identify muscle weakness; the SFT, specifically the 30-second push-up test and the 6-minute walk test of the Senior Fitness Test battery, showed the ability to discriminate between elderly people from Novo Aripuanã, Amazonas, Brazil, with and without suspicious symptoms of sarcopenia.

In conclusion, the dissertation presents scientific evidence on the risk phenotype for sarcopenia in elderly people from Novo Aripuanã, Amazonas, thus highlighting the most relevant markers to be evaluated, with a view to preventing sarcopenia in elderly people in this region of Brazil.

Keywords: Physical Fitness, Muscle Weakness, Muscle Function, SARC-CalF, Sarcopenia

CAPÍTULO 1

Introdução

1.1 - Introdução

O envelhecimento da população é uma realidade concreta, que nos últimos anos tem sido amplamente discutida (Santana et al., 2023). O envelhecimento é entendido como um processo fisiológico que ocorre ao longo da vida de modo continuo e irreversível ao nível de diversos sistemas com impacto na qualidade de vida a nível físico, cognitivo, emocional e social (Silva & Brito, 2017). De acordo com a Organização Mundial da Saúde (OMS) a proporção da população mundial com mais de 60 anos quase dobrará de 12% para 22% entre 2015 e 2050, o número de pessoas com 60 ou mais anos ultrapassará até 2020 o número de crianças com menos de 5 anos, 80% das pessoas idosas viverão em países de baixa e média renda em 2050, o ritmo de envelhecimento da população será mais rápido do que no passado e os sistemas sociais e de saúde de todos os países enfrentarão grandes desafios para face a esta mudança demográfica (Rudnicka et al., 2020). Atualmente, na América Latina e no Caribe, as pessoas idosas somam aproximadamente 56,4 milhões, sendo 10% da população total (Alves, 2019). Em quatro décadas, seu número terá mais que triplicado, chegando a 186 milhões, o que irá representar uma quarta parte dos habitantes da região (Alves, 2019).

No Brasil o processo de envelhecimento ocorre em condições econômicas sociais e de saúde desfavoráveis (Andrade et al., 2018), esse cenário gera condições propícias para o desenvolvimento de complicações graves de saúde à medida que as pessoas envelhecem (Andrade et al., 2018). Estima-se que no ano 2050, a população idosa passará de 841 milhões para dois bilhões (Economic & Division, 2017). Neste contexto, a vigilância de saúde, das pessoas idosas se tornará cada vez mais relevante, incitando o desenvolvimento de estratégias que promovam a saúde dessa população (Marques et al., 2020). Segundo o Instituto Brasileiro de Geografia e Estatística (IBGE), a longevidade da população brasileira atingiu 76 anos em 2018, um aumento de 22 anos em relação à década de 1960 (IBGE, 2018). Esse aumento da expectativa de vida tem sido associado à diminuição da saúde física e mental das pessoas idosas, juntamente com o surgimento e aumento da prevalência de doenças crônicas, perda de autonomia, além de limitações socioeconômicas e ambientais, que interferem diretamente no desempenho funcional e na capacidade da pessoa idosa (WHO, 2015).

A redução da capacidade funcional, além da perda de independência, agrava a dependência de cuidados (Casagrande et al., 2022). Essa dependência implica dificuldades para as famílias em encontrar cuidadores ao domicílio, contribuindo assim para a institucionalização (Santana et al., 2023). Estes fatores contribuem para o aumento da demanda por lares de longa permanência para pessoas idosas, que pretendem oferecer os cuidados necessários a essa população (Cruz-Jentoft et al., 2019; WHO, 2015). Um dos determinantes da redução da capacidade funcional com a idade, sobretudo a nível físico, é a alteração da composição corporal (Casagrande et al., 2022). Com o envelhecimento verifica-se um aumento da massa gorda corporal, principalmente a nível visceral, e simultaneamente uma diminuição da massa magra, ou seja, da massa muscular esquelética e massa óssea (Casagrande et al., 2022). Estas alterações da composição corporal quando não devidamente monitoradas, podem comprometer a capacidade funcional da pessoa idosa (Oliveira Neta et al., 2018; Pícoli et al., 2011). Esta perda gradual de massa muscular e consequentemente da força muscular esquelética associada ao envelhecimento depois dos 60 anos, mas que também pode ocorrer antes a partir dos 40 anos, é designada por sarcopenia primária (Petermann-Rocha et al., 2022).

Para além da redução da capacidade funcional, a sarcopenia na saúde pública vai ganhando importância devido à sua associação com a ocorrência e severidade de quedas

(Zhang et al., 2020), fragilidade óssea (Nielsen et al., 2018), frequência e duração de hospitalizações e aumento do risco de morte (Beaudart et al., 2017). A investigação nesta área é, todavia, diversificada incluindo associações da sarcopenia com sintomas depressivos (Taani et al., 2018) ou comprometimento cognitivo (Chang et al., 2016).

A sarcopenia pode vir a representar um importante problema de saúde pública uma vez que a prevalência atual de ~ 10% (Shafiee et al., 2017) vai aumentar muito significativamente nas próximas décadas com o envelhecimento da população (Ethgen et al., 2017). As estimativas de prevalência de sarcopenia apresentam, no entanto, divergências significativas, em virtude da diversidade dos critérios de diagnóstico, das características da população (Fernandes et al., 2022) ou da natureza transversal ou longitudinal dos estudos (Petermann-Rocha et al., 2020).

A nível global, o Japão é apontado como o país com maior prevalência de pessoas idosas com sarcopenia, seguido de países como o Brasil, Coreia do Sul, Estados Unidos, Taiwan e Reino Unido (Diz et al., 2015). No Brasil, a prevalência da sarcopenia parece variar consoante a região, entre 4,8% em São Paulo (Alexandre et al., 2019), 9,4% em Belém (Souza et al., 2019), 15,3% em Cuiabá (Neves et al., 2018), 18% no Rio de Janeiro (Moreira et al., 2019) ou 17% considerando um total de 9.416 participantes de 31 estudos com participantes de Salvador, Florianópolis, Cuiabá, São Paulo, Pará e Rio de Janeiro (Diz et al., 2017). A nível de grupo, a sarcopenia é mais prevalente em homens do que em mulheres, em pessoas inativas e em pessoas com problemas de saúde (Confortin et al., 2018; Ligthart-Melis et al., 2020).

Para estabelecer medidas de baixo custo relativamente à prevenção da sarcopenia é necessário caracterizar a diversidade das populações (prevalência, fenótipos) e compreender quais as melhores abordagens para o rastreio, avaliação e intervenção (melhores marcadores) (Cruz-Jentoft et al., 2010; Schoufour et al., 2021; Locquet & Beaudart, 2021). Neste sentido, o objetivo geral desta dissertação foi investigar o Fenótipo da Síndrome Sarcopênica em Pessoas Idosas do Amazonas (Brasil). Esta informação pode ser utilizada para planejar medidas de saúde pública para mitigar a sarcopenia e as suas consequências adversas (Tey et al., 2019). Para o efeito foram realizados quatro trabalhos com os seguintes objetivos específicos:

O trabalho 1 (capítulo 3) pesquisou o desempenho de diversos instrumentos para o rastreamento de sarcopenia em pessoas idosas de Novo Aripuanã;

O trabalho 2 (capítulo 4) analisou a prevalência de sarcopenia em pessoas idosas de Novo Aripuanã, de acordo com a fraqueza muscular ou a lentidão na marcha;

O trabalho 3 (capítulo 5) estudou a relevância da aptidão física para a sintomatologia da sarcopenia;

O trabalho 4 (capítulo 6): investigou o fenótipo da síndrome sarcopênica em pessoas idosas de Novo Aripuanã com recurso à aptidão física, à composição corporal, à atividade física e funcionamento físico.

Esta tese é composta por sete capítulos: a introdução (capítulo 1); a revisão da literatura (capítulo 2) sobre sarcopenia, nomeadamente, o mapeamento conceptual, as causas e consequências, os sintomas, o rastreio e o diagnóstico; os trabalhos de investigação realizados (capítulos 3 a 6) e respetiva metodologia; e a discussão (capítulo 7) sobre os principais achados dos estudos produzidos, destacando os aspetos mais relevantes da tese, as principais conclusões, bem como implicações práticas para futuras pesquisas. Por fim, o anexo inclui informação mencionado ao longo do documento e é essencial para a integridade do trabalho apresentado.

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CAPÍTULO 2

Sarcopenia

2.1 - Sarcopenia

Em 1989, Irwin Rosenberg, definiu sarcopenia como perda de massa muscular tendo como origem as palavras gregas "*sarx*" que significa músculo e "*penia*" que significa perda; portanto, perda de músculo (Rosenberg, 1989). A relevância desta condição estava relacionada ao risco potencial de redução da funcionalidade (Rosenberg, 1997) e à observação de que nenhuma outra alteração relacionada ao envelhecimento era tão importante na determinação de desfechos não desejáveis quanto a redução de massa muscular (Rosenberg, 2011). Embora a definição inicial de sarcopenia incluísse unicamente a massa muscular atualmente incorpora também a função muscular e o conceito de dinapenia, ou seja, de força muscular diminuída (Cruz-Jentoft & Sayer, 2019), podendo se manifestar em diferentes graus de severidade (Alexandre et al., 2019). Atualmente a sarcopenia é reconhecida como uma doença muscular pela classificação internacional de doenças CID-10-CM62.84 (Anker et al., 2016; Cao & Morley, 2016).

A sarcopenia é uma das doenças musculoesqueléticas mais predominantes em pessoas idosas, representando um risco para a competência funcional diária e para a saúde, ou seja, para a qualidade de vida (Beaudart, Zaaria, et al., 2017; Giovannini et al., 2021; Piotrowicz et al., 2021).

De acordo com o Grupo de Trabalho Europeu sobre Sarcopenia em Pessoas Idosas a sarcopenia é diagnosticada operacionalmente através da força muscular diminuída e massa muscular esquelética diminuída (Cruz-Jentoft, 2010; Cruz-Jentoft et al., 2019). A inclusão da força muscular diminuída é devida ao facto de melhor capacidade preditiva da saúde incluindo capacidade funcional, do que a massa muscular diminuída (Barbosa-Silva et al., 2016; Phu et al., 2019; Schaap et al., 2018).

Apesar das orientações do Grupo Europeu serem as mais consensuais em termos de utilização na prática clínica e comunitária outras posições/orientações existem sobre esta matéria, nomeadamente a *European Society for Clinical Nutrition and Metabolism Special Interest Group on Cachexia/anorexia in Chronic Wasting Diseases* (ESPEN) (Muscaritoli et al., 2010), *International Working Group on Sarcopenia* (IWGS) (Fielding et al., 2011), *Society of Sarcopenia, Cachexia and Wasting Disorders* (SCWD) (Morley et al., 2011), *Foundation for the National Institutes of Health* (FNIH) (Dam et al., 2014), *Asian Working Group for Sarcopenia* (AWGS) (Chen et al., 2014; Chen et al., 2020), *Sarcopenia Definition and Outcomes Consortium* (SDOC) (Bhasin et al., 2020), *South Asian Working Action Group on SARCOpenia* (SWAG-SARCO) (Dhar et al., 2022) e *Singapore Clinical Practice Guidelines For Sarcopenia: Screening, Diagnosis, Management and Prevention* (Lim et al., 2022). Embora possa haver alguma variação nos critérios de avaliação, com exceção do SDOC, os diversos grupos de trabalho estão de acordo quanto à massa muscular esquelética diminuída para o diagnóstico da sarcopenia (Bhasin et al., 2020).

A abordagem de diagnóstico da sarcopenia mais utilizado atualmente nas pessoas idosas é o proposto pelo grupo de trabalho europeu (EWGSOP) (Dent et al., 2021). Para a sarcopenia ser diagnosticada, as pessoas idosas devem apresentar obrigatoriamente dois critérios: critério 1- baixa força muscular e critério 2 - baixa massa muscular (Cruz-Jentoft et al., 2019). O critério 3 define a severidade, quando identificado baixo desempenho físico medido através de teste de mobilidade ou baterias de testes funcionais (Cruz-Jentoft et al., 2019).

O consórcio Americano (SDOC) define sarcopenia de modo semelhante ao consenso europeu, contudo não recomenda utilizar a massa muscular diminuída como critério, por a massa muscular avaliada pelos métodos mais usuais - absorciometria radiológica de dupla energia (DXA), bioimpedância ou antropometria, não se mostrar um bom preditor de outras condições/eventos adversos do envelhecimento como a limitação de mobilidade, as quedas ou fraturas ósseas (Bhasin et al., 2020). Assim, segundo o SDOC, a sarcopenia deve ser diagnosticada quando há redução conjunta de dois critérios: critério 1- baixa força muscular (i.e., força de preensão manual) e critério 2- baixo desempenho físico (i.e., velocidade usual de marcha) (Bhasin et al., 2020). A sarcopenia é considerada "primária" ou relacionada com o envelhecimento quando não existe nenhuma outra causa específica para além da idade, no entanto outras causas podem ser identificadas (Cruz-Jentoft et al., 2019). A sarcopenia pode ocorrer secundariamente a uma doença, especialmente em doenças de natureza inflamatória, doenças malignas ou doenças que causem insuficiência (cardíaca, respiratória, renal) (Cruz-Jentoft, 2010).

Podem estar associadas à sarcopenia, as doenças crônicas (obesidade, doença pulmonar obstrutiva crônica (DPOC), diabetes tipo 2, câncer,); doenças neurológicas (demência e depressão), fragilidade e desnutrição (Martinez et al., 2021). Outro importante fator para a sarcopenia secundária pode estar associado aos aspectos nutricionais, como ingestão inadequada de energia, macro e micronutrientes, desordens gastrointestinais (má absorção), ou uso de medicamentos que causem anorexia (Martinez et al., 2021). A inatividade física também contribui para o desenvolvimento da sarcopenia, seja devido ao estilo de vida sedentário ou à incapacidade física relacionada à doença (Cruz-Jentoft et al., 2019; Mijnarends et al., 2016).

2.2 - Sintomas e Rastreio da Sarcopenia

Os métodos atuais para diagnosticar a sarcopenia são complexos de implementar na prática diária, métodos simplificados foram desenvolvidos por diferentes autores, não para substituir um diagnóstico clínico completo da sarcopenia, mas para oferecer uma maneira fácil para uma primeira triagem de pessoas idosas em risco de sarcopenia (Veronese et al., 2021). Se o teste de triagem se revelar positivo, uma avaliação mais sofisticada da sarcopenia pode ser realizada (Veronese et al., 2021).

Uma vez que a triagem para detectar possível sarcopenia antes da ocorrência de incapacidade física é de grande importância para prevenir essa dependência (Cruz-Jentoft, 2010) têm sido propostas ao longo do tempo diversas abordagens simples e rápidas, primeiro através da velocidade usual da marcha (Cruz-Jentoft, 2010; Morley et al., 2011) e mais recentemente através de sinais ou sintomas sugestivos de sarcopenia (Beaudart, Dawson, et al., 2017) com o SARC-F, o SARC-Calf e o MSRA. De facto, os sintomas da sarcopenia podem não ser óbvios para a pessoa idosa até que o declínio da força e do desempenho físico se torne grave, resultando em dependência física e funcional (Veronese et al., 2021).

SARC-F

O questionário SARC-F foi desenvolvido em 2013 pelo grupo da *Saint Louis University* para fornecer um teste de triagem rápido para o reconhecimento de possível diagnóstico de sarcopenia; este rastreio foi desenvolvido considerando que a deterioração funcional das atividades que requerem força muscular é a marca registada da sarcopenia (Malmstrom & Morley, 2013). O SARC-F é um questionário composto por cinco perguntas que analisam força, assistência para locomoção, levantar de uma cadeira, subir escadas e quedas relatadas pelo próprio individuo, com uma pontuação de 0 a 2 pontos para cada item (Malmstrom & Morley, 2013). A pontuação total varia de 0 a 10, com ≥ 4 pontos indicando risco de sarcopenia (Locquet & Beaudart, 2021). Diversos estudos testaram o SARC-F como uma ferramenta de triagem para sarcopenia relatando consensualmente alta especificidade, mas baixa sensibilidade (Locquet & Beaudart, 2021; Shafiee et al., 2019). Apesar desta limitação, o EWGSOP2, AWGS2 e o SCWD recomendam o uso do SARC-F para a triagem de sarcopenia (Cao et al., 2014; Bauer et al., 2019; Chen et al., 2020; Cruz-Jentoft et al., 2019).

Versões modificadas do SARC-F têm sido desenvolvidas para aumentar a sua sensibilidade (Bahat et al., 2022). Nessas versões, foram adicionados itens ao SARC-F original, como a circunferência da panturrilha (CP), a circunferência da coxa (CC), a idade (I) ou o índice de massa corporal (IMC) (Bahat et al., 2022). Deste modo, concebidos e testados os seguintes instrumentos: SARC-F+CP (SARC-CalF) (Barbosa-Silva et al., 2016), SARC-F+CC (Mienche et al., 2019), SARC-F+CP+CC (Mienche et al., 2019), SARC-F+I (Kurita et al., 2019) e SARC-F+IMC (Kurita et al., 2019).

Circunferência da Panturrilha

A circunferência da panturrilha constitui uma medida sensível à alteração da massa muscular nas pessoas idosas (WHO, 1995), em que valores menores que 31 cm indicam massa muscular reduzida e alertam para o risco de sarcopenia (Cruz-Jentoft et al., 2019). A baixa massa muscular é um componente do diagnóstico de sarcopenia, que requer equipamento para a avaliação da composição corporal, que pode não estar disponível na maioria dos ambientes clínicos e comunitários (Bahat et al., 2022). A circunferência da panturrilha demonstrou estar positivamente correlacionada com a massa muscular esquelética apendicular (MMEA) e MMEA/estatura^2 medida por DXA e BIA (Kawakami et al., 2020). Como tal, a circunferência da panturrilha é um dos testes recomendados como abordagem de deteção de casos positivos para sarcopenia (Chen et al., 2020).

SARC-CalF

Devido à baixa sensibilidade do questionário SARC-F, diferentes grupos de pesquisadores sugeriram combinar o questionário SARC-F com a medida da circunferência da panturrilha (SARC-Calf) e que essa combinação poderia melhorar significativamente a precisão diagnóstica do SARC-F e principalmente a sua sensibilidade (Veronese et al., 2021); por exemplo, a sensibilidade do SARC-F aumentou de 33,3% para 66,7% quando combinado com a circunferência da panturrilha (SARC-CalF) (Barbosa-Silva et al., 2016).

Alguns estudos recentes sugerem que o SARC-CalF pode apresentar sensibilidade muito maior (Mazocco et al., 2020) ou um pouco maior (Lim et al., 2020) e especificidade um pouco menor (Mazocco et al., 2020) ou semelhante (Lim et al., 2020) quando comparado com o SARC-F (Mazocco et al., 2020). No entanto, nesses estudos a prevalência da sarcopenia era muito baixa (Mazocco et al., 2020) ou com um número pequeno de participantes (Lim et al., 2020). Recentemente, uma meta-análise com 1127 participantes, indicou uma sensibilidade de 58% e uma especificidade de 87% para o SARC-CalF (Mo et al., 2020).

MSRA: Mini questionário de avaliação de risco de sarcopenia

O questionário *Mini Sarcopenia Risk Assessment* (MSRA) é composto por sete questões (ou cinco questões, a versão curta) e investiga características anamnésticas e nutricionais relacionadas ao risco de aparecimento de sarcopenia (idade, nível de atividade física, consumo de refeição regular, laticínios e proteínas, número de internações e perda de peso no último ano) (Rossi et al., 2017). Este instrumento encontra-se validado para chinês e polaco (Krzymińska-Siemaszko et al., 2021).

As versões polacas de MSRA-7 e MSRA-5 mostraram alta sensibilidade (cerca de 85-90%) com as definições de sarcopenia comumente usadas (Krzymińska-Siemaszko et al., 2021). As especificidades foram menores, cerca de 45% com MSRA-5 e 35% com MSRA-7. Em todos os três estudos de validação, a versão abreviada (MSRA-5) apresentou melhor especificidade e precisão. parecendo ser superior a MSRA-7 para triagem. O MSRA-7 foi recentemente examinado quanto ao seu desempenho para prever a perda de massa muscular em pessoas idosas e demonstrou prever a perda muscular e seu declínio mais acentuado ao longo de um acompanhamento de 5,5 anos (Rossi et al., 2021).

Teste de ishii

O teste de Ishii para o rastreio da sarcopenia é baseado em três parâmetros: idade, força de preensão e circunferência da panturrilha (Ishii et al., 2014). Uma pontuação é atribuída a cada parâmetro e a pontuação final indica a probabilidade de ter ou não sarcopenia. Uma pontuação >105 e >120 em homens e mulheres, respectivamente, identifica pessoas com alta probabilidade de ter sarcopenia (Ishii et al., 2014). É recomendado para triagem de sarcopenia pelo EWGSOP2 (Cruz-Jentoft et al., 2019). Os autores destacaram uma sensibilidade de 75,5% para mulheres e 84,9% para homens e uma especificidade de 92% para mulheres e 88,2% para homens com base nos critérios de diagnóstico EWGSOP.

2.3 - Diagnóstico da Sarcopenia

Triagem e diagnóstico são essenciais para prevenção e monitoramento de doenças incluindo a sarcopenia (Lin et al., 2023). O diagnóstico é usado para estabelecer a presença ou ausência da doença naqueles que podem ser sintomáticos ou assintomáticos, mas com um teste de triagem positivo (Bolboacă, 2019). Para o diagnóstico da sarcopenia é importante a existência de um consenso global (Crosignani et al., 2021). A nível Europeu o consenso é de que o processo de avaliação da sarcopenia deve iniciar-se com um rastreio utilizando o questionário SARC-F (Malmstrom & Morley, 2013), seguido da avaliação da força muscular e finalmente da massa muscular (Cruz-Jentoft et al., 2019). O EWGSOP2 prioriza a avaliação da força muscular, definindo-o como o primeiro parâmetro a avaliar e o indicador de "provável sarcopenia". A sarcopenia é indicada como "provável" quando o valor referente à força muscular corresponde a um valor abaixo do ponto de corte estabelecido. A confirmação do diagnóstico de sarcopenia é quando ambos os valores de força e de massa muscular se encontram abaixo dos respetivos valores de corte. A última etapa consiste na avaliação do desempenho físico, que permite avaliar a severidade da sarcopenia. Perante valores de força muscular, massa muscular e desempenho físico abaixo dos respetivos valores de corte, a sarcopenia classifica-se como severa. Outros grupos de trabalho que recomendam tanto a força de preensão manual quanto a velocidade de marcha como alternativas para a identificação da sarcopenia (Lin et al., 2021).

Os valores de corte para identificação da sarcopenia também é variada, principalmente na força de preensão manual, com maior consenso para velocidade da marcha (≤0,8 m/s) (Bhasin et al., 2020; Cawthon et al., 2020; Manini et al., 2020). O algoritmo de diagnóstico da sarcopenia proposto pelo EWGSOP2 é caracterizado por rastreio, diagnóstico e determinação da sua severidade (Figura 1) (Cruz-Jentoft et al., 2019).

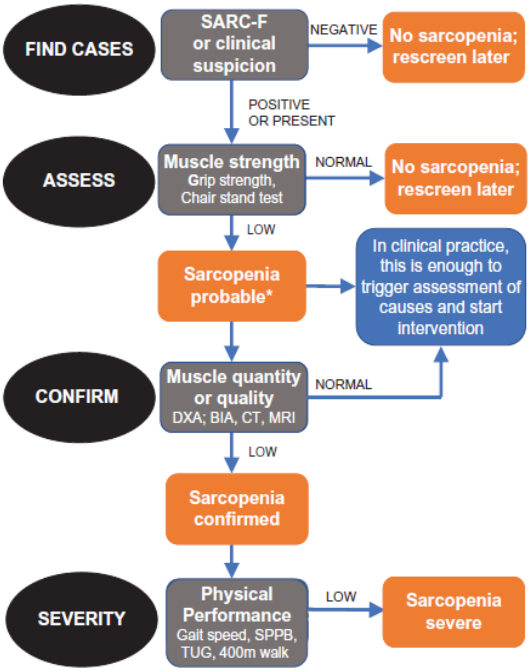

Figura 1 – Identificação e diagnóstico de sarcopenia
Fonte: Cruz-Jentoft *et al.* 2019

Avaliação da Força Muscular

Atualmente, a força muscular é o principal marcador de sarcopenia, o que facilita a identificação imediata da doença na prática, pois é considerado um método simples e pouco dispendioso (Cruz-Jentoft et al., 2019). A avaliação da força muscular é realizada pela avaliação da força de preensão manual, utilizando um dinamômetro manual portátil calibrado (Cruz-Jentoft et al., 2019), solicitando-se que o individuo sentado em uma cadeira com o encosto reto, o braço dobrado em um ângulo de 90º segure e pressione o dinamômetro com sua força máxima (de Oliveira et al., 2019; Guillamón-Escudero et al., 2020). Os valores < 27kg para homens e < 16kg para mulheres são indicativos de força muscular diminuída (Cruz-Jentoft et al., 2019; Lera et al., 2018).

Outro método que também é utilizado para verificar a força muscular, é o teste de levantar da cadeira, no qual pode ser utilizado para avaliar a força dos membros inferiores (Cruz-Jentoft et al., 2019). Um tempo de teste superior a 15 segundos, é indicativo de baixa força muscular para ambos os sexos (Cruz-Jentoft et al., 2019; Melo et al., 2019).

Avaliação da Massa Muscular

Embora sejam possíveis diversas abordagens para a avaliação da massa muscular, a prática clinica para confirmação da sarcopenia requer avaliações relativamente simples e rápidas o que não é o caso da ressonância magnética (RM) ou da tomografia computadorizada (TC), consideradas métodos de referencia para mensurar a massa muscular (Mijnarends et al., 2018).

A Absociometria de raio-X de dupla energia (DXA) constitui uma abordagem simples, rápida, segura (baixa dose de radiação) para avaliar a massa magra total ou apendicular, preponderantemente constituída por massa muscular esquelética (Buckinx et al., 2018; Cruz-Jentoft et al., 2019; Minetto et al., 2021). Todavia o custo do exame e a não portabilidade do equipamento constitui uma desvantagem para a determinação da massa muscular de pessoas idosas de baixas posses e limitações de mobilidade.

A bioimpedância elétrica (BIA) por ser uma técnica simples, não-invasiva, pouco dispendiosa para a estimação da massa muscular, parece ser uma opção razoável na prática clínica (Cruz-Jentoft et al., 2019; Urzi et al., 2017). Há que ter porém em consideração as equações derivadas para o efeito, que são especificas do equipamento (fabricante/modelo) e da amostra em estudo (Yamada et al., 2017; Gonzalez & Heymsfield, 2017).

É possível estimar também a massa muscular total a partir de medidas antropométricas (Tosato et al., 2017). A apesar de não serem recomendadas pelo

EWGSOP2 para avaliação da massa muscular, podem ser utilizadas como instrumento de triagem de casos suspeitos de sarcopenia, devido ao baixo custo e à facilidade de aplicação (Confortin et al., 2017; Cruz-Jentoft et al., 2019).

Avaliação do Desempenho Físico

O desempenho físico é um critério importante na identificação do grau da sarcopenia (severa ou não), recomendado pelo EWGSOP2 (Cruz-Jentoft et al., 2019). É um conceito multidimensional que não envolve apenas os músculos, mas também a função nervosa central e periférica, incluindo o equilíbrio (Beaudart et al., 2019). O desempenho físico pode ser mensurado de diversos modos donde se destaca a velocidade de marcha, a Short Physical Performance Battery (SPPB), o teste de caminhada de 400m e o Timed-Up and Go test (TUG), (Cruz-Jentoft et al., 2019). É importante realçar que nem sempre é possível avaliar o desempenho físico, em virtude da pessoa idosa poder apresentar limitações cognitivas ou motoras (Cruz-Jentoft et al., 2019).

A velocidade de marcha é considerada um teste rápido, seguro e confiável para prever o grau de sarcopenia, e é amplamente utilizado na prática (Ackermans et al., 2022). A velocidade da marcha demonstrou prever resultados adversos relacionadas à sarcopenia - incapacidade, comprometimento cognitivo, necessidade de institucionalização, quedas e mortalidade (Guralnik et al., 2000). Um teste de velocidade de marcha comumente utilizado é o teste de velocidade de caminhada usual de 4 m, (Arnal-Gómez et al., 2021; Grosicki et al., 2020; Maggio et al., 2016). O grupo europeu EWGSOP2 recomenda o ponto de corte < 0,8m/s, como indicador de sarcopenia severa (Cruz-Jentoft et al., 2019).

O SPPB é uma bateria de avaliação com três testes distintos: equilíbrio por meio da variação da posição dos pés (juntos, semi-linha e em linha), força muscular dos membros inferiores através do teste de sentar e levantar 5 vezes cronometrado e por fim, velocidade de marcha (Guralnik et al., 1994). Os testes são pontuados tendo em conta o tempo que o individuo demorou na realização de cada um, resultando na pontuação final da SPPB (Guralnik et al., 1994). A pontuação máxima é de 12 pontos, e uma pontuação de ≤ 8 pontos indica desempenho físico ruim (Cruz-Jentoft et al., 2019).

O TUG é um teste pratico e de fácil aplicação que avalia a agilidade, capacidade indicadora do equilíbrio dinâmico e/ou risco de quedas. O teste consiste em levantar de uma cadeira, caminhar até um marcador a 3 m de distância, contornar o marcador, retornar à cadeira e sentar-se novamente (Podsiadlo & Richardson, 1991).

O teste de caminhada de 400m avalia a capacidade aeróbia, mas também a mobilidade. Para este teste, os participantes são convidados a completar 20 voltas de 20m, cada volta o mais rápido possível, e são permitidas até duas paradas de descanso durante o teste (Cruz-Jentoft et al., 2019).

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CAPÍTULO 3

Diagnostic Performance of SARC-F and SARC-CalF in Screening for Sarcopenia in Older Adults from Northern Brazil[1]

[1]Barreto de Lima, A., dos Santos Ribeiro, G., Henriques-Neto, D., Rúbio Gouveia, É., & Baptista, F. (2023). Diagnostic performance of SARC-F and SARC-CalF in screening for sarcopenia in older adults in Northern Brazil. *Scientific Reports*, 13(1), 11698. https://doi.org/10.1038/s41598-023-39002-y

3.1 - Abstract

Background: To compare the performance of SARC-F and SARC-CalF as screening tools for sarcopenia.

Methods: Cross-sectional study with a convenience sample of 312 community-dwelling older people. Sarcopenia was defined as low handgrip strength (HGS) or low gait speed (GS≤0.8m/s). HGS was measured by dynamometry and GS by the 4-meter walking speed test. For HGS, six criteria (C) were used to identify sarcopenia in men/women: CI: <27kg/16kg; CII: <35.5kg/20.0kg; CIII: grip over body mass index <1.05/<0.79; CIV: grip strength over total body fat <1.66/<0.65; CV: grip over bodyweight <0.45/<0.34; CVI:<27kg/16kg and low skeletal muscle mass index (SMMI); CI and CVI defined according to the European Working Group on Sarcopenia in Older People and the rest according to the Sarcopenia Definition and Outcomes Consortium. For sarcopenia screening, the SARC-F (≥4 points) and the SARC-CalF (≥11 points) were used.

Results: The Kappa analysis revealed no agreement between the SARC-F and the various criteria for the identification of sarcopenia in men. The same lack of agreement was observed in women with some exceptions: CI=0.161±0.074; p=0.020; GS=0.209±0.076; p=0.003. Concerning the Cohen´s kappa between the SARC-Calf and the reference criteria of sarcopenia, the following coefficients were observed as significant for women: CI=0.201±0,069 p=0.003; CII=0.186±0,064 p=0.005; GS=0.273±0.068 p=0.0001; and for men: CII=0.139±0.053 p=0.021; GS=0.223±0.099 p=0.011. ROC curves revealed the SARC-Calf with acceptable discrimination and reasonable sarcopenia predictive capacity considering a cutoff value of 10.5 in both men (AUC:67.5%; p=0.022; Se=52.9%; Sp=76.8%) and women (AUC:72.4%; p<0.001; Se=63%; Sp=68.5%) concerning GS.

Conclusions: The SARC-CalF performed better than the SARC-F for screening sarcopenia in the population ≥ 60 years of age in the Amazonas, measured through walking slowness.

Keywords: Sarcopenia; Screening; Elderly; SARC-F; SARC-CALF

3.2 - Introduction

The life expectancy of the human population has been increasing worldwide, which is to be welcomed. However, this increase may not correspond to a more significant number of years of healthy life as aging is the expression of a continuous biological process associated with a decrease in the function of different bodily systems (Lu et al., 2021; Moskalev et al., 2014; Robine, 2021). The loss of skeletal muscle mass and muscle function (strength and performance) with aging or from other secondary causes characterizes sarcopenia, a disease established by the International Classification of Diseases-10 code in 2016 (Anker et al., 2016; Morley, 2016). Sarcopenia is associated with an increased risk of falls, fractures, physical disability, higher morbidity, and death (Morley, 2016; Piotrowicz et al., 2021). These associations reveal the need for help and treatment services for older adults with sarcopenia in a community, institutional, or hospital context and the associated costs (Cruz-Jentoft et al., 2010). Sarcopenia can be prevented and reversed (Gülistan Bahat et al., 2018; Malmstrom & Morley, 2013). However, simple approaches capable of discriminating against suspected cases of sarcopenia are needed (Sánchez-Rodríguez et al., 2019).

In 2010 the European Working Group on Sarcopenia in Older People (EWGSOP) proposed an approach to diagnosing sarcopenia that combined low muscle mass with low strength or low physical performance (Cruz-Jentoft et al., 2010). The diagnosis was recently updated by the same group (EWGSOP2), evolving into an evaluation of sarcopenia in three steps: identification (low strength), confirmation (low muscle mass), and degree of severity (low physical performance), preceded by a screening questionnaire (da Luz et al., 2021; Hajaoui et al., 2019). In 2020, another working group, the Sarcopenia Definition and Outcomes Consortium (SDOC), emphasizes muscle strength and physical performance for the diagnosis of sarcopenia but does not recommend the assessment of muscle mass for the diagnosis of sarcopenia because muscle mass (assessed by dual-energy x-ray absorptiometry or by bioimpedance) does not seem to be a predictor of the risk of functional disability (Bhasin et al., 2020; Cawthon et al., 2019). Screening for sarcopenia, based on symptomatology and the occurrence of events is, however, the first step in assessing sarcopenia suggested by both approaches (Gasparik et al., 2020; Parra-Rodriguez et al., 2016). This process precedes the objective assessment in case of suspicion. To this end, the SARC-F questionnaire is the most popular.

The SARC-F questionnaire has been validated for different languages (Gülistan Bahat et al., 2018; Ida et al., 2017; Kim et al., 2018; Parra-Rodriguez et al., 2016; Sánchez-Rodríguez et al., 2019; Urzi et al., 2017) and clinical settings (Gülistan Bahat et al., 2018; Kera et al., 2019; Parra-Rodriguez et al., 2016; Urzi et al., 2017; Yang et al., 2019) using several gold standard diagnostic modalities as a reference (Ida et al., 2021; Kim & Won, 2020). SARC-F is a simple, easy-to-use, 5-item sarcopenia screening questionnaire (Malmstrom & Morley, 2013), where five domains are included in the questionnaire: 1) Strength, 2) Assistance with walking, 3) Rising from a chair, 4) Climbing stairs, and 5) Falls (Krzyminska-Siemaszko, Deskur-Smielecka, et al., 2020). Since 2018, SARC-F has been part of the sarcopenia diagnostic algorithm proposed by the European Working Group on Sarcopenia in Older Adults 2 (EWGSOP2) (Cruz-Jentoft et al., 2019).

However, the performance of the SARC-F for screening sarcopenia has been shown to be highly variable, (Ida et al., 2018) with the sensitivity for suspected cases of sarcopenia ranging from 2.1 to 95.4% (Ha et al., 2020). The high variability, with poor to fair diagnostic accuracy, and greater specificity than sensitivity (Ida et al., 2021; Ida et al., 2018; Ida et al., 2017; Initiative et al., 2002; Kim & Won, 2020; Krzyminska-Siemaszko, Deskur-Smielecka, et al., 2020) constitutes a limitation to correctly identifying positive cases of sarcopenia (Barbosa-Silva, Menezes, et al., 2016). It is postulated that the low sensitivity of SARC-F for the suspicion of sarcopenia is because it does not require information on any muscle mass marker (Bhasin et al., 2020; Esparza-Ros et al., 2019; Roberts et al., 2011).

To identify sarcopenia symptoms the SARC-F, and SARC-CALF are instruments widely validated worldwide (Krzymińska-Siemaszko et al., 2023). However, when compared with each other, the SARC-CalF demonstrated greater sensitivity (66.7% vs. 33.3%), high discrimination (AUC: 0.736 vs. AUC: 0.592), and a similar specificity (82.9% vs. 84.2%) (Krzyminska-Siemaszko, Deskur-Smielecka, et al., 2020). Based on data the SARC-F can better classify non-sarcopenic than sarcopenic older adult populations (Lauretani et al., 2003). Additionally, CalF circumference measurements (SARC-CalF) showed that this specific variable improves the screening for sarcopenia (Barbosa-Silva, Bielemann, et al., 2016; Barbosa-Silva, Menezes, et al., 2016; Gasparik et al., 2020; Yang et al., 2018). by increasing its sensitivity relative to SARC-F (Ito et al., 2021; Kandinata et al., 2023).

However, it is necessary to analyze the performance of sarcopenia screening instruments regarding the various objective criteria for assessing muscle function (strength and performance) proposed by the different working groups. Thus, the present study aimed to compare the performance of SARC-F and SARC-CalF as approaches for the screening of sarcopenia using the criteria proposed by the EWGSOP2 and the SDOC as a reference for the diagnosis of sarcopenia in older adults from the state of Amazonas, Brazil (Bhasin et al., 2020).

3.3 - Methods

3.3.1 Design and study population

This work is based on a cross-sectional study with a convenience sample involving 312 community-dwelling older adults (64% women) living in the urban area of the city of Novo Aripuanã (Amazonas), Northern Brazil. Older adults living in rural areas were excluded from the research due to difficulty accessing the evaluation site (distance and necessary means of transport) (figure 1). The sample size was calculated using GPower (Heinrich-Heine-University, Düsseldorf, Germany; software 3.1.9.7) (Faul et al., 2007). Calculations were based on direct logistic regression, family of z tests, considering an odds ratio of 1.5 and α=0.05, and a computational power of 0.95. The following criteria were considered for the inclusion of participants: a) older adults aged 60 or over living in the urban area of the city; b) be independent in carrying out activities of daily living; c) moderate or high level of cognitive functioning; d) without chest pain and/or angina pectoris and limiting joint pain (Rikli & Jones, 2013). The Mini-Mental State Examination (MMSE) evaluated the cognitive criteria selection (Folstein et al., 1975). An MMSE $\leq$ 15/30 points were used to exclude the participants of study (Folstein et al., 1975). Before the data collection process, all procedures and potential risks were explained and informed consent forms were signed by all participants. This study was conducted in accordance with the Declaration of Helsinki (Parsa-Parsi, 2022). After selecting the participants, the following evaluations were performed: sociodemographic, anthropometric, muscle function (strength and performance) and sarcopenia symptoms.

This study was approved by the Ethics Committee of the State UEA and the study was carried out in accordance with the Declaration of Helsinki and Resolution 466/12 of the National Health Council, making part of the research project: "Sarcopenic Syndrome

- Physical Function, Phenotype and Quality of Life" (CAAE 74055517.9.0000.5016 / Referee 2.281.400).

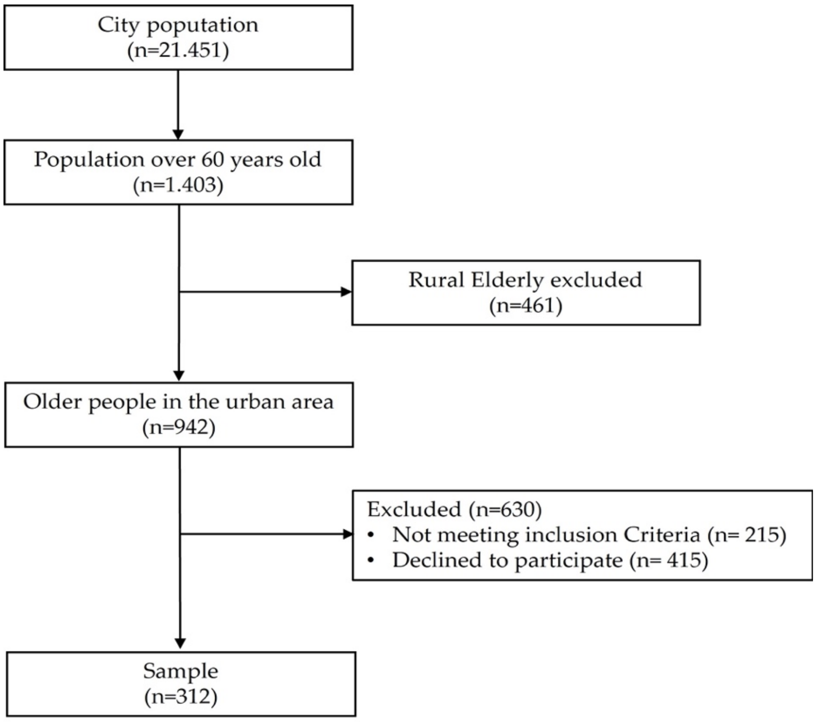

Figure 1. Flow chart of the study.

3.3.2 Sociodemography

The questionnaire from the Brazilian Association of Research Companies was used to assess the sociodemographic variables. (Pesquisa-ABEP, 2019). The questionnaire classifies individuals into five social classes, ranging from class A (those with higher purchasing power) to class E (those with lower purchasing power) based on ownership of some consumer goods, head's schooling family, and access to public services.

3.3.3 Anthropometric and body composition characteristics

Body height and body mass were determined using a mechanical scale with the stadiometer attached, with the older adults barefoot and wearing light clothing. The categorization of body mass index (BMI) followed the guidelines of the World Health

Organization (Initiative et al., 2002). The CalF circumference is a marker of muscle mass and was measured with an inelastic metallic tape measure, the measurement was taken at the point of the greatest circumference with the individual seated, with the leg forming a 90° angle and feet flat on the ground (Esparza-Ros et al., 2019) without compressing subcutaneous tissues and was used to calculate the SARC-CalF. Skeletal muscle mass (SMM) was estimated according to Lee and colleagues (Lee et al., 2000) using the corrected arm, thigh, and CalF circumferences and normalized for body height (SMMI, kg/m2). To identify participants with low SMMI, the cutoff values proposed by Walowski and colleagues were used (Walowski et al., 2020). The cutoff values align with those recommended by the EWGSOP (-2 SD below the healthy young adult population) but are adjusted for the BMI.

3.3.4 Sarcopenia identification – muscle function (strength and performance)

For the identification of sarcopenia, muscle function, namely handgrip strength and performance (gait speed), were considered according to the criteria of the EWGSOP2 and SDOC (Bhasin et al., 2020; Cruz-Jentoft et al., 2019). Handgrip strength was measured using a digital hand dynamometer (Camry EH10; Sensun Weighing Apparatus Group Ltd., Guangdong, China) (Huang et al., 2022) following the procedures recommended by Roberts and colleagues (Roberts et al., 2011). The assessment was performed sitting with the elbow flexed at 90 degrees. Both the left and right arms were measured twice. Two measurements were performed for each hand alternately, and the highest value found among the four measures was used. The results were recorded in kilograms (kg). For the diagnosis of sarcopenia through the handgrip strength, six criteria were considered, the first and the sixth criteria according to the EWGSOP2 (Cruz-Jentoft et al., 2019) I) <27kg in men and <16kg in women, VI) <27kg in men and <16kg in women and low SMMI; and the remaining criteria according to SDOC (Bhasin et al., 2020): II) <35.5kg in men and <20.0 kg in women; III) grip over body mass index <1.05 for men and 0.79 for women; IV) grip strength over total body fat <1.66 for men and <0.65 for women; V) grip over body weight <0.45 for men and <0.34 for women. The usual walking speed (criterion VII) was evaluated at a 4 m distance (Parra-Rodriguez et al., 2016). The test was performed twice, adopting the best execution time. Values below 0.8 m/s, regardless of sex, were considered indicative of decreased physical performance because it is the most consensual cutoff value by the various sarcopenia working groups, except for the International Working Group on Sarcopenia (IWGS: < 1.0 m/s) (Bhasin et al., 2020; Chen et al., 2016; Chumlea et al., 2011; Parra-Rodriguez et al., 2016).

3.3.5 Sarcopenia suspicion – symptoms

The signalling of possible cases of sarcopenia was performed through SARC-F and SARC-CalF. The SARC-F is a 5-item questionnaire that asks about difficulties in strength, walking, getting up from a chair, climbing stairs, and history of falls. A score > 4 points on the SARC-F is suggestive of sarcopenia (Cao et al., 2014). For this purpose, the translated and validated version of the SARC-F for the Brazilian population was used. (Barbosa-Silva, Menezes, et al., 2016). The SARC-CalF consists of the SARC-F complemented with a measurement of CalF circumference. The SARC-CalF score ranges from 0 to 20 points, with a score >11 points suggestive of sarcopenia (Barbosa-Silva, Menezes, et al., 2016): men and women with CalF circumference < 34 cm and < 33 cm, respectively (suggestive of low muscle mass) receive a 10-point increase from the original SARC-F score.

3.4 - Statistical Analysis

All statistical analyses were performed using SPSS version 26.0 for Windows software (SPSS, Chicago, IL, USA). Data were stratified by sex and described as the absolute and relative frequency of cases (n, %) and mean + standard deviation (SD). Comparisons of means made using the student's t-test. The Chi-Square Test, the Mann-Whitney test, and Fisher's exact test were used to compare continuous and nominal characteristics of the sample between the sexes, respectively. Data normality was verified with the Kolmogorov-Smirnov. The accuracy of the screening tools (SARC-F and SARC-CalF) was evaluated through K analysis and the area under the curve (AUC), sensitivity (Se), specificity (Sp), positive predictive value (PPV), and negative predictive value (NPV) analysis. The Kappa values below 0.2 are considered poor. The significance level was set at $p \leq 0.05$.

3.5 - Results

The sociodemographic and anthropometric characteristics, the sarcopenia symptoms, and markers of sarcopenia (muscle strength and performance) of the sample are described in Table 1. Our sample was predominantly female, aged > 70 yrs, non-literate, and of socioeconomic class D/E. Most participants were overweight (42.0%) and obese (21.2%). No sex differences were observed for sarcopenia symptoms, assessed using the SARC-F and SARC-CalF, despite differences in CalF circumference, muscle strength, and performance, with men showing better results than women in these variables.

Table 1. Characteristics of the participants by sex: sociodemographic, body composition, sarcopenia symptoms, and sarcopenia biomarkers (muscle function: strength and gait speed).

Variables	Overall	Men	Women	p-value
Sample size, n (%)	312	112 (35.9)	200 (64.1)	
Age, years				0.122*
60-69	132 (42.3)	39 (34.8)	93 (46.5)	
70-79	120 (38.5)	50 (44.6)	70 (35.0)	
≥ 80	60 (19.2)	23 (20.5)	37 (18.5)	
Educational level				0.123*
Non-literate, n (%)	176 (56.4)	63 (56.3)	113 (56.5)	
Elementary school, n (%)	83 (26.6)	29 (25.9)	54 (27.0)	
High school, n (%)	28 (9.0)	6 (5.4)	22 (11.0)	
Graduate or above, n (%)	25 (8.0)	14 (12.5)	11 (5.5)	
Socioeconomic status class, n (%)				0.615†
C	18 (5.8)	5 (4.5)	13 (6.5)	
D/E	294 (94.2)	107 (95.5)	187 (93.5)	
Body composition				
Body mass, kg	63.7±12.7	69.3±11.6	60.5±12.2	<0.001**
Body height, cm	153.7±8.2	160.0±8.3	150.1±5.7	<0.001**
BMI, kg/m² (%)				0.131*
Underweight	6 (1.9)	0 (0)	6 (3.0)	
Normal weight	109 (34.9)	37 (33.0)	72 (36.0)	
Overweight	131 (42.0)	54 (48.2)	77 (38.5)	
Obese	66 (21.2)	21 (18.8)	45 (22.5)	
SMMI (kg/m²)	8.34±1.47	9.23±1.16	7.84±1.39	<0.001**
Sarcopenia symptoms				
SARC-F (pts)	1.75±1.88	1.43±1.68	1.92±1.95	0.025**
SARC-F ≥4 pts, n (%)	56 (17.9)	14 (12.5)	42 (21.0)	0.061
SARC-CalF (pts)	7.2±5.5	6.42±5.12	7.57±5.71	0.080**
Calf circunference, cm	32.8±3.4	33.8±3.0	32.2±3.5	<0.001**
Muscle function				
Handgrip strength, kg	23.7±9.2	31.4±8.9	19.3±5.9	<0.001**
Gait speed, m/s	1.1±0.4	1.2±0.4	1.0±0.4	<0.001**

BMI: body mass index; SMMI, skeletal muscle mass index; SARC-F, sarcopenia screening questionnaire; SARC-Calf, sarcopenia screening questionnaire adding calf circumference; **Test t student independent; *Chi-Square test; †Fisher's exact test

The prevalence of sarcopenia assessed through symptoms and muscle function are described in Tables 2 and 3. Sarcopenia was suspected in 12.5% of men and 21% of women when evaluated by the SARC-F (table 2) and in 27.7% of men and e 40% of women when evaluated by SARC-CalF (table 3). Regarding the cross-classification analysis between sarcopenia symptoms and muscle function, the Kappa analysis revealed no agreement between the SARC-F and the various criteria of handgrip strength ($C_{I\text{-}VI}$)

and gait speed (C_{VII}) for the identification of sarcopenia in men (table 2): K_I=0.139±0.090, p=0.087; K_{II}=0.039±0.034, p=0.322; K_{III}=-0.021±0.072, p=0.770; K_{IV}=-0.049±0.082, p=0.590; K_V=0.036±0.062, p=0.568; K_{VI} = -0.014±0.029, p=0.548; K_{VII} = 0.065±0.105, p=0.486. The same lack of agreement was observed in women except for handgrip strength C_I and gait speed C_{VII}: K_I=0.161±0.074, p=0.020; K_{II}=0.067±0.051; p=0.200; K_{III}=0.038±0.045; p=0.403; K_{IV}= -0.101±0.063; p=0.146; K_V=0.079±0.052; p=0.135; K_{VI} = -0.004±0.030, p=0.892; K_{VII} =0.209±0.076; p=0.003.

Table 2. Cross classification analysis between suspected cases of sarcopenia through SARC-F and muscle function by sex

		SARC-F					
		Men			**Women**		
Criteria		- cases	+ cases	Total	- cases	+ cases	Total
C_I_LowHandgrip$_{EWGSOP2}$	- cases	63.4%	6.3%	69.6%	59.5%	12.0%	71.5%
	+ cases	24.1%	6.3%	30.4%	19.5%	9.0%	28.5%
C_{II}_LowHandgrip$_{SDOC}$	- cases	23.2%	1.8%	25.0%	35.0%	7.0%	42.0%
	+ cases	64.3%	10.7%	75.0%	44.0%	14.0%	58.0%
C_{III}_LowHandgrip/BMI	- cases	52.7%	8.0%	60.7%	28.0%	6.0%	34.0%
	+ cases	34.8%	4.5%	39.3%	51.0%	15.0%	66.0%
C_{IV}_LowHandgrip/FM	- cases	69.6%	10.7%	80.4%	55.0%	17.0%	72.0%
	+ cases	17.9%	1.8%	19.6%	24.0%	4.0%	28.0%
C_V_LowHandgrip/BM	- cases	44.6%	5.4%	50.0%	36.5%	7.0%	43.5%
	+ cases	42.9%	7.1%	50.0%	42.5%	14.0%	56.5%
C_{VI}_LowHandgrip$_{EWGSOP2}$	- cases	6.3%	2.7%	8.9%	11.0%	4.0%	15.0%
& LowSMMI	+ cases	33.9%	2.7%	36.6%	18.0%	3.0%	21.0%
C_{VII}_LowGaitSpeed	- cases	75.0%	9.8%	84.8%	61.5%	11.5%	73.0%
	+ cases	12.5%	2.7%	15.2%	17.5%	9.5%	27.0%

C, criterion; SARC-F, a rapid diagnostic tool for sarcopenia; BM, body mass; BMI, body mass index; FM, fat mass; SMMI, skeletal muscle mass index; EWGSOP, European Working Group on Sarcopenia in Older People; SDOC, Sarcopenia Definition and Outcomes Consortium.

Concerning the Kappa analysis between the SARC - CalF and the different criteria of handgrip strength and gait speed for the identification of sarcopenia, there were more agreements (Table 3). In women, agreement of SARC-CalF with handgrip strength criteria CI and CII and with the gait speed criterion C_{VII} was observed with the following K coefficients: K_I= 0.201±0.069 p=0.003; K_{II}= 0.186±0,064 p=0.005; K_{III}= -0.034±0.062; p=0.583; K_{IV}= -0.031±0.068 p=0.653; K_V= -0.101±0.067 p=0.130; K_{VI} = -0.009±0.040, p=0.815; K_{VII} =0.273±0.068; p=0.0001. In men, it was found concordance of SARC-CalF with the handgrip criterion C_{II} and with the gait speed criterion C_{VII}: K_I=0.155±0.098; p=0.099; K_{II}=0.139±0.053; p=0.021; K_{III}= -0.032±0.092; p=0.722; K_{IV}=-0.053±0.088; p=0.563; K_V= 0.018±0.085; p=0.833; K_{VI} = -0.047±0.37, p=0.183; K_{VII} =0.223±0.099 p=0.011. Since K values below 0.2 are considered poor, we highlight the agreement between SARC-CalF and gait speed criterion CVI in both sexes.

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Table 3. Cross classification analysis between suspected cases of sarcopenia through SARC-CalF and muscle function by sex

		SARC-Calf					
		Men			**Women**		
Criteria		- cases	+ cases	Total	- cases	+ cases	Total
C_I_LowHandgrip$_{EWGSOP2}$	- cases	53.6%	16.1%	69.6%	47.5%	24.0%	71.5%
	+ cases	18.8%	11.6%	30.4%	12.5%	16.0%	28.5%
C_{II}_LowHandgrip$_{SDOC}$	- cases	22.3%	2.7%	25.0%	30.0%	12.0%	42.0%
	+ cases	50.0%	25.0%	75.0%	30.0%	28.0%	58.0%
C_{III}_LowHandgrip/BMI	- cases	44.6%	16.1%	60.7%	19.5%	14.5%	34.0%
	+ cases	27.7%	11.6%	39.3%	40.5%	25.5%	66.0%
C_{IV}_LowHandgrip/FM	- cases	57.1%	23.2%	80.4%	42.5%	29.5%	72.0%
	+ cases	15.2%	4.5%	19.6%	17.5%	10.5%	28.0%
C_V_LowHandgrip/BM	- cases	36.6%	13.4%	50.0%	23.5%	20.0%	43.5%
	+ cases	35.7%	14.3%	50.0%	36.5%	20.0%	56.5%
C_{VI}_LowHandgrip$_{EWGSOP2}$	- cases	5.4%	3.6%	8.9%	7.5%	7.5%	15.0%
& LowSMMI	+ cases	25.0%	11.6%	36.6%	15.0%	6.0%	21.0%
C_{VII}_LowGaitSpeed	- cases	65.2%	19.6%	84.8%	50.0%	23.0%	73.0%
	+ cases	7.1%	8.0%	15.2%	10.0%	17.0%	27.0%

C, criterion; SARC-Calf, a rapid diagnostic tool for sarcopenia; BM, body mass; BMI, body mass index; FM, Fat Mass; SMMI, skeletal muscle mass index; EWGSOP2, European Working Group on Sarcopenia in Older People; SDOC, Sarcopenia Definition and Outcomes Consortium.

AUC, sensitivity, specificity, and positive and negative predictive values of SARC-F and SARC-CalF for sarcopenia screening according to different criteria of muscle function (handgrip strength and gait speed), are presented in Tables 4 and 5, respectively. The SARC-F did not reveal any ability to discriminate sarcopenia in men, regardless of the muscle function variable (muscle strength or gait speed) taken as a reference. In women, the SARC-F showed a poor discrimination ability with AUC values of 0.665 for criterion C_{I}, 0.651 for C_{II}, and 0.660 for C_{VII}. When SARC-CalF was used to screen for sarcopenia in women, the corresponding AUC for the same reference criteria were 0.631 for C_{I}, 0.641 for C_{II}, and 0.724 for C_{VII}. The SARC-CalF, in turn, was able to discriminate sarcopenia in men using the criteria C_{II} (AUC: 0.676) and C_{VII} (AUC: 0.675) as references. Generally, an AUC >0.9 indicates exceptional discrimination, 0.7–0.9 indicates moderate discrimination, 0.5–0.7 indicates poor discrimination, and < 0.5 indicates result at chance (Mandrekar, 2010). In the significant models, the predictive power was reasonable, with the specificity consistently higher than the sensitivity and consequently higher values of NPV than PPV. Greater sensitivity for suspected sarcopenia was observed with the SARC-CalF in women with gait speed criterion CVII (Se=63.0) and men with handgrip criterion CII (Se=60.7) as references; the cutoff for these criteria was 10.5 pts and 4.5 pts, respectively.

Table 4. Sensitivity, specificity, positive and negative predictive values of SARC-F for screening sarcopenia according to different criteria

Criteria	Cutoff	Sensitivity	Specificity	PPV	NPV	AUC	p
Men							
C_{I}_LowHandgrip$_{EWGSOP2}$	-	-	-	-	-	0.535	0.552
C_{II}_LowHandgrip$_{SDOC}$	-	-	-	-	-	0.599	0.119
C_{III}_LowHandgrip/BMI	-	-	-	-	-	0.488	0.828
C_{IV}_LowHandgrip/FM	-	-	-	-	-	0.506	0.933
C_{V}_LowHandgrip/BM	-	-	-	-	-	0.537	0.503
C_{VI}_LowHandgrip$_{EWGSOP2}$ & LowSMMI	-	-	-	-	-	0.624	0.134
C_{VII}_LowGaitSpeed	-	-	-	-	-	0.589	0.241
Women							
C_{I}_LowHandgrip$_{EWGSOP2}$	2.5	47.4 (34.0 - 61.0)	73.4 (65.4 - 80.5)	31.0 (22.5 – 41.1)	83.1 (78.8 - 86.6)	0.665	<0.001
C_{II}_LowHandgrip$_{SDOC}$	1.5	57.0 (47.4 - 66.1)	68.0 (56.8 - 77.6)	24.1 (19.8 – 29.1)	83.3 (75.9 – 88.8)	0.651	<0.001
C_{III}_LowHandgrip/BMI	1.5	52.3 (43.4 - 61.0)	64.7 (52.2 - 75.9)	22.7 (19.0 – 26.9)	82.8 (73.5 - 88.7)	0.618	0.006
C_{IV}_LowHandgrip/FM	-	-	-	-	-	0.435	0.155
C_{V}_LowHandgrip/BM	1.5	54.0 (44.4 - 63.4)	63.2 (52.2 - 73.3)	24.8 (20.3 – 29.9)	83.9 (76.7 – 89.2)	0.612	0.006
C_{VI}_ Handgrip$_{EWGSOP2}$ & LowSMMI	-	-	-	-	-	0.556	0.262
C_{VII}_LowGaitSpeed	2.5	51.9 (37.8 - 65.7)	74.7 (66.8 - 81.5)	35.2 (25.8 – 45.8)	84.2 (80.1 – 87.7)	0.660	<0.001

C, criterion; EWGSOP2, European Working Group on Sarcopenia in Older People SDOC, Sarcopenia Definition and Outcomes Consortium; II, maximal grip strength. III, grip strength over body mass index. IV, grip strength over total body fat. V, grip strength over body mass; SMMI, skeletal muscle mass index; PPV, predictive positive values; NPV, negative predictive values.

Table 5. Sensitivity, specificity, positive and negative predictive values of SARC-CalF for screening sarcopenia according to different criteria

Criteria	Cutoff	Sensitivity	Specificity	PPV	NPV	AUC	p
Men							
C_{I}_LowHandgrip$_{EWGSOP2}$	-	-	-	-	-	0.606	0.076
C_{II}_LowHandgrip$_{SDOC}$	4.5	60.7 (49.5-71.2)	60.7 (40.6 - 78.5)	33.3 (29.3 – 37.6)	89.3 (73.0 – 96.2)	0.676	0.005
C_{III}_LowHandgrip/BMI	-	-	-	-	-	0.472	0.621
C_{IV}_LowHandgrip/FM	-	-	-	-	-	0.501	0.991
C_{V}_LowHandgrip/BM	-	-	-	-	-	0.441	0.280
C_{VI}_Low Handgrip$_{EWGSOP2}$ & LowSMMI	-	-	-	-	-	0.484	0.792
C_{VII}_LowGaitSpeed	10.5	52.9 (27.8-77.0)	76.8 (67.1 - 84.9)	52.9 (32.3 – 72.6)	76.8 (72.4 – 80.8)	0.675	0.022
Women							
C_{I}_LowHandgrip$_{EWGSOP2}$	10.5	56.1 (42.4 - 69.3)	66.4 (58.1 - 74.1)	56.9 (46.1 – 67.1)	66.9 (62.2 – 71.3)	0.631	0.004
C_{II}_LowHandgrip$_{SDOC}$	10.5	48.3 (38.9 - 57.7)	71.4 (60.5 - 80.8)	48.3 (42.6 – 54.0)	71.4 (63.1 – 78.5)	0.641	0.001
C_{III}_LowHandgrip/BMI	-	-	-	-	-	0.456	0.310
C_{IV}_LowHandgrip/FM	-	-	-	-	-	0.485	0.740
C_{V}_LowHandgrip/BM	-	-	-	-	-	0.432	0.100
C_{VI}_Low Handgrip$_{EWGSOP2}$ & LowSMMI	-	-	-	-	-	0.567	0.108
C_{VII}_LowGaitSpeed	10.5	63.0 (48.7 - 75.7)	68.5 (60.3 - 75.9)	63.0 (51.4 – 73.2)	68.5 (63.9 - 72.7)	0.724	0.001

C, criterion; EWGSOP2, European Working Group on Sarcopenia in Older People SDOC, Sarcopenia Definition and Outcomes Consortium; II, maximal grip strength. III, grip strength over body mass index. IV, grip strength over - total body fat. V, grip strength over body mass; SMMI, skeletal muscle mass index; PPV, predictive positive values; NPV, negative predictive values.

3.6 - Discussion

This study aimed to compare SARC-F and SARC-CalF tests as approaches for screening sarcopenia in older people. This is the first study examining these questionnaires in populations with specific characteristics, such as older adults from Amazonas. These are inexpensive, easy to administer, and minimally invasive approaches that assess the symptoms of sarcopenia (SARC-F) complemented by the CalF circumference as a possible indicator of muscle mass (SARC-CalF) (Sánchez-Rodríguez et al., 2019). This type of analysis is essential because there still needs to be a consensus on evaluating sarcopenia, including screening, among the different working groups dedicated to this subject (Chen et al., 2014; Cruz-Jentoft et al., 2010; Fielding et al., 2011; Morley et al., 2011; Muscaritoli et al., 2010; Studenski et al., 2014).

A greater suspicion of sarcopenia was observed when screening was performed with SARC-CalF: sarcopenia was detected by SARC-CalF in 27.7% of men and 40.0% of women, and SARC-F in 12.5% of men and 21.0% of women. Taking handgrip strength and gait speed as references, the prevalence of sarcopenia ranged between 15.2% and 75.0% for men and 27% and 66% for women, with the lowest prevalence associated with gait speed and the highest prevalence with handgrip in both sexes. From the analyzes carried out on the agreement between the measures for the suspicion (symptoms) and the identification (muscle function) of sarcopenia, a poor to fair diagnostic accuracy was observed in both sexes when the screening instrument was the SARC-CalF (AUC: 0.631-0.724, $p<0.01$).

The SARC-F did not show any ability to discriminate against sarcopenia in men. The predictive ability of SARC-CalF was reasonable with sensitivity and specificity values above 50%, considering a cutoff value of 10.5 in both men and women when gait speed CVII was the reference criteria for muscle function. As in most studies on the ability to predict sarcopenia from SARC-F or SARC-CalF, specificity was superior to sensitivity, meaning there were few false negative results than false positive results (Gülistan Bahat et al., 2018; Kim et al., 2018; Krzyminska-Siemaszko, Deskur-Smielecka, et al., 2020; Parra-Rodriguez et al., 2016). Low sensitivity implies that many subjects with sarcopenia will not be detected if assessed using these questionnaires. Specificity relates to the test's ability to reject subjects without a condition correctly. Therefore, if not detected from SARC-F or SARC-CalF, sarcopenia can be ruled out without further evaluation (Krzyminska-Siemaszko, Deskur-Smielecka, et al., 2020).

The use of different approaches in this study is due to the need for more consensus regarding the most appropriate methodologies for screening and identifying sarcopenia (Chen et al., 2016). In 2016, Barbosa-Silva and colleagues proposed the SARC-F + CC (or SARC- CalF score), a modified version of the SARC-F, to improve its performance (Barbosa-Silva, Bielemann, et al., 2016). The SARC-CalF adds an anthropometric marker (CalF circumference) to the muscle functionality markers present in the original SARC-F (G. Bahat et al., 2018; Barbosa-Silva, Bielemann, et al., 2016; Bauer et al., 2019; Yang et al., 2018; Yang et al., 2019). CalF circumference assessment is a simple procedure of measuring the widest part of the right CalF with a non-elastic flexible plastic tape (Krzyminska-Siemaszko, Deskur-Smielecka, et al., 2020). In older populations, the CalF circumference is measured as the most sensitive anthropometric index of muscle mass (Organization, 1995).

The results of this investigation are similar to the findings demonstrated in previous studies, namely a) a greater suspicion (screening) of sarcopenia in women than in men, and no differences in the objective identification of sarcopenia (assessment) were identified (Gade et al., 2020; Gasparik et al., 2020; Kera et al., 2019; Krzyminska-Siemaszko, Tobis, et al., 2020); b) a higher number of cases who suspected sarcopenia, with SARC-CalF than with SARC-F(da Luz et al., 2021; Krzyminska-Siemaszko, Deskur-Smielecka, et al., 2020); c) a better diagnostic accuracy of sarcopenia of SARC-CalF compared to SARC-F having the EWGSOP2 as the gold standard (Bahat et al., 2022; Krzyminska-Siemaszko, Tobis, et al., 2020; Yang et al., 2018); d) screening instruments showed higher specificity than sensitivity(Bahat et al., 2022; G. Bahat et al., 2018; da Luz et al., 2021; Drey et al., 2020; Krzyminska-Siemaszko, Tobis, et al., 2020; Rossi et al., 2021; Yang et al., 2018). Age is a factor that favours the development of sarcopenia since the prevalence of symptoms is higher in older people (Barbosa-Silva, Bielemann, et al., 2016; Hashemi et al., 2016; Spira et al., 2016). In addition to age, sex also seems to be a determinant for the differences in the prevalence of sarcopenia observed in older adults: a lower muscle mass and lower use of muscle during the aging process (less physical activity) are likely explanations (Bijlsma et al., 2013; da Silva Alexandre et al., 2014; Mijnarends et al., 2016).

This study has several limitations, namely the sample's representativeness (age group, sex, socio-economic status, residential area). For example, most participants were women, and sex plays an essential role in sarcopenia (Du et al., 2019; Hwang & Park, 2022). On the other hand, we limited our cross-sectional study to a comparison of SARC-F and SARC-CalF; a comparison between different sarcopenia screening approaches to predict important health outcomes such as disability, frailty, quality of life, and mortality should be investigated in prospective studies in the future. As strengths of this work, we highlight the investigation with a peculiar and little-studied sample whose participants live in poor cities with difficult access in Brazil, where screening is even more critical for health promotion and facilitation of clinical practice. However, this is the first study that compares the diagnosis of the two main sarcopenia screening instruments in the elderly population of Amazonas, including cutoff points for (not) suspected sarcopenia (SARC-Calf = 10.5 pts). Despite the promising results found in this study, its validity will need to be confirmed in further studies.

3.7 - Conclusion

Using walking slowness (≤ 8 m/s) as a reference method for identifying sarcopenia, the SARC-CalF performed better than the SARC-F for screening sarcopenia in the population ≥ 60 years of age in Amazonas, Brazil. Further studies are needed to verify this finding in other population groups and, above all, continue research to improve the performance of screening instruments.

3.8 - References

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CAPÍTULO 4

Muscle Weakness and Walking Slowness for the Identification of Sarcopenia in the Older Adults from Northern Brazil: A Cross-Sectional Study[2]

[2]**Lima, A.B.d**.; Henrinques-Neto, D.; Ribeiro, G.S.; Gouveia, E.R.; Baptista, F. Muscle Weakness and Walking Slowness for the Identification of Sarcopenia in the Older Adults from Northern Brazil: A Cross-Sectional Study. *Int. J. Environ. Res. Public Health* **2022**, *19*, 9297. https://doi.org/10.3390/ijerph19159297

4.1 - Abstract

Purpose: This study aimed to analyze the prevalence of sarcopenia in elderly people from Northern Brazil according to muscle weakness or walking slowness.

Methods: The sample consisted of 312 elderly people (72.6 ± 7.8 years). For walking slowness, a gait speed ≤ 0.8 m/s was used as a cut-off value, and for muscle weakness the following handgrip strength criteria were used for men and women, respectively: CI: <27.0/16.0 kg; CII: <35.5/20.0 kg; CIII: grip strength corrected for body mass index (BMI) < 1.05/0.79; CIV: grip strength corrected for total fat mass: <1.66/0.65; CV: grip strength corrected for body mass: <0.45/0.34.

Results: Walking speed was reduced in 27.0% of women and 15.2% of men ($p < 0.05$). According to grip strength criteria, 28.5% of women and 30.4% of men (CI), 58.0% of women and 75.0% of men (CII), 66.0% of women and 39.3% of men (CIII), 28.8% of women and 19.6% of men (CIV), and 56.5% of women and 50.0% of men (CV) were identified as having sarcopenia. Walking slowness is more prevalent in women and muscle weakness is more prevalent in men in Northern Brazil.

Conclusions: Walking slowness proved to be more concordant with muscle weakness in both sexes when the CI for handgrip strength was adopted.

Key words: gait speed; handgrip; sarcopenia; slowness; weakness

4.2 - Introduction

Muscle weakness is characterized by a lack of muscle strength and has diverse causes. Aging is the main cause of decreasing muscle strength, being identified as sarcopenia when a certain threshold is reached (according to the definitions proposed by different working groups) (Cruz-Jentoft et al., 2010; Cruz-Jentoft et al., 2019). In addition to aging, disease, physical inactivity, sedentary behavior, and malnutrition are also relevant causes of sarcopenia (Keller, 2019). Regardless of the cause, muscle strength is one of the key components when evaluating sarcopenia and is strongly associated with several negative outcomes in older adults (Cruz-Jentoft et al., 2019). Among those outcomes, limited mobility is commonly the first sign and predisposes older adults to functional disability, falls (Cruz-Jentoft et al., 2010; Cruz-Jentoft et al., 2019), fractures, increased risk of depression (Abdalla et al., 2020), hospitalizations (Kim & Choi, 2013), institutionalization, and premature death (Alexandre et al., 2018). It is noteworthy that limited mobility seems to be even more important than multimorbidity to forecast mortality amongst older adults (Abdalla et al., 2021). As a result of its predictive ability, assessment of muscle weakness and assessment of walking slowness (as a marker of limited mobility) are used for the identification of geriatric syndromes such as sarcopenia, frailty, and the risk of falling (Clark & Manini, 2012; Cruz-Jentoft et al., 2019).

Some working groups focus the diagnosis of sarcopenia in assessing handgrip strength (Cruz-Jentoft et al., 2019), while other groups recommend the assessment of either handgrip strength or gait speed as an alternative to each other (Lin et al., 2021). Additionally, the cut-off values for identifying sarcopenia are different according to different working groups criteria, especially for handgrip strength, with a greater consensus for gait speed (≤0.8 m/s) (Cawthon, Manini, et al., 2020; Cawthon, Travison, et al., 2020; Manini et al., 2020). This highlights the need for further studies (Cawthon, Travison, et al., 2020).

Muscle weakness is usually assessed using an absolute muscle strength score (Abdalla et al., 2021; Albrecht et al., 2021; Gadelha et al., 2018; Lima et al., 2019) or by normalizing the absolute muscle strength to a body size variable (Cawthon, Manini, et al., 2020; Gadelha et al., 2018). Inaccuracy tends to increase in the first case, especially in older people with lower body mass and height (Maranhao Neto et al., 2017). Low absolute values may identify lighter and shorter body size older adults as having muscle weakness, even if they sustain their basic and instrumental activities of daily living (Abdalla et al., 2020). On the other hand, the ratio standard procedure seems to overestimate the real strength of light/short older adults and underestimate it for tall/heavy ones (Abdalla et al., 2020), because of the nonlinear relationship between muscle strength and body-size variables (Maranhao Neto et al., 2017). Studies with particular body phenotypes, considering different regions of the globe, but in particular different regions of Brazil, e.g., interior of São Paulo (de Almeida Campos et al., 2020), Nova Santa Rita (de Oliveira et al., 2020), Macapá (Esteves et al., 2020), Natal (Fernandes et al., 2021), and Manaus (Miranda et al., 2022), contribute to the identification of vulnerable groups with greater urgency in the intervention. This mapping is essential to align public health policies with the needs of the elderly.

To contribute information about muscle weakness and walking slowness and sarcopenia prevalence from older people of Novo Aripuanã that is currently non-available, this study aimed: (1) to analyze the prevalence of sarcopenia in elderly people from Northern Brazil, according to the algorithms proposed by the European Working Group on Sarcopenia in Older People (EWGSOP) (Cruz-Jentoft et al., 2019) and

Sarcopenia Definitions and Outcomes Consortium (SDOC) (Bhasin et al., 2020) for muscle weakness and slow walking, and (2) to investigate the agreement of the prevalence between the slow walking and the different criteria of handgrip strength for sarcopenia. This information can be used to compare the prevalence of sarcopenia between sexes and age groups but also between national and international regions as a function of muscle weakness and slow walking (Tey et al., 2019), aiming at tailored public health interventions.

4.3 - Methods

4.3.1 Sample and Study Design

This cross-sectional study was approved by the Ethics Committee of the State University of Amazonas (UEA) according to the Declaration of Helsinki and Resolution 466/12 of the National Health Council, making part of the research project: "Sarcopenic Syndrome - Physical Function, Phenotype and Quality of life in elderly with and without sedentary lifestyle" (CAAE 74055517.9.0000.5016/Referee 2.281.400).

The sample included 312 older adults from the community of Novo Aripuanã (Amazonas, Brazil). Participants were recruited in basic health units, parks, squares, churches, and other public places in the urban area of the city, in addition to invitations broadcast on local radio stations. Older adults living in rural areas were excluded from the study due to difficulties in accessing the evaluation site (distance and means of transportation needed) (Figure 1). After explanations about the procedures and risks of the study, all participants signed the informed consent form. All assessments were performed out at UEA. The following criteria were considered for participant's inclusion: (1) older aged 60 and over residing in the community; (2) reported be independent in carrying out activities of daily living; (3) moderate or high level of cognitive functioning; (4) no contraindications for physical exertion (stroke, neurological diseases, unstable chronic conditions); (5) without chest pain, and/or angina pectoris and limiting joint pain (Rikli & Jones, 2013).

The cognitive level was evaluated with the Mini-Mental State Examination (MMSE) (Folstein et al., 1975). MMSE ≤ 15/30 points were used to exclude the participants of the study.

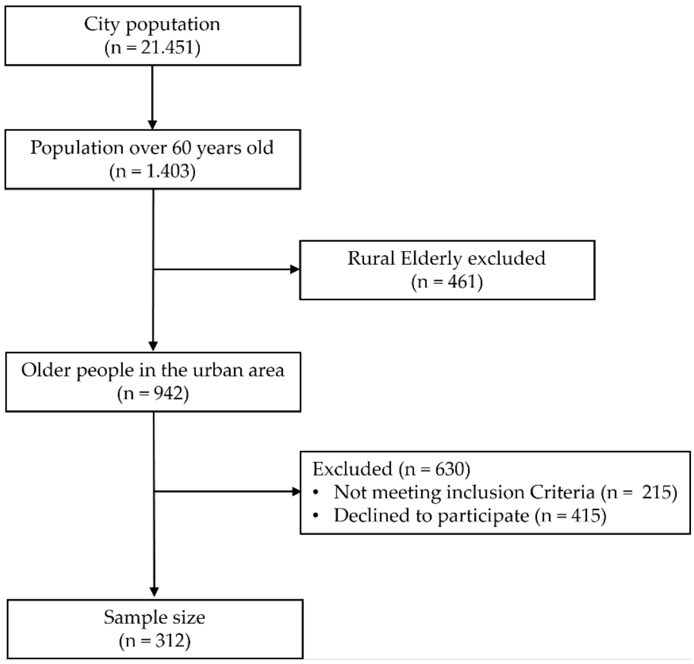

Figure 1. Flowchart diagram of the participant recruitment process

4.3.2 Instruments

4.3.2.1 Socioeconomic Status

Participants reported sociodemographic data (age and education). The Brazilian Association of Research Companies (Pesquisa-ABEP, 2019) questionnaire was applied to evaluate socioeconomic status, which considers the possession of some consumer goods, educational level of the head of household, and access to public services.

4.3.2.2 Muscle Weakness

Muscle strength was assessed using a handgrip dynamometer (Camry EH10; Sensun Weighing Apparatus Group Ltd., Shenzhen, China). Participants performed the handgrip strength test in a sitting position, with arms bent to 90 degrees in the elbow and shoulder joint. Both the left and right arms were measured twice. The results were recorded in kilograms (kg). The mean value of all measurements was used as the final score for each individual. Muscle weakness was identified using 5 criteria. The first criterion was according to the EWGSOP (Cruz-Jentoft et al., 2019) and the remaining criteria were according to SDOC (Bhasin et al., 2020). Criteria were the following: (I) <27.0 kg in men and <16.0 kg in women; (II) <35.5 kg in men and <20.0 kg in women; (III) grip over body mass index <1.05 for men and 0.79 for women; (IV) grip strength over total body fat <1.66 for men and <0.65 for women; (V) grip over bodyweight <0.45 for men and <0.34 for women.

4.3.2.3 Slow Walking

To identify slow walking, we used the 4-m gait speed test (4-MGS) (Guralnik et al., 1994). The 4-MGS speed is valid to assess gait speed, identify walking slowness, and the severity of sarcopenia (Arnal-Gómez et al., 2021; Grosicki et al., 2020; Mazocco et al., 2020). Other distances (2.4 m to 15 m) are also used, but less frequently (Mehmet et al., 2020). Subjects were asked to walk the course at their usual gait speed. Time taken to perform the walk was recorded, and the result was expressed as meters per second. If necessary, canes or walkers were permitted during this test. A gait speed ≤ 0.8 m/s was considered indicative of slow walking (Cruz-Jentoft et al., 2019; Studenski et al., 2011).

4.3.2.4 Body Size and Composition

Body height, weight, fat-mass (FM), fat free mass (FFM), and muscle mass were assessed using anthropometric measures. All measurements followed the recommendations of the International Society for the Advancement of Kinanthropometry-ISAK (Marfell-Jones et al., 2018). Height and weight were measured using a mechanical scale (Welmy, São Paulo City, Brazil), girths of the relaxed arm, waist, abdomen, hip, and calf were measured with 2 m-metallic tape (Cescorf, Porto Alegre City, Brazil), and the skinfold triceps, calf, subscapular, and abdominal skinfolds using a skinfold caliper (Sanny, São Paulo City, Brazil). Muscle mass (MM) was estimated applying the equation proposed by Lee et al. (Lee et al., 2000). Posteriorly, skeletal muscle mass index (SMMI) was obtained dividing muscle mass by height squared. Body fat was estimated using equations proposed by Williams et al. (Williams et al., 1992). FM was estimated by multiplying the % body fat by weight (FM = weight x% body fat) and FFM was obtained by subtracting FM from weight (FFM = weight − FM). Lastly, the body mass index (BMI) was determined by dividing weight by height squared. Participants with a BMI ≥ 30 kg/m2 and a decreased grip strength according to criterion I were considered to have sarcopenic obesity (Donini et al., 2022).

4.4 - Statistics

All analyses were performed using the Statistical Package for the Social Sciences (Version 24 for Windows; SPSS, Chicago, IL, USA). Data were stratified by sex and age range (60–69, 70–79, ≥80 years) and presented as mean ± standard deviation (SD) or percentage (%). Participants with muscle weakness and slow walking were identified according to the criteria described, and the respective prevalence (%) was calculated concerning the number of participants (total and by age group). Comparisons of means made using the student's t-test. Comparisons of prevalence between different age groups for the same sex and between the two sexes for the same age group were assessed using the Chi-Square Test. The proportions of limitations in handgrip strength and gait speed were also compared using the Cochran Q test. The level of agreement between participants with muscle weakness and slow walking was analyzed using the kappa statistic. The Kappa values below 0.2 are considered poor. The level of significance was set at $p \leq 0.05$.

4.5 - Results

A total of 312 older adults living in the community of Northern Brazil were evaluated (112 men and 200 women). Table 1 shows the educational level, body size, composition, and physical fitness of the participants. Participants were predominantly illiterate and female, with men presenting a higher level of academic education, greater muscle mass, gait speed, and handgrip strength (regardless of normalization for body composition) than women.

The prevalence of low muscle strength and low gait speed of the participants stratified according to the consensus definition of sarcopenia and age group is shown in Tables 2 and 3. In women, differences in muscle weakness (criteria I and II) and walking slowness were observed. The ≥80-year-old group presented a higher prevalence compared to the younger groups. However, when muscle strength was adjusted for body composition, the prevalence of muscle weakness in women was similar in the three age groups. In men, there were differences in muscle weakness (criterion I, III, and V) and in walking slowness between age groups, from 70 years onwards compared to younger groups, except for handgrip strength criterion I, in which the differences were evidenced only in the ≥80-year-old group. Considering the gait speed, whose cutoff value for walking slowness is similar for both genders, women have a higher prevalence of walking slowness than men ($p < 0.05$) in different age groups, except for the 70–79-year-old group.

Table 4 presents the agreement between the diagnosis of walking slowness and muscle weakness assessed through different criteria (I–V). In men, there was agreement of the diagnosis of walking slowness with all muscle weakness criteria except criterion IV: KI = 0.287 ± 0.095; p = 0.001; KII = 0.113 ± 0.032; p = 0.010; KIII = 0.265 ± 0.082; p = 0.001; KIV = 0.041 ± 0.099; p = 0.661; kV = 0.196 ± 0.066; p = 0.004. In women, there was only agreement on the diagnosis of walking slowness with criteria I and II for muscle weakness, i.e., with the criteria not adjusted for body composition: KI = 0.265 ± 0.074; p = 0.0001; KII = 0.162 ± 0.055; p = 0.005; KIII = 0.076 ± 0.050; p = 0.143; KIV = 0.097 ± 0.073; p = 0.169; KV = 0.049 ± 0.058; p = 0.424. The level of agreement between variables was, however, fair, i.e., with a K value between 0.21–0.40.

Table 1. Characteristics of the participants.

Variables	Overall	Men	Women	*p*-Value
Sample size, *n*	312	112	200	<0.001
Age, years	72.6 ± 7.8	73.1 ± 7.3	72.4 ± 8.1	0.232
Educational level				
Non-literate, *n* (%)	176 (56.4)	63 (56.3)	113 (56.5)	1.000
Elementary school, *n* (%)	83 (26.6)	29 (25.9)	54 (27.0)	0.894
High school, *n* (%)	28 (9.0)	6 (5.4)	22 (11.0)	0.103
Graduate or above, *n* (%)	25 (8.0)	14 (12.5)	11 (5.5)	0.048
Mini mental, score	21.2 ± 5.1	21.8 ± 4.6	20.8 ± 5.3	0.124
Body size and composition				
Height, cm	153.7 ± 8.2	160.0 ± 8.3	150.1 ± 5.7	<0.001
Weight, kg	63.7 ± 12.7	69.3 ± 11.6	60.5 ± 12.2	<0.001
BMI, kg/m²	26.9 ± 4.7	27.1 ± 4.6	26.8 ± 4.7	0.588
Muscle mass, kg	19.9 ± 4.6	23.7 ± 3.6	17.7 ± 3.6	<0.001
SMMI, kg/m²	8.3 ± 1.5	9.2 ± 1.2	7.8 ± 1.4	<0.001
Sarcopenic obesity, *n* (%)	57 (18.3)	22 (19.6)	35 (17.5)	0.253
Physical performance				
Gait speed, m/s	1.09 ± 0.36	1.20 ± 0.35	1.03 ± 0.35	<0.001
Muscle strength				
Handgrip strength, kg	23.7 ± 9.2	31.4 ± 8.9	19.3 ± 5.9	<0.001
Handgrip/body mass, kg/kg	0.37 ± 0.13	0.46 ± 0.12	0.33 ± 0.10	<0.001
Handgrip/BMI, kg/kg.m^{-2}	0.89 ± 0.35	1.18 ± 0.34	0.74 ± 0.23	<0.001
Handgrip/body fat, kg/kg	1.41 ± 0.88	2.07 ± 1.08	1.04 ± 0.43	<0.001

BMI: body mass index. SMMI: skeletal muscle mass index.

Table 2. Prevalence (%) of low muscle strength and low gait speed in elderly of Northern Brazil according to consensus definition of sarcopenia and age group—WOMEN.

Age Group (Years)	**Overall**	**60–69**	**70–79**	**≥80**	***p*-Value**
Participants (*n*)	**200**	**93**	**70**	**37**	
EWGSOP (2019)					
Low muscle strength	57 (29.0)	20 (21.5) $_a$	17 (24.3) $_a$	20 (54.1) $_b$	0.001
SDOC (2020)					
Low muscle strength	116 (58.0)	49 (52.7) $_a$	37 (52.9) $_a$	30 (81.1) $_b$	0.007
Low muscle strength/BMI	132 (66.0)	58 (62.4) $_a$	45 (64.3) $_a$	29 (78.4) $_a$	0.205
Low muscle strength/FM	56 (28.0)	23 (24.7) $_a$	21 (30.0) $_a$	12 (32.4) $_a$	0.609
Low muscle strength/BM	113 (56.5)	52 (55.9) $_a$	39 (55.7) $_a$	22 (59.5) $_a$	0.922

Low gait speed	54 (27.0)	17 (18.3) a	17 (24.3) a	20 (54.1) b	≤0.001

EWGSOP, European Working Group on Sarcopenia in Older People; SDOC, Sarcopenia Definition and Outcomes Consortium; BMI, body mass index; FM, fat mass; BM, body mass. Values expressed as n (%). a and b in subscript indicate the existence (or not) of significant differences between the proportions of the groups according to the Chi-square test; equal letters indicate no differences ($p < 0.05$).

Table 3. Prevalence (%) of low muscle strength and low gait speed in elderly of Northern Brazil according to consensus definition of sarcopenia and age group - MEN.

Age Group (Years)	Overall	60–69	70–79	≥80	*p*-Value
Participants	**112**	**39**	**50**	**23**	
EWGSOP (2019)					
Low muscle strength	34 (30.4)	6 (15.4) a	13 (26.0) a	15 (65.2) b	≤0.001
SDOC (2020)					
Low muscle strength	84 (75.0)	26 (66.7) a	38 (76.0) a	20 (87.0) a	0.199
Low muscle strength/BMI	44 (39.3)	9 (23.1) a	22 (44.0) a,b	13 (56.5) b	0.022
Low muscle strength/FM	22 (19.6)	9 (23.1) a	7 (14.0) a	6 (26.1) a	0.386
Low muscle strength/BM	56 (50.0)	12 (30.8) a	29 (58.0) b	15 (65.2) b	0.010
Low gait speed	17 (15.2)	1 (2.6) a	10 (20.0) b	6 (26.1) b	0.020

EWGSOP, European Working Group on Sarcopenia in Older People; SDOC, Sarcopenia Definition and Outcomes Consortium; BMI, body mass index; FM, fat mass; BM, body mass. Values expressed as n (%). a and b in subscript indicate the existence (or not) of significant differences between the proportions of the groups according to the Chi-square test; equal letters indicate no differences ($p < 0.05$).

Table 4. Cross classification analysis between positive (+) cases for muscle weakness and for walking slowness by sex.

		Gait Slowness					
		Men			**Women**		
Muscle Weakness Criteria (C)		**−Cases**	**+Cases**	**Total**	**−Cases**	**+Cases**	**Total**
CI_	−cases	64.3%	5.4%	69.6%	57.5%	14.0%	71.5%
Handgrip Strength	+cases	20.5%	9.8%	30.4%	15.5%	13.0%	28.5%
CII_	−cases	25.0%	0.0%	25.0%	35.0%	7.0%	42.0%
Handgrip Strength	+cases	59.8%	15.2%	75.0%	38.0%	20.0%	58.0%
CIII_	−cases	57.1%	3.6%	60.7%	27.0%	7.0%	34.0%
Handgrip/BMI	+cases	27.7%	11.6%	39.3%	46.0%	20.0%	66.0%
CIV_	−cases	68.8%	11.6%	80.4%	54.5%	17.5%	72.0%
Handgrip/FM	+cases	16.1%	3.6%	19.6%	18.5%	9.5%	28.0%
CV_	−cases	47.3%	2,7%	50.0%	33.0%	10.5%	43.5%
Handgrip/BM	+cases	37.5%	12.5%	50.0%	40.0%	16.5%	56.5%

CI_Hanggrip strength: <27.0 kg for men and <16.0 kg for women; CII_Handgrip strength: <35.5 kg for men and < 20.0 kg for women; BMI: body mass index; FM: Fat Mass; BM: body mass.

Comparing the prevalence of slow walking with that of muscle weakness in criterion I, i.e., the criterion with the greatest agreement, differences were observed between these prevalence in men aged 80 years and over (Figure 2).

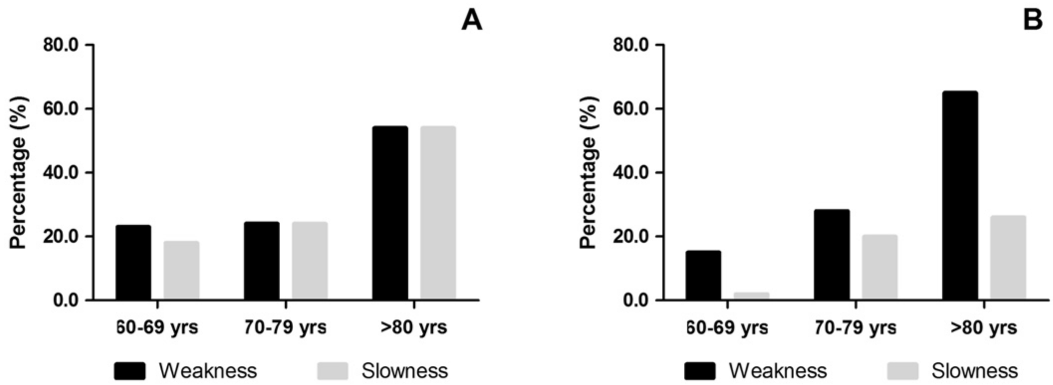

Figure 2. Comparison of the prevalence (%) of muscle weakness with gait slowness in women (**A**) and men (**B**); difference in prevalence in men aged 80 and over ($p = 0.04$).

4.6 - Discussion

This study aimed to describe the prevalence of sarcopenia in older adults from the Northern Brazil, according to the two main criteria based on muscle weakness and walking slowness and to investigate the concordance of the prevalence between these criteria. The results reveal a prevalence of ~20.0% in muscle weakness and walking slowness in women aged 60–79 years and more than 50.0% at 80 years and older, considering a handgrip strength < 16.0 kg as a cut-off value for the identification of sarcopenia (criterion I). Taking a handgrip strength < 20.0 kg as the cut-off value for the identification of sarcopenia in women (criterion II), the prevalence rises to ~53% between the ages of 60 and 79 years and to 81.0% at age 80 and over. In men, muscle weakness is more prevalent than slow walking, especially from the age of 80 where it reaches 65.0%

(criterion I) or 87.0% (criterion II) against a prevalence of 26.1% for slow walking. Walking slowness was shown to be more concordant with muscular weakness when the cut-off value for handgrip strength was 16.0 kg for women and 27.0 kg for men (Criterion I).

The use of different cut-off values for muscle weakness in the present study is due to the lack of consensus that still exists regarding the assessment of sarcopenia (Fernandes et al., 2021). The criteria adopted are normative (positioning of an individual in relation to a group) (Cruz-Jentoft et al., 2019) or referred to functional capacity (mobility limitation) and risks (falls, hip fractures, mortality) (Bhasin et al., 2020). However, in both cases, the establishment of cut-off values will depend not only on sexual dimorphism but possibly also on population polymorphism concerning body size (Bahat et al., 2021; Bahat et al., 2020; Bahat et al., 2018; Bijlsma et al., 2013)

The handgrip cut-offs have been widely used to diagnose sarcopenia in populations living in developed countries, where they were originally defined, so the use of such values in other populations may lead to inaccurate prevalence rates (Moreira et al., 2019), particularly when the criteria is not adjusted for body dimensions. According the EWGSOP (Cruz-Jentoft et al., 2019), the prevalence of muscle weakness in our study was ~30% considering the total sample in both men and women. This prevalence is higher than those observed in other regions of Brazil for the same muscle weakness criterion as in the Interior of São Paulo (17.5%) (de Almeida Campos et al., 2020), Nova Santa Rita (23.7%) (de Oliveira et al., 2020), Macapá (6.1%) (Esteves et al., 2020), Natal (4.6%) (Fernandes et al., 2021), or Manaus (Miranda et al., 2022).

As the comparison of the prevalence of sarcopenia between geographic regions can be affected by the composition of the groups in terms of sex and age, we proceeded with a more selective analysis: in addition to the average age in these studies being lower than that of our sample, possible differences in body height (not reported in some studies) may be the main reason for prevalence discrepancies. For example, the average handgrip strength for men and women aged 65 to 74 years in an international study was, respectively, 41.68 kg and 22.85 kg in Kingston (Canada), 34.09 kg and 20.78 kg in Tirana (Albania), 31.88 kg and 18.94 kg in Natal (Brazil) (de Souza Barbosa et al., 2016). The corresponding values for our sample of Novo Aripuanã (Amazonas, Brazil), comprising only participants aged 65 to 74 years was 31.62 kg and 20.24 kg for men and women, respectively, showing relatively close handgrip strength for similar body heights as is the case with our sample (men: 1.61 ± 0.07 m; women 1.51 ± 0.05 m) and the Natal sample in Brazil (men: 1.64 ± 0.07 m; women: 1.50 ± 0.05 m). Surprisingly, identical or higher values were evidenced for gait speed by our sub-sample aged 65 to 74 (men: 1.32 ± 0.36 m/s; women: 1.07 ± 0.32 m/s), having the same international study as a reference (de Souza Barbosa et al., 2016). This observation may have to do with the usual physical activity of our sample whose livelihood comes from agriculture and fishing: 73.0% of women and 89.0% of men are considered active according to international recommendations (Organization, 2020).

Findings support the use of handgrip strength as a proxy for detecting slow walking speed (≤0.8 m/s) in community-dwelling older adults owing (Visser et al., 2000). Several cutoff values for the handgrip have been proposed for this purpose (Alley et al., 2014; Dong et al., 2016; Duchowny et al., 2017; Lauretani et al., 2003; Sallinen et al., 2010; Vasconcelos et al., 2016). We highlight the cutoff values of the group of Vasconcelos and colleagues (<25.8 kg for men; <17.4 kg for women) (Vasconcelos et al., 2016), but also of the group of Alley and colleagues (<26.0 kg for men; <16.0 kg for women) (Alley et al., 2014), as they are very similar to those observed in our sample to discriminate mobility limitation, namely 27.3 kg for men and 18.6 kg for women (data not shown; men: AUC 0.791, 95% CI: 0.689–0.892; Se 70.6%; Sp 74.7%; $p < 0.001$; women: AUC: 0.657, 95% CI: 0.565–0.749; Se 61.1%; Sp 63%; $p = 0.001$).

The latest SDOC panel confirmed the need to include muscle weakness and slowness in the definition/screening of sarcopenia because of its strong association with incidence of falls, hip fracture, and mobility limitation (Bhasin et al., 2020; Cawthon, Manini, et al., 2020). In addition, the low level of physical activity and muscle weakness related to age may affect the lower limbs, directly compromising the elderly autonomy (Henwood & Taaffe, 2005). Further research with larger samples and follow-up is needed to validate the cutoff values. It is also necessary to investigate the universality of cut-off values for muscle weakness and slow gait, considering not only physical impairment but also cognitive impairment (Chou et al., 2019).

Since sarcopenia has serious implications, early identification is an important task. Several sarcopenia evaluation tools have been proposed and it is necessary to investigate its validity in different population groups due, at least, to differences in body dimensions. For example, the population of Novo Aripuanã in Northern Brazil has lower body dimensions than other populations in southern and southeastern Brazil, where the prevalence of sarcopenia has been characterized (de Almeida Campos et al., 2020; de Oliveira et al., 2020; Moreira et al., 2019; Pinheiro et al., 2020).

In recent years, sarcopenia has been discussed by two large working groups: the EWGSOP2 (Cruz-Jentoft et al., 2019) and the SDOC (Bhasin et al., 2020). Both agree with the general concept that involves impairment of function (muscle weakness and slowness). However, there is divergence concerning the third component of screening:

structural damage (low muscle quantity/quality). While the EWGSOP2 recommends that low muscle mass be the confirmation criterion for sarcopenia, the SDOC does not consider muscle mass (evaluated by DXA or BIA) in its guidelines, as it has not been associated with adverse outcomes in longitudinal studies and large clinical trials (Bhasin et al., 2020). Thus, the SDOC proposes the interpretation of the handgrip strength with or without adjustment for body mass or body mass index, body fat, or arm muscle mass (Bhasin et al., 2020). However, we did not find handgrip strength studies with this type of adjustment for comparative purposes.

The suggested use of muscle weakness or walking slowness for the identification of sarcopenia (Alley et al., 2014; Bhasin et al., 2020; Chen et al., 2020) raises the question of the possibility of agreement between the two for diagnosis, although the correlation appears to be weak between the values of these two criteria (Stuck et al., 2021).

4.7 - Study Limitations and Strengths

We acknowledged some limitations of the present study that must be considered when interpreting the results. First, the cross-sectional design is inadequate to capture the temporal relations that occur throughout life, and this approach precludes inference of causality between muscle weakness or walking slowness and sarcopenia. However, besides this being a descriptive study, we considered the algorithms proposed by EWGSOP2 (Cruz-Jentoft et al., 2019) and SDOC (Bhasin et al., 2020) for muscle weakness and slow walking in the calculations of sarcopenia. Second, the sample did not include older people living in rural areas and only included participants that could walk without assistance or aid of other people where the assessments were conducted. The generalizability of our findings to less-mobile populations of Novo Aripuanã and people who live in rural areas is not possible. Third, the heterogeneity among the participants of this study can introduce bias in the identification of sarcopenia due to different physical phenotypes (larger dimensions), favoring the increase in the prevalence of muscle weakness and walking slowness in our sample.

However, when women's handgrip is adjusted for body size (BMI or body mass), the prevalence of muscle weakness remains or increases, while in men, it remains or decreases. Finally, the prevalence of muscle weakness is also affected by morbidity, information which was not properly collected in this study, constituting a limitation, especially at the level of comparison between geographic regions. Nonetheless, the strongest point is the analysis of the agreement between muscle weakness and walking slowness for the identification of sarcopenia in this population of the northern region of Brazil. We acknowledged that further research with larger samples and follow-up is necessary to validate the cutoff values of muscle weakness and walking slowness in intrinsic capacity and adverse events such as falls, hospitalization, and mortality.

4.8 - Conclusions

In conclusion, walking slowness was more prevalent in women than in older men from the north of Brazil, while muscle weakness was more prevalent in men. The prevalence of muscle weakness seems to be higher in this elderly population than in other regions of Brazil or internationally. Despite a weak level of agreement, the walking slowness was more in agreement with muscle weakness in both sexes when the criterion was that of the EWGSOP2.

4.9 - References

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CAPÍTULO 5

Symptoms of Sarcopenia and Physical Fitness through the Senior Fitness Test[3]

[3]**Lima, A.B.d**.; Baptista, F.; Henrinques-Neto, D.; Pinto, A.d.A.; Gouveia, E.R. Symptoms of Sarcopenia and Physical Fitness through the Senior Fitness Test. *Int. J. Environ. Res. Public Health* **2023**, 20, 2711. https://doi.org/10.3390/ ijerph20032711

5.1 - Abstract

Introduction: Physical fitness concerns a set of attributes related to the ability to perform physical activity that may justify the symptoms reported by the elderly in the context of sarcopenia.

Purpose: This study aimed to investigate the relationship between the perception (symptomatology) of physical functioning (what the person thinks they are capable of) and the capacity itself for physical functioning in elderly people in northern Brazil.

Methods: Cross-sectional study that analyzed 312 elderly people (72.6 ± 7.8 years) from the city of Novo Aripuanã, Amazonas, Brazil. Sarcopenia symptomatology was assessed using the SARC-F, a 5-item questionnaire designed for screening sarcopenia in older individuals in five domains: strength, walking aids, difficulty getting up from a chair, difficulty climbing stairs, and falls. Physical fitness was assessed by the Senior Fitness Test (SFT) battery including balance evaluated with the short version of the Fullerton Advanced Balance scale (FAB).

Results: ROC curve analysis revealed that the tests with the greatest ability to discriminate participants with significant symptoms for sarcopenia (≥4 points on SARC-F) were arm curl and 6 min walk: the probability of suspected sarcopenia increased exponentially with an arm curl <11.5 reps for men (se = 71%; sp = 69%; AUC = 0.706, 95% CI: 0.612–0.788; *p* = 0.013) and women (se = 81%; sp = 51%; AUC = 0.671, 95% CI: 0.601–0.735; *p* ≤ 0.001) or with a 6-min walk <408.5 m for men (se = 71%; sp = 63%; AUC = 0.720, 95% CI: 0.628–0.690; *p* = 0.001) and <366.0 m for women (se = 69%; sp = 58%; AUC = 0.692, 95% CI: 0.623–0.755; *p* = 0.0001). **Conclusions**: Physical fitness assessed through the senior fitness test, particularly the 30-s-arm curl test and the 6-min walk test, can discriminate for suspected symptoms of sarcopenia.

Keywords: physical fitness; SARC-F; sarcopenia; senior fitness test

5.2 - Introduction

Sarcopenia has been defined as a generalized disease characterized by decreased muscle mass and muscle function (Cruz-Jentoft et al., 2010; Cruz-Jentoft et al., 2019). As in other diseases, the prevalence of sarcopenia increases with the aging of the population, constituting a public health problem of great priority in the elderly (Gülistan Bahat et al., 2018). Although sarcopenia is identified in young people with particular clinical conditions (Orsso et al., 2019) and healthy young people (Baptista et al., 2021), it is in the elderly that sarcopenia has mostly been investigated (Ackermans et al., 2022). The disease varies in severity and can limit the individual's daily living activities (ADLs) and increase the risk of frailty, hospitalization, functional dependence, and mortality (Dent et al., 2018). Most cases of sarcopenia are attributed to physical inactivity and inadequate protein/energy intake (Liu et al., 2020), although other causes may also contribute (Gulistan Bahat et al., 2018; Dent et al., 2018; Dent et al., 2021; Liu et al., 2020).

A wide variety of tools are available for screening, evaluating, and monitoring sarcopenia, but population differences in body composition, physical capacity, and perceptions of physical functioning as well as diverse research scenarios have hampered the systematic implementation of these tools (Ackermans et al., 2022). In this context, the vast majority of cases of sarcopenia are not diagnosed (Dent et al., 2018). A case-finding approach is recommended practice (Cruz-Jentoft et al., 2019) and the screening of sarcopenia with user-friendly, simple tools is necessary (Gulistan Bahat et al., 2018). This approach involves investigating sarcopenia when relevant symptoms are reported (Cruz-Jentoft & Sayer, 2019). The symptoms/signs that have been most associated with sarcopenia include a history of falls and difficulties in lifting and carrying a shopping bag-like load (4.5 kg), moving around a room, getting up from a chair/bed, or going up a flight of stairs (Cruz-Jentoft & Sayer, 2019). The SARC-F is the most widely used questionnaire for the rapid screening of sarcopenia (T. Malmstrom & J. Morley, 2013). For this purpose, the SARC-F consists of five questions referring to difficulties or events (falls) resulting from muscle weakness (T. K. Malmstrom & J. E. Morley, 2013). The sensitivity of SARC-F for screening positive cases has, however, been shown to be low in contrast to the specificity, which is high (Gülistan Bahat et al., 2018; Woo et al., 2014; Yang et al., 2018), meaning that SARC-F better signals people who do not have sarcopenia than people who have (Cruz-Jentoft et al., 2019; Ida et al., 2017). For this reason, several changes have been investigated including the addition of information to the original SARC-F (Gülistan Bahat et al., 2018; Rodrigues et al., 2022). However, attention is drawn to the fact that most of the answers to the SARC-F questions are due to musculoskeletal fitness and multisensory integration (balance) at the level of the lower limbs to ensure mobility for carrying out activities of daily living (ADLs) (Yee et al., 2021), while the identification of sarcopenia is assessed using a maximal handgrip strength test (upper limbs) (Cruz-Jentoft et al., 2019). As people get older, their level of physical fitness decreases (Rodrigues et al., 2022), compromising, in the first instance, their health and, in the second instance, intrinsic capacity (Todde et al., 2016).

The Senior Fitness Test (SFT) is a battery widely used to assess the physical fitness of older people in a community context (Todde et al., 2016). The SFT is composed of several tests that aim to inform about aerobic, musculoskeletal, and neuro-motor fitness (de Souza Moreira et al., 2020), and ultimately about health and intrinsic capacity (Chen et al., 2021; Sui et al., 2020; Vagetti et al., 2015). Bearing in mind that the symptoms of sarcopenia are expressed by difficulties in performing activities of daily living due to insufficient physical fitness and a previous history of falls, it was intended to analyze associations between the perception of symptoms as a whole and individually and physical fitness assessed by the Senior Fitness Test. Since this battery of simple and inexpensive tests is widely used in community exercise programs, the question arises as to its relevance for a more objective screening (suspect) of sarcopenia. The purpose of this investigation was to analyze the relationships between the perception of physical functioning (what the person thinks they are capable of) and the capacity itself for physical functioning in elderly people in northern Brazil.

5.3 - Methods

5.3.1 Sample and Study Design

The sample included 312 older adults from the community of Novo Aripuanã (Amazonas, Brazil). Of the 942 older adults who met the search criteria, 630 were excluded (215 not meeting the inclusion criteria and 415 declined to participate). Participants were recruited in basic health units, parks, squares, churches, and other public places in the city's urban area, in addition to invitations broadcast on local radio stations. Participants living in rural areas were excluded from the study due to difficulties in accessing the evaluation site (distance and means of transportation needed). After explanations about the procedures and risks of the study, all participants signed the informed consent form. All assessments were performed at UEA. The following criteria were considered for participant inclusion: (1) older aged 60 and over residing in the community; (2) be in-dependent in carrying out activities of daily living; (3) moderate or high level of cognitive functioning; (4) no contraindications for physical exertion (stroke, neurological diseases, unstable chronic conditions); and (5) without chest pain, and/or angina pectoris and limiting joint pain (Rikli & Jones, 2013). The cognitive level was evaluated with the Mini-Mental State Examination (MMSE) (Creavin et al., 2016). MMSE ≤15/30 points were used to exclude the participants of the study.

This cross-sectional study was approved by the Ethics Committee of the Declaration of Helsinki and Resolution 466/12 of the National Health Council, making part of the research project: "Sarcopenic Syndrome-Physical Function, Phenotype and Quality of Life in Elderly with and without Sedentary Lifestyle" (CAAE 74055517.9.0000.5016/Referee 2.281.400).

5.3.2 Instruments

5.3.2.1 Anthropometric Measurements

Body mass was measured using a calibrated mechanical anthropometric scale (110 CH, Welmy, São Paulo City, Brazil), with participants barefoot and wearing light clothes. Body height was measured using the anthropometric scale metal stadiometer, with participants in an upright position, arms hanging at their sides, heels together, and occipital and gluteal regions touching the upright ruler of the scale. Body mass index (BMI) was calculated by the ratio between body mass and height (meters) squared (body mass/height^2).

5.3.2.2 Symptomatology of Sarcopenia

The SARC-F is a 5-item questionnaire designed for screening sarcopenia in older individuals and addresses five domains: strength, walking aids, difficulty getting up from a chair, difficulty climbing stairs, and falls (T. K. Malmstrom & J. E. Morley, 2013). Each domain has a question, and the answer is scored from 0 to 2 points for each item (T. K. Malmstrom & J. E. Morley, 2013). The total score ranges from 0 to 10, with ≥4 points indicating a risk of sarcopenia (T. K. Malmstrom & J. E. Morley, 2013). The (Brazilian)

Portuguese-translated version (Barbosa-Silva et al., 2016) of the SARC-F questionnaire was applied.

5.3.2.3 Senior Fitness Test (SFT)

According to Rikli and Jones (Rikli & Jones, 1999), the Senior Fitness Test (SFT) was developed for adults over 60 years of age. It is primarily used to evaluate physical function in healthy elderly people but is also used for people with dementia (Hesseberg et al., 2015). The SFT includes six tests: the 30-s Chair Stand Test (CST), the 30-s arm curl test (ACT), the chair sit and reach test (CSAR), the back-scratch test (BST), the 8-foot up-and-go test (FUG), and the 6-min walk test (6MWT).

5.3.2.4 Body Balance

Balance was assessed using the short version of the Fullerton Advanced Balance scale (FAB) (Rose et al., 2006). The FAB is an assessment tool used to measure the multiple dimensions of balance in older adults. The short version is composed of four tests, each test is scored using a 4-point ordinal scale (0–4), resulting in a maximum score of 16 possible points, representing the optimal balance performance. The cutoff point is 9 out of 16 points, concluding that an elderly person with a score < 9 on the FAB short version scale will be considered at a higher risk of falling (Rose, 2010).

5.4 - Statistics

Statistical analyses were performed using SPSS (v26.0, Chicago, IL, USA). Descriptive statistics were calculated for all outcome measurements. Comparisons between sex were made by using the student's t-test. Comparisons of prevalence between different age groups for the same sex and between the two sexes for the same age group were assessed using the Chi-Square Test. When the assumptions of the parametric tests were not verified, the Mann–Whitney test was used. Given the existence of an interaction effect for sex ($p < 0.01$), logistic regression analysis was used to examine the associations, for each sex, between the physical fitness tests and the risk of sarcopenia assessed by the SARC-F. The odds ratio of the physical fitness tests for predicting the sarcopenia symptoms was also estimated, according to sex, using the logistic regression. Significance was set at $p < 0.05$.

5.5 - Results

Table 1 presents the sample characteristics for the total sample and by sex. Men were taller and heavier than women ($p \leq 0.001$) but there were no differences in the BMI. Regarding the physical fitness tests, males showed better scores on the ACT, FUG, and 6MWT tests compared to females ($p < 0.05$). Conversely, females showed higher scores on BST and FAB. Despite a tendency of women to present a higher prevalence of significant symptoms (≥4 pts), no differences were observed between men and women in terms of total symptomatology.

Table 1. Descriptive characteristics of the participants: mean ± standard deviation or median (interquartile range) *.

	Mean ± SD			
	All (*n* = 312)	Male (*n* = 112)	Female (*n* = 200)	*p*-Value
Age, years	72.63 ± 7.81	73.07 ± 7.31	72.39 ± 8.09	0.458
Body Height, cm	153.65 ± 8.22	159.99 ± 8.26	150.10 ± 5.67	<0.001
Body Mass, kg	63.70 ± 12.67	69.29 ± 11.61	60.52 ± 12.18	<0.001
BMI, kg/m^2	26.88 ± 4.65	27.08 ± 4.64	26.76 ± 4.65	0.566
SARC-F score, pts	1.75 ± 1.88	1.43 ± 1.68	1.92 ± 1.95	0.915
SARC-F ≥4 pts, *n* (%) #	56 (17.9)	14 (12.5)	42 (21.0)	0.061
Physical Fitness				
Chair Stand Test, *n*	10.86 ± 3.22	11.08 ± 3.34	10.74 ± 3.15	0.365
Arm Curl Test, *n*	12.56 ± 3.83	13.19 ± 4.07	12.22 ± 3.66	0.031
CSAR, cm *	4.00 (11)	6.00 (11)	3.00 (11)	0.284
BST, cm *	−19.00 (21)	−23.00 (18)	−17.00 (23)	<0.001
FUG, seg	8.08 ± 2.67	7.43 ± 2.06	8.44 ± 2.89	<0.001
6MWT, m	407.29 ± 108.43	450.76 ± 125.58	382.95 ± 88.99	<0.001
FAB score, pts	12.44 ± 3.66	13.29 ± 3.07	11.97 ± 3.88	0.002

Notes: SD, standard deviation, BMI, body mass index; SARC-F, sarcopenia screening questionnaire; CSAR, chair sit-and-reach test; BST, back scratch test; FUG, foot up-and-go test; 6MWT, 6-min walk test; FAB, Fullerton Advanced Balance Scale. Comparison between groups using the Chi-square # or Mann–Whitey test *.

Table 2 presents the prevalence of each symptom of sarcopenia separately. Symptom 1 relates to strength, symptom 2 to assistance in walking, symptom 3 to rise from a chair, symptom 4 to climbing stairs, and symptom 5 to the occurrence of falls. Difficulty climbing stairs and assistance in walking were the most and least prevalent symptoms, respectively, in both men and women. Table 2 shows a trend toward a higher prevalence of total symptomatology, but not individual symptoms, suggestive of sarcopenia in women compared to men.

Table 2. Prevalence of symptoms of sarcopenia evaluated through the SARC-F questionnaire.

	Male (n = 112)			Female (n = 200)			
Symptoms	**None**	**Some**	**A Lot, or Unable**	**None**	**Some**	**A Lot, or Unable**	***p*-Value**
1. Lack of strength, *n* (%)	79 (70.5)	20 (17.9)	13 (11.6)	133 (66.5)	48 (24.0)	19 (9.5)	0.808
2. Assistance in walking, *n* (%)	93 (83.0)	18 (16.1)	1 (0.9)	156 (78.0)	37 (18.5)	7 (3.5)	0.175
3. Difficulty rising from a chair, *n* (%)	84 (75.0)	26 (23.2)	2 (1.8)	142 (71.0)	55 (27.5)	3 (1.5)	0.521
4. Difficulty climbing stairs, *n* (%)	63 (56.3)	41 (36.6)	8 (7.1)	115 (57.5)	71 (35.5)	14 (7.0)	0.851
5. Falls, *n* (%)	73 (65.2)	39 (34.8)	0 (0.0)	150 (75.0)	50 (25.0)	0 (0.0)	0.124

Table 3 presents the results of the logistic regression to predict the likelihood of the occurrence of significant symptoms of sarcopenia (≥4 points) according to several attributes of physical fitness evaluated through the SFT. In women (back stretch, up-and-go, balance), in men (chair stand, sit and reach), or in both sexes (arm curl, 6 min walk), all tests showed the ability to discriminate participants with and without significant symptoms for sarcopenia.

Table 3. Associations through logistic regression between the occurrence of significant symptoms of sarcopenia (≥4 points) based on the participants' physical fitness.

	SARC-F (Score)							
	Male (n = 112)				Female (n = 200)			
Functional Fitness Tests	**B**	***p***	**OR**	**95%CI**	**B**	***p***	**OR**	**95%CI**
30-s chair stand test, *n*	−0.244	0.014	0.784	0.645–0.953	−0.105	0.081	0.900	0.800–1.013
30-s arm curl test, *n*	−0.246	0.012	0.782	0.646–0.947	−0.187	0.001	0.829	0.742–0.926
Chair sit-and-reach test, cm	−0.051	0.028	0.950	0.907–0.994	−0.007	0.624	0.993	0.964–1.022
Back scratch test, cm	−0.036	0.126	0.964	0.961–1.010	−0.031	0.026	0.969	0.943–0.996
Foot up-and-go test, seg	0.161	0.182	1.174	0.928–1.486	0.125	0.024	1.133	1.016–1.263
6-min walk test, m	−0.007	0.032	0.993	0.987–0.999	−0.008	0.001	0.992	0.988–0.997
Fullerton Advanced Balance, *n*	−0.084	0.305	0.919	0.783–1.079	−0.095	0.026	0.910	0.837–0.989

CST, 30 s chair stand test. ACT, 30-s arm curl test CSAR, chair sit-and-reach test. BST, back scratch test. FUG, foot up-and-go test. 6MWT, 6-min walk test. 4-MGS, m/s, 4-m gait speed; FAB, Fullerton Advanced Balance Scale. B, betas coefficients.

Logistic regression analysis and the ROC curve indicated that the likelihood of suspected sarcopenia (associated with SARC-F ≥ 4 points) increased exponentially with an arm curl test <11.5 reps for men (sensitivity = 71.43%; specificity = 69.39%; AUC = 0.706, 95% CI: 0.612–0.788; $p = 0.013$) and women (sensitivity = 80.95%; specificity = 50.63%; AUC = 0.671, 95% CI: 0.601–0.735; $p = 0.0001$) or with a 6-min walk test <408.5 m for men (sensitivity = 71.43%; specificity = 63.27%; AUC = 0.720, 95% CI: 0.628–0.690; $p = 0.001$ and <366 m for women (sensitivity = 69.05%; specificity = 58.23%; AUC = 0.692, 95% CI: 0.623–0.755; $p = 0.0001$), respectively (Figure 1). The odds ratio of having a SARC-F ≥4 pts decreased by 21.8% in men and 17.1% in women for each repetition (Table 3). Regarding the 6-min walk, the odds ratio of having a SARC-F ≥4 pts decreased by 0.7% in men and 0.8% in women per meter walked (or 7–8% per 10 m).

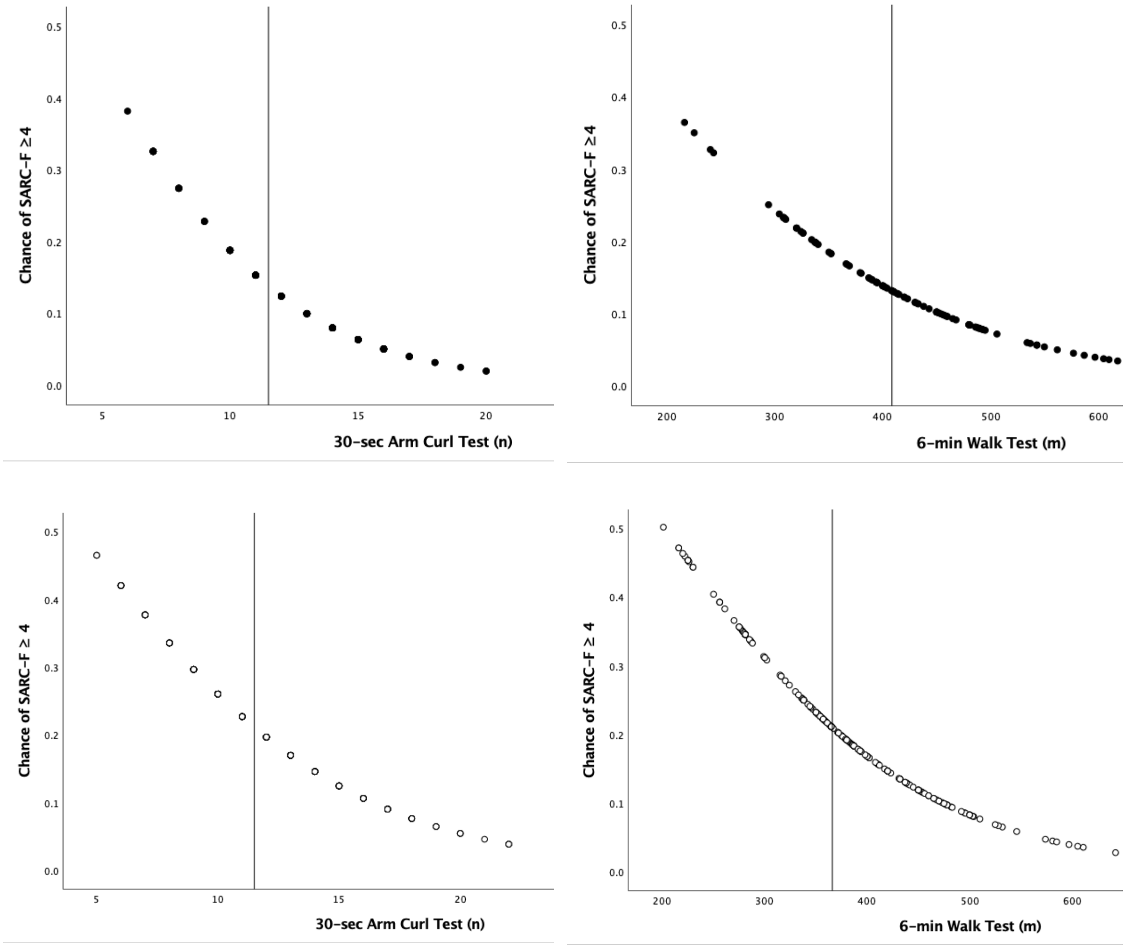

Figure 1. Probability of SARC-F ≥4 points according to the 30-s arm curl test and 6-min walk test (men, black dots (**top**); women white dots (**bottom**)).

Table 4 shows the same type of analysis as Table 3, but individually considering each of the symptoms included in the SARC-F questionnaire. In women, a predictive capacity of the shoulder flexibility for the ability to lift and carry a load of 4.5 kg, the strength of arms to get up from a chair, and the balance for the occurrence of falls were observed. In men, no predictive ability of physical fitness was observed for individual symptoms.

Table 4. Associations through logistic regression between the occurrence of each sarcopenia symptom based on the participants' physical fitness.

	Difficulty in Lifting and Carrying 4.5 kg							
	Male (*n* = 112)				Female (*n* = 200)			
Predictor	**β**	***p***	**OR**	**95%CI**	**β**	***p***	**OR**	**95%CI**
30-s chair stand test, *n*	−0.070	0.276	0.932	0.822–1.058	0.013	0.784	1.013	0.923–1.112
30-s arm curl test, *n*	−0.087	0.128	0.917	0.820–1.025	−0.030	0.476	0.971	0.895–1.053
Chair sit-and-reach test, cm	0.002	0.908	1.002	0.966–1.040	−0.015	0.257	0.985	0.960–1.011
Back scratch test, cm	0.001	0.925	1.001	0.975–1.028	0.022	0.046	1.022	1.000–1.044
8-foot up-and-go test, seg	0.039	0.689	1.040	0.857–1.262	−0.023	0.669	0.978	0.882–1.084
6-min walk test, m	−0.002	0.195	0.998	0.994–1.001	−0.001	0.441	0.999	0.995–1.002
Fullerton Advanced Balance Scale, *n*	−0.069	0.291	0.934	0.822–1.061	0.046	0.258	1.047	0.967–1.132
	Difficulty in Walking Across a Room							
	Male (*n* = 112)				**Female (*n* = 200)**			
Predictor	**β**	***p***	**OR**	**95%CI**	**β**	***p***	**OR**	**95%CI**
30-s chair stand test, *n*	0.008	0.911	1.008	0.870–1.169	-0.037	0.504	0.964	0.864–1.074
30-s arm curl test, *n*	−0.066	0.336	0.936	0.819–1.070	−0.025	0.593	0.975	0.889–1.070
Chair sit-and-reach test, cm	0.005	0.815	1.005	0.961–1.052	−0.025	0.098	0.975	0.947–1.005
Back scratch test, cm	−0.024	0.215	0.977	0.941–1.014	0.015	0.218	1.015	0.991–1.039
8-foot up-and-go test, seg	−0.015	0.904	0.985	0.772–1.257	0.012	0.837	1.012	0.903–1.134
6-min walk test, m	0.001	0.956	1.000	0.996–1.004	0.001	0.730	1.001	0.997–1.004
Fullerton Advanced Balance Scale, *n*	−0.036	0.645	0.965	0.828–1.124	0.033	0.467	1.034	0.945–1.131
	Difficulty in Transferring from a Chair or Bed							
	Male (*n* = 112)				**Female (*n* = 200)**			
Predictor	**β**	***p***	**OR**	**95%CI**	**β**	***p***	**OR**	**95%CI**
30 s chair stand test, *n*	−0.031	0.635	0.696	0.851–1.103	−0.098	0.065	0.907	0.817–1.006
30 s arm curl test, *n*	−0.012	0.819	0.988	0.887–1.099	−0.101	0.027	0.904	0.827–0.989
Chair sit-and-reach test, cm	0.007	0.728	1.007	0.968–1.047	−0.022	0.109	0.978	0.952–1.005
Back scratch test, cm	−0.016	0.299	0.984	0.955–1.014	0.018	0.103	1.018	0.996–1.041
8-foot up-and-go test, seg	−0.090	0.435	0.914	0.729–1.146	0.013	0.808	1.013	0.913–1.125
6-min walk test, m	−0.001	0.655	0.999	0.996–1.003	−0.001	0.672	0.999	0.996–1.003
Fullerton Advanced Balance Scale, *n*	0.086	0.297	1.090	0927–1.280	0.049	0.245	1.050	0.967–1.141
	Difficulty in Climbing a Flight of 10 Stairs							
	Male (*n* = 112)				**Female (*n* = 200)**			
Predictor	**β**	***p***	**OR**	**95%CI**	**β**	***p***	**OR**	**95%CI**
30-s chair stand test, *n*	−0.023	0.962	0.977	0.873–1.094	−0.036	0.428	0.964	0.881–1.055
30-s arm curl test, *n*	−0.050	0.301	0.951	0.864–1.046	−0.003	0.929	0.997	0.923–1.076
Chair sit-and-reach test, cm	−0.014	0.414	0.986	0.953–1.020	0.007	0.581	1.007	0.983–1.032
Back scratch test, cm	0.002	0.841	1.002	0.978–1.027	0.018	0.091	1.018	0.997–1.039
8-foot up-and-go test, seg	0.005	0.957	1.005	0.838–1.205	0.005	0.917	1.005	0.912–1.107
6-min walk test, m	−0.001	0.394	0.999	0.996–1.002	0.001	0.868	1.000	0.997–1.003
Fullerton Advanced Balance Scale, *n*	−0.084	0.188	0.919	0.811–1.042	0.029	0.439	1.029	0.957–1.108
	Falls in the Past Year							
	Male (*n* = 112)				**Female (*n* = 200)**			
Predictor	**β**	***p***	**OR**	**95%CI**	**β**	***p***	**OR**	**95%CI**
30-s chair stand test, *n*	0.049	0.411	1.051	0.934–1.182	0.061	0.230	1.063	0.962–1.175
30-s arm curl test, *n*	−0.043	0.399	0.958	0.867–1.059	0.001	0.991	1.000	0.917–1.092
Chair sit-and-reach test, cm	0.016	0.374	1.017	0.980–1.054	0.016	0.276	1.016	0.988–1.044
Back scratch test, cm	−0.012	0.371	0.988	0.962–1.015	−0.019	0.127	0.981	0.958–1.005
8-foot up-and-go test, seg	−0.076	0.453	0.927	0.759–1.131	0.032	0.564	1.032	0.927–1.149
6-min walk test, m	0.001	0.786	1.000	0.996–1.003	−0.002	0.245	0.998	0.994–1.002
Fullerton Advanced Balance Scale, *n*	0.033	0.626	1.033	0.906–1.179	0.014	0.043	0.107	0.933–1.103

5.6 - Discussion

This study with elderly people in northern Brazil aimed to analyze associations between symptoms of sarcopenia explained from physical fitness and reported through the SARC-F questionnaire, and physical fitness itself assessed through the SFT. Specifically, it was intended with this work to know (a) which components of physical fitness assessed through the SFT could screen the symptoms associated with sarcopenia and (b) which values of these components should be considered sufficient, that is, indicators of the absence of significant symptoms of sarcopenia when evaluated by SARC-F. The results revealed a trend toward a higher prevalence of total symptomatology, but not of individual symptoms, suggestive of sarcopenia in women compared to men. Individually, difficulty climbing stairs was the most reported symptom by both men (43.7%) and women (42.5%), while gait difficulty was the least reported symptom by both men (17%) and women (22%); that is, greater symptomatology in line with the physical demands of the activity. In men, falls were the second most reported symptom/event (34.8%), followed by strength to carry a load (29.5%) and to get up from a chair (25%). In women, strength to carry a load (33.5%) and to get up from a chair (29%) were the second and third most reported symptoms, followed by a history of falls (25%).

All physical fitness assessment tests were able to discriminate sarcopenia symptoms, although some tests were able to predict the presence of significant symptoms only in men and others in women. showed the ability to discriminate for the symptomatology of sarcopenia, although some tests were more predictive in men and others in women. The 30-s arm curl and the 6-min walk are noteworthy as they are tests with the greatest ability (acceptable discrimination) to suspect sarcopenia in both sexes.

The increase of 1 repetition in the 30-s arm curl test corresponded to a decrease in the odds ratio of suspicion of sarcopenia of 22% in men and 17% in women. With the increase in the distance covered in the 6-min walk test, a decrease in the odds ratio of sarcopenia suspicion was also observed in both sexes: the decrease was 7–8% for every 10 m of distance covered.

Interestingly, the cutoff values of these tests for suspected sarcopenia coincided with the cutoff values proposed by Rikli and Jones (Rikli & Jones, 2013a) to distinguish between maintenance and the risk of loss of functional independence in older adults (11 reps in arm curl and 366 m in 6 min walk). This means that the SFT, usually implemented in community programs to assess physical fitness and identify the risk of loss of functional independence, also seems to show capacity for screening (suspect) sarcopenia. Additionally, this study also showed that the reference values for screening for sarcopenia appear to be similar to the screening values for the risk of loss of functional independence, at least concerning the 30-s arm curl test and the 6-min walk test. If the most prevalent sarcopenia symptoms are related to difficulty climbing stairs and carrying loads, it is likely that the physical fitness components that most discriminated sarcopenia symptoms in our sample were the 6-min walk test (the SFT does not assess stair climbing) and the 30-s arm curl test. Physical fitness is the ability to perform daily tasks with vigor and safety (Rikli & Jones, 1999) and with sufficient energy reserves to meet emergencies and/or enjoy leisure or personal development activities (Liguori & Medicine, 2020). High levels of physical fitness are associated with better physical and cognitive functioning, a better quality of life, and lower health costs (Glenn et al., 2017; Liu et al., 2019; Milanović et al., 2013). Sarcopenia has only recently been classified as a medical condition (Yang et al., 2018b), and therefore its importance is still poorly recognized, and diagnosis is scarce in clinical practice. The SARC-F is a simple and easy-to-use screening tool for sarcopenia that would be of great use for identifying sarcopenia in clinical practice. As the pioneer of screening tools for sarcopenia, SARC-F has been widely used in the field of sarcopenia research. The SARC- F has been validated in different ethnic populations (Drey et al., 2020; Gade et al., 2020; Gasparik et al., 2020; Tsekoura et al., 2020; Zasadzka et al., 2020) since it was developed in 2013 (T. K. Malmstrom & J. E. Morley, 2013).

Previous studies have revealed SARC-F to be a valuable tool to predict clinically significant outcomes such as functional impairment, hospitalization (Ida et al., 2017; Malmstrom et al., 2016; Woo et al., 2014; Wu et al., 2016), poor quality of life, and mortality. Several works that tested SARC-F as a screening tool for sarcopenia consensually reported moderate to high specificity (sp: ~70–90%), that is, the ability to identify elderly people who were not suspected of having sarcopenia and who therefore should not proceed with the diagnostic evaluation (Ida et al., 2018; Lu et al., 2021; T. K. Malmstrom & J. E. Morley, 2013; Voelker et al., 2021). The main limitation of the present study is related to the selection of the reference instrument for the assessment of suspected sarcopenia the SARC-F since several screening approaches (Kera et al., 2020) have been proposed. However, the different sarcopenia screening approaches present validation limitations related to the determination of muscle mass by dual-energy x-ray absorptiometry (Yi et al., 2022). Another limitation is that the diagnosis of sarcopenia was not carried out, but only its suspicion through the symptomatology and the analysis of its relationship with physical fitness assessed by the SFT. As strengths of this work, we highlight the recruitment, characterization, and investigation with a peculiar and rarely studied sample, whose participants live in poor and difficult-to-access cities in Brazil where screening is even more important for health promotion and the facilitation of clinical practice.

5.7 - Conclusions

The 30-s arm curl test (<11.5 reps) and the 6-min walk test (<408.5 for men and <366.0 m for women) of the SFT showed the ability to discriminate between elderly people from Novo Aripuanã with and without suspicious symptoms of sarcopenia.

5.8 - References

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CAPÍTULO 6

Risk Phenotype for Sarcopenia in older adults from Amazonas, Brazil; A cross-sectional Study[4]

[4]**de Lima, A. B**., Torres-Costoso, A., Zymbal, V., Gouveia, É. R., & Baptista, F. Risk phenotype for sarcopenia in older adults from Amazonas, Brazil; a cross-sectional study. *PloS one* 2023, 18(10), e0292801. https://doi.org/ 10.1371/journal.pone.0292801

6.1 - Abstract

Introduction: There are several markers for the suspicion, identification, and confirmation of sarcopenia.

Objectives: To analyze the importance of several markers for assessing sarcopenia through the classification of phenotypes based on five domains: symptomatology, muscle function, muscle mass, physical performance, and physical function**.**

Methods: Cross-sectional study that analyzed 312 older adults (72.6±7.8 yrs) from the city of Novo Aripuanã, Amazonas, Brazil. Sarcopenia symptoms were determined with the SARC-Calf; muscle function was assessed using the 30-Chair Stand test (CST), 30-CST power, and handgrip strength (HGS) with and without normalization for body mass/height; the skeletal muscle mass index (SMMI) was estimated from anthropometry; performance was determined through the 4-m gait speed (GS) and 6-min walking test (6MWT); physical function was determined with the Composite Physical Function Scale (CPF). A two-step cluster analysis was performed by sex to rank profiles concerning sarcopenia risk. For the selection of variables, a bivariate correlation analysis was previously performed. The prevalence of sarcopenia risk in each domain was compared with T-tests to validate the clustering solution.

Results: Cluster analysis revealed two phenotypes (at risk vs. not at risk for sarcopenia) and the contribution of each marker (from 0 to 1); in men: 1 for SARC-Calf, 0.18 for SMMI, 0.09 for 30-CST power and 0.06 for HGS; in women: 1 for SARC-Calf, 0.25 for 30-CST power, 0.22 for SMMI, 0.06 for GS, 0.04 for HGS, and 0.03 for CPF. Considering the cutoff values proposed by Rikli and Jones (2013) for physical function and Cruz-Jentoft et al. (2019) for the other domains, the risk group for sarcopenia had a higher prevalence of high SARC-Calf in both sexes (men:51.8 vs. 3.6%, $p<0.001$;

women:71.2 vs. 1.1%, p<0.001), and low SMMI (men:73.2 vs. 44.6%, p<0.002; women:44.1 vs. 23.6%, p=0.002); in women, low GS (38.7 vs. 12.4%, p<0.001) and low CPF (29.7 vs. 15.7%, p=0.020) were observed, with no differences in HGS between groups in both sexes.

Conclusions: SARC-Calf, SMMI, and 30-CST were shown to be more relevant for sarcopenia risk in older adults and women and, additionally, GS and CPF in women.

Keywords: Sarcopenia, Muscle Function, Muscle Quantity, Physical Performance, Physical Function

6.2 - Introduction

Sarcopenia is a disease characterised by decreased muscle mass and muscle function (Tagliafico et al., 2022). Sarcopenia mainly affects older people, as ageing is a primary risk factor (Cruz-Jentoft et al., 2019). In turn, sarcopenia constitutes a risk for other clinical conditions, resilience to specific treatments, hospitalisations and their duration, functional dependence, and mortality, with high socioeconomic costs (Cruz-Jentoft & Sayer, 2019; Soares et al., 2023; Westbury et al., 2023). Despite the consequences, the approach to assessing muscle mass, muscle function and/or physical performance for the diagnosis of sarcopenia is still not well established (Petermann-Rocha et al., 2022).

The recommendation proposed by the different working groups for Sarcopenia - European (EWGSOP2 (Cruz-Jentoft et al., 2019)), Asian (AWGS2, (Chen et al., 2020)) and American (SDOC (Bhasin et al., 2020)) does not is consensual regarding the assessment or not of muscle mass, EWGSOP2 and AWGS2 vs SDOC, respectively (Westbury et al., 2023). The assessment of muscle function, namely the handgrip strength (HGS) and chair raise for muscle strength, and the gait speed, SPPB, and walking distance test for physical performance, is consensual among the three groups of studies, but with differences in the form how results are expressed, precisely without or with adjustment for body dimensions (EWGSOP2 and AWGS2 vs SDOC), or differing in cutoff values (EWGSOP2 vs AWGS2 vs SDOC) (Mastavičiūtė et al., 2021). For example, although the AWGS2 suggests a cutoff value of 28 kg for men and 18 kg for women for low grip strength (Chen et al., 2020), the EWGSOP2 proposes a cutoff value of 27 kg for men and 16 kg for women (Cruz-Jentoft et al., 2019).

In addition to objective assessments for the identification/diagnosis of sarcopenia in the older people, a previous screening based on symptomatology/events (SARC-F) has also been proposed (Malmstrom & Morley, 2013), which may or may not include a measurement of calf circumference (SARC-Calf) (Barbosa-Silva et al., 2016). Considering the different screening and evaluation possibilities for sarcopenia and having the functional capacity for activities of daily living as the primary outcome, it is urgent to characterise a risk phenotype in older people who inhabit the Amazonian tropical areas, a unique region in ethnic, sociocultural terms, economic, and macroenvironmental. This idea is supported by the multifactorial and complex nature of biological ageing (Duque, 2021). Consequently, this study aimed to identify a risk phenotype for sarcopenia in older people in Amazonas, Brazil and to analyse the relevance of risk of markers from the different domains of sarcopenia expression: symptomatology, muscle function, muscle mass, physical performance and physical function.

6.3 - Methods

6.3.1 Participants

The sample consisted of 312 older adults (200 women and 112 men) living in Novo Aripuanã (Amazonas, Brazil). Participants were invited and recruited from primary health units, public squares, churches, and other public places, and invitations were aired on local radio stations. All research participants signed the free and informed consent form after explaining the study procedures and risks. The evaluations were conducted on the premises of the superior study nucleus of Universidade do Estado do Amazonas (UEA) from Novo Aripuanã. The following criteria were considered for participant's inclusion: (1) older adults aged 60 and over residing in the community; (2) be independent in carrying out activities of daily living; (3) moderate or high level of cognitive functioning; (4) no contraindications for physical exertion (stroke, neurological diseases, unstable chronic conditions; (5) without joint pain, chest pain, and angina pectoris (Rikli & Jones, 2013a). The cognitive level was evaluated with the Mini-Mental State Examination (MMSE) (Folstein et al., 2020). An MMSE ≤ 15/30 points was used to exclude the participants from the study. This study was approved by the Ethics Committee of the State UEA according to the Declaration of Helsinki and Resolution 466/12 of the National Health Council, making part of the research project: "Sarcopenic Syndrome - Physical Function, Phenotype and Quality of Life in Elderly with and without Sedentary Lifestyle" (CAAE 74055517.9.0000.5016 / Referee 2.281.400).

6.3.2 Body Size and Composition

Anthropometric measurements were performed following the recommendations of the International Society for the Advancement of Kinanthropometry-ISAK (Marfell-Jones et al., 2018) to assess body size and body composition. Body mass and height were measured using a calibrated mechanical scale (110 CH, Welmy, São Paulo, Brazil). Participants were barefoot, wearing light clothing, in an erect position, arms relaxed along the body, heels together, and occipital and gluteal regions touching the vertical ruler of the scale. The body mass index (BMI) was calculated by the ratio between body mass and body height (kg/m2). Fat mass was estimated from the equations proposed by Williams and colleagues (Williams et al., 1992) using triceps, subscapular, abdominal, and calf skinfolds.

Total muscle mass was estimated using equations with corrected arm, thigh and calf circumferences (Lee et al., 2000). The skeletal muscle mass index (SMMI, kg/m2) was used to identify reduced muscle mass, using as reference the cutoff values proposed by Walowski and colleagues (Walowski et al., 2020).

6.3.3 Muscle Function and Physical Performance

The assessment of muscle function in the upper limbs was conducted with a handgrip test and a chair stand test, respectively. HGS (kg) was assessed twice in each hand, alternately using a dynamometer (EH10, Camry, California City, USA) with the participants seated and the arm to be assessed flexed at 90 degrees at the elbow (de Oliveira et al., 2019; Roberts et al., 2011). The mean value of all measurements was used as the final score for each individual. Values of HGS <27kg and <16kg in men and women, respectively, indicated decreased muscle strength (Cruz-Jentoft et al., 2019).

The chair stand test (CST) was performed for 30 seconds (30-CST) to assess lower limb muscle strength (Rikli & Jones, 2013b) and muscle power (Alcazar et al., 2021). The participants performed as many repetitions as possible in this period. The test was performed in a standardised armless chair measuring 43 cm in height from a sitting position with the arm crossed over the chest. Verbal encouragement was given in assessing muscle function, and participants were allowed to try two times before the definitive measurement was recorded (Alcazar et al., 2021). Physical performance, namely, gait speed and mobility, were measured using the 4 m walking speed test at the usual gait speed (4-MGS) (Guralnik et al., 1994) and the six-minute walk (6MWT) (Rikli & Jones, 2013a).

6.3.4 Physical Function

For physical function, habitual physical activity and the ability to carry out activities of daily living were evaluated. Physical activity was assessed using the validated International Physical Activity Questionnaire (IPAQ) (Matsudo et al., 2001). Participants provided information about the type (walking, moderate and vigorous activity) and duration of activity performed in the last week (if usual week) for estimation of metabolic equivalents (METs.min/week). The ability to perform basic, instrumental, and advanced activities of daily living was assessed using the Composite Physical Function (CPF) scale questionnaire, composed of 12 activities (Rikli & Jones, 2013b). Poor functionality was identified for scores less than 14 points.

6.3.5 Symptoms of Sarcopenia

To assess the symptoms of sarcopenia, the SARC-CAlf was used. The SARC-Calf combines the questions included in the SARC-F (Malmstrom & Morley, 2013) with calf circumference (Barbosa-Silva et al., 2016). The SARC-CalF score ranges from 0 to 20 points, and individuals with a score >11 are considered to have significant symptomatology.

6.4 - Statistical analysis

All analyses were conducted using the SPSS software, version 26.0 (IBM Inc., Chicago, IL, USA). Values were presented descriptively, as the mean ± standard deviation (SD) for continuous variables and frequency (%) for categorical values. Unpaired t-tests and chi-square tests were used for continuous and categorical variables to compare the older adults' characteristics according to sex. For continuous variables, analysis of variance (ANOVA) was used; when statistical differences were found, the Bonferroni posthoc test was applied. For categorical variables, the chi-square test was used. Pearson's correlation coefficient was calculated using Bivariate Correlations. A two-step cluster analysis was performed by sex to rank a sarcopenia profile based on continuous variables of body composition (SMMI), physical fitness (HGS, 30-CST power and 4-MGS) and physical functioning (SARC-CalF score and CPF) of the participants. This approach for cluster analysis uses a distance measure to separate groups and then a probabilistic approach to choose the optimal subgroup model (Kent et al., 2014). The Log-Likelihood was used as the similarity measure, and Schwarz's Bayesian Information criterion was used to identify the automatic selection of the optimal number of clusters (Tkaczynski, 2017). The silhouette coefficient, which compares the average within-cluster cohesion with the average between-cluster separation, was examined to assess the goodness of fit of the cluster solution. Values between 0.20 and 0.50 indicate a fair fit, and values of 0.50 or more indicate a good fit (Marko & Erik, 2019). ANOVAs or t-tests were performed on continuous segmentation variables to validate and interpret the cluster solution. In addition, the identified clusters were compared on a set of diverse variables not included in the clustering algorithm to validate them as distinct subgroups.

6.5 - Results

The characterisation of the sample is described in Table 1. Men were heavier and taller than women ($p < 0.001$) but with no differences in BMI. Men had greater muscle mass, skeletal muscle mass index, and calf circumference ($p < 0.001$). Conversely, women had a higher value in the fat mass index ($p < 0.001$). Regarding physical performance and muscle function, males had better scores than females on mobility (6MWT) and walking speed, on HGS and 30-CST power (regardless of normalisation), (p <0.001). In physical functioning, CPF was higher in men than women (p <0.001). Women showed a higher prevalence than men of low gait speed and significant symptomatology of sarcopenia (p <0.05).

Table 1. Descriptive characteristics of participants as mean ± standard deviation.

	Male (n=112)	**Female (n=200)**	**p-value**
Age, years	73.07±7.31	72.39±8.09	0.458
Body Composition			
Body Height, cm	159.99±8.26	150.10±5.67	<0.001
Body Mass, kg	69.29±11.61	60.52±12.18	<0.001
BMI, kg/m²	27.08±4.64	26.76±4.65	0.566
Muscle mass, kg	23.65±3.55	17.73±3.61	<0.001
SMMI, kg/m²	9.23±1.16	7.84±1.39	<0.001
Fat Mass Index, kg/m²	10.76±3.48	13.49±4.35	<0.001
Calf Circunference, cm	90.79±8.83	86.16±10.41	<0.001
Physical Performance			
6MWT, m	450.76±125.59	382.96±89.00	<0.001
Gait Speed, m/s	1.20±0.35	1.03±0.35	<0.001
Low Gait Speed, n (%)	16 (23.5)	52 (76.5)	0.016
Muscle Function			
Handgrip strength, kg	31.41±8.86	19.33±5.87	<0.001
Low Handgrip Strength, n (%)	77 (35.2)	142 (64.8)	0.677
Handgrip/body mass, kg/kg	0.45±0.11	0.33±0.10	<0.001
Handgrip/body height, kg/m²	19.61±5.27	12.86±3.83	<0.001
30-Chair Stand Test, n	11.08±3.34	10.74±3.16	0.365
30-CST Power (W)	43.50±18.73	31.43±13.47	<0.001
30-CST Power (W/kg)	0.62±0.19	0.51±0.17	<0.001
30-CST Power (W/m²)	16.71±6.03	13.75±5.27	<0.001
Physical Functioning			
Physical Activity, MET.min/wk	2662.63±3896.88	2023.50±3131.22	0.115
CPF, pts	21.33±3.76	18.41±4.99	<0.001
Sarcopenia Symptoms			
SARC-CalF score, pts	6.42±5.12	7.57±5.71	0.080
SARC-CalF ≥ 11 pts, n (%)	31 (27.9)	80 (72.1)	0.029

BMI, body mass index. SMMI, skeletal muscle mass index; 6MWT, 6-minute walk test. CPF, composite physical function scale. SARC-Calf, sarcopenia screening.

Table 2 presents the bivariate correlation coefficients between body composition, physical performance, muscle function, physical function, and symptomatology of sarcopenia in men (Table 2A) and women (Table 2B). The bivariate correlations were conducted to select the most relevant variables in each domain for the cluster analysis carried out later. In both men and women, significant associations were observed between

SMMI and HGS, HGS/m2, 30-CST Power and SARC-Calf ($p<0.05$). Men also showed a positive association between SMMI and habitual physical activity, and women with gait speed, 30-CST Power/m2 and CPF ($p<0.05$).

Table 2A. Bivariate correlations coefficients between body composition, physical performance, muscle function, physical function, and symptomatology of sarcopenia – Men.

	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. BMI	0.573**	0.778**	0.081	-0.098	0.224*	0.324**	0.129	0.282**	-0.008	0.383**	-0.107	-0.275**
2. SMMI	-	0.353**	-0.073	0.074	0.294**	0.364**	0.133	0.204*	0.056	0.281**	-0.010	-0.385**
3. Fat Mass Index		-	0.006	-0.011	0.138	0.136	0.128	0.456**	-0.081	0.491**	-0.066	-0.361**
4. 6MWT			-	0.181	0.248**	0.204*	0.143	0.196*	-0.041	0.164	0.348**	-0.099
5. Gait Speed				-	0.357**	0.317**	0.322**	0.367**	-0.111	0.350**	0.287**	-0.123
6. HGS					-	0.973**	0.274**	0.471**	0.120	0.440**	0.188*	-0.302**
7. HGS/m^2						-	0.266**	0.359**	0.119	0.371**	0.137	-0.234*
8. 30-CST							-	0.669**	-0.042	0.747**	0.219*	-0.186*
9. 30-CST Power								-	0.031	0.972**	0.272**	-0.459**
10. 30-CST Power/m^2									0.047	0.047	0.247**	-0.438**
11. PA									-	-	0.055	0.093
12. CPF											-	-0.112
13. SARC-CalF												-

BMI, body mass index; HGS, handgrip strength; 30-CST, 30-Chair Stand Test; SMMI, skeletal muscle mass index; 6MWT, 6-minute walk test. CPF, composite physical function scale. SARC-Calf, sarcopenia screening; PA, physical activity.
** $p < 0.01$; *$p < 0.05$

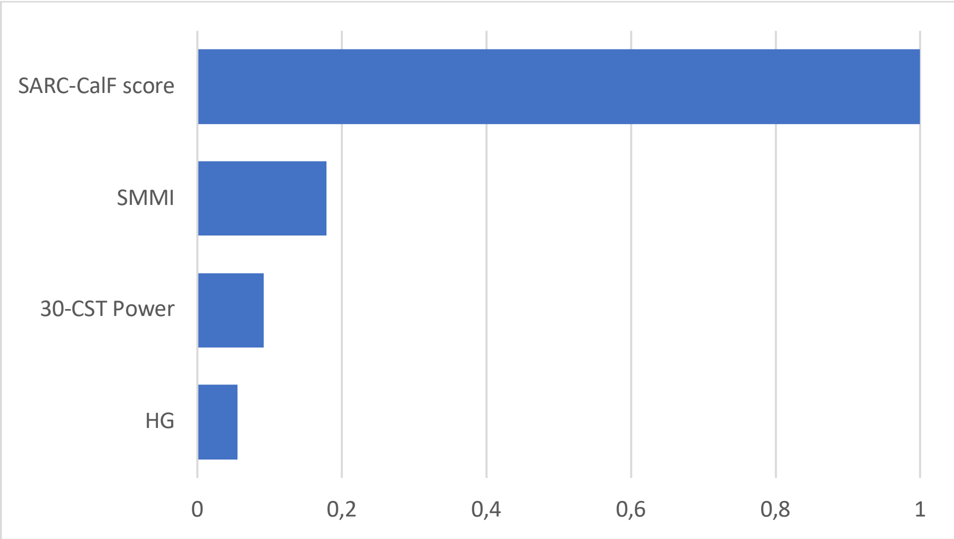
Table 2B. Bivariate correlations coefficients between body composition, physical performance, muscle function, physical function, and symptomatology of sarcopenia – Women.

	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. BMI	0.564**	0.912**	0.078	0.150*	0.200**	0.183**	0.127	0.536**	0.574**	0.031	0.091	-0.603**
2. SMMI	-	0.493**	0.048	0.179*	0.311**	0.302**	0.065	0.328**	0.338**	-0.014	0.206**	-0.477**
3. Fat Mass Index		-	0.122	0.218**	0.195**	0.159*	0.201**	0.609**	0.625**	0.023	0.103	-0626**
4. 6MWT			-	0.367**	0.262**	0.247**	0.164*	0.203**	0.196**	-0.056	0.290**	-0.257**
5. Gait Speed				-	0.249**	0.218**	0.315**	0.370**	0.361**	-0.038	0.371**	-0.360**
6. HGS					-	0.991**	0.159*	0.276**	0.256**	0.012	0.238**	-0.210**
7. HGS/m^2						-	0.133	0.201**	0.199**	0.021	0.219**	-0.168
8. 30-CST							-	0.789**	0.837**	0.011	0.174*	-0.261**
9. 30-CST Power								-	0.984**	-0.007	0.223**	-0.554**
10. 30-CST Power/m^2									-	0.007	0.218**	-0.549**
11. PA										-	-0.049	-0.001
12. CPF											-	-0.325**
13. SARC-CalF											-	-

BMI, body mass index; HGS, handgrip strength; 30-CST, 30-Chair Stand Test; SMMI, skeletal muscle mass index; 6MWT, 6-minute walk test. CPF, composite physical function scale. SARC-Calf, sarcopenia screening; PA, physical activity.
** $p < 0.01$; *$p < 0.05$

Figure 1 summarizes the Two-Step cluster analysis of sarcopenia markers in several domains: symptomatology (SARC-CalF), body composition (SMMI), muscle function (HG, 30-CST power), physical performance (gait speed) and physical function (CPF). Symptomology (SARC-Calf), muscle mass (SMMI), and muscle function (30-CSt Power and HGS) were the most relevant markers for the configuration of risk clusters for sarcopenia (risk vs no risk) in both men and women and physical performance (gait speed) and physical function (CPF) in women.

A)



B)

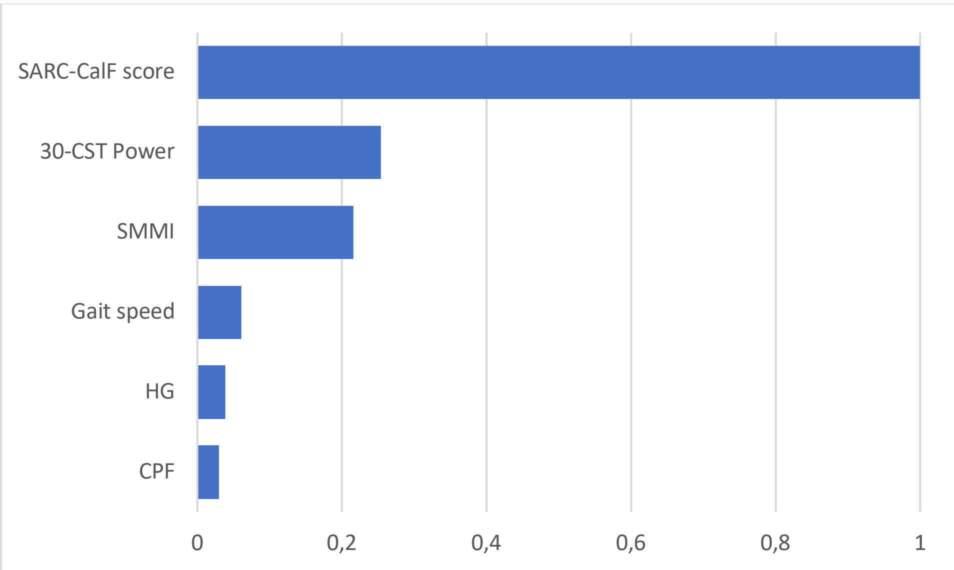


Figure 1 Index of the relative importance of each marker for the formation of clusters (risk vs. no risk for sarcopenia): body composition (SMMI), muscle strength (HG, 30-CST power) physical performance (gait speed), symptomatology (SARC-CalF) and physical functioning (CPF), by sex (A: Men; B: Women).

*SMMI, skeletal muscle mass index; HG, handgrip strength; 30-CST Power, 30-chair stand muscle power test; SARC-Calf, sarcopenia screening; CPF, composite physical function scale

Table 3 compares body composition, physical fitness, physical functioning and symptomatology of sarcopenia between two clusters to "validate" its identification in men (panel A) and women (panel B): cluster 1 representing a phenotype without risk for sarcopenia and cluster 2 representing a risk phenotype for sarcopenia. Differences were observed between the groups in the previously evidenced variables for the formation of clusters, with more unfavourable results for cluster 2 in both sexes. The prevalence of low SMMI and high SARC-Calf was higher in the risk cluster in both genders (men: 73.2 vs 44.6%, p=0.002; women: 44.1 vs 23.6%, p= 0.002) and in women, it was even observed a higher prevalence of low gait speed in the risk cluster compared to the non-risk cluster (38.7 vs 12.4%).

Table 3A. Comparison of body composition, physical fitness and physical functioning between phenotypes according to risk for sarcopenia - Men

Men	**Cluster 1 W/O Sarcopenia Risk (n= 56)**	**Cluster 2 Sarcopenia Risk (n= 56)**	**p-value**
Age, years	71.41±6.55	74.73±7.71	0.016
Body Composition			
Body Mass, kg	75.59±10.87	63.00±8.56	<0.001
Body Height, cm	161.80±9.38	158.19±6.58	0.020
BMI, kg/m^2	29.01±5.03	25.16±3.28	<0.001
Muscle mass, kg	25.67±3.18	21.62±2.64	<0.001
SMMI, kg/m^2	9.82±1.09	8.63±0.92	<0.001
Low SMMI (%)	25 (44.6)	41 (73.2)	0.002
Fat Mass Index, kg/m^2	12.25±3.48	9.26±2.79	<0.001
Calf circunference, cm	36.05±2.16	31.67±1.93	<0.001
Physical Performance			
6MWT, m	456.52±128.54	455.00±123.45	0.630
Gait Speed, m/s	1.22±0.33	1.17±0.38	0.568
Low Gait Speed, n (%)	6 (10.7)	11 (19.6)	0.188
Muscle Function			
Handgrip strength, kg	33.84±9.69	28.98±7.24	0.003
Low Handgrip Strength, n (%)	43 (76.8)	34 (68.7)	0.067
Handgrip/body mass, kg/kg	0.45±0.11	0.47±0.12	0.404
Handgrip/body height, kg/m^2	20.90±5.65	18.32±4.56	<0.009
30-Chair Stand Test, n	11.36±3.52	10.80±3.17	0.384
30-CST Power (W)	50.31±21.93	36.67±11.48	<0.001
30-CST Power (W/kg)	0.65±0.21	0.58±0.16	0.050
30-CST Power (W/m^2)	18.85±6.87	14.56±4.10	<0.001
Physical Functioning			
Physical Activity, MET.min/wk	2479.42±3371.44	2890.11±4390.03	0.582
CPF, pts	21.00±4.20	21.66±3.26	0.355
Sarcopenia Symptoms			
SARC-CalF score (pts)	1.92±2.62	10.92±2.21	<0.001
SARC-CalF ≥ 11, n (%)	2 (3.6)	29 (51.8)	<0.001

BMI, body mass index. SMMI, skeletal muscle mass index; 6MWT, 6-minute walk test. CPF, composite physical function scale. SARC-Calf, sarcopenia screening questionnaire.

Table 3B. Comparison of body composition, physical fitness and physical functioning between phenotypes according to risk for sarcopenia - Women

Women	**Cluster 1 W/O Sarcopenia Risk (n= 89)**	**Cluster 2 With Sarcopenia Risk (n= 111)**	**p-value**
Age, years	70.21±6.73	74.13±8.67	0.001
Body Composition			
Body Mass, kg	70.04±10.07	52.97±7.51	<0.001
Body Height, cm	152.63±5.46	148.07±5.02	<0.001
BMI, kg/m^2	30.06±3.99	24.12±3.27	<0.001
Muscle mass, kg	20.26±3.71	15.70±1.81	<0.001
SMMI, kg/m^2	8.69±1.54	7.16±0.76	<0.001
Low SMMI (%)	21 (23.6)	49 (44.1)	0.002
Fat Mass Index, kg/m^2	16.71±3.67	10.92±2.90	<0.001
Calf Circunference, cm	35.22±2.52	29.81±2.06	<0.001
Physical Fitness			
30-Chair Stand Test, n	11.66±3.18	9.99±2.95	<0.001
6MWT, m	399.27±90.65	369.87±85.83	0.020
Gait Speed, m/s	1.14±0.28	0.93±0.37	<0.001
Low Gait Speed, n (%)	11 (12.4)	43 (38.7)	<0.001
Handgrip strength, kg	20.81±6.26	18.14±5.27	0.001
Low Handgrip Strength, n (%)	69 (77.5)	73 (65.8)	0.068
Handgrip/body mass, kg/kg	0.30±0.11	0.34±0.09	0.004
Handgrip/body height, kg/m^2	13.62±4.04	12.26±3.55	0.011
30-CST Power (W)	40.23±13.46	24.36±8.38	<0.001
30-CST Power (W/kg)	0.57±0.17	0.46±0.14	<0.001
30-CST Power (W/m^2)	17.12±5.08	11.04±3.60	<0.001
Physical Functioning			
Physical Activity, MET.min/wk	1924.48±3053.81	2102.90±3203.81	0.690
CPF, pts	19.49±4.74	17.54±5.04	0.006
Sarcopenia Symptoms			
SARC-CalF score, pts	1.89±2.42	12.12±2.70	<0.001
SARC-CalF ≥ 11 pts, n (%)	1 (1.1)	79 (71.2)	<0.001

BMI, body mass index. SMMI, skeletal muscle mass index; 6MWT, 6-minute walk test. CPF, composite physical function scale. SARC-Calf, sarcopenia screening questionnaire.

6.6 - Discussion

Considering the various evaluation possibilities, from screening and identification to confirmation and severity of sarcopenia, this investigation aimed to identify a risk phenotype in a sample of older people in Amazonas, Brazil. The results suggest symptomatology (SARC-Calf), muscle mass (SMMI) and muscle function (30-CST Power, HGS) as the most relevant markers for a sarcopenia risk phenotype in men and women and, additionally, physical performance (speed gait) and physical function (ability to perform activities of daily living) for the risk of sarcopenia in women.

The grouping of these variables to classify people based on the observation of similarities and dissimilarities concerning sarcopenia thus proved to be different for men and women. Gait slowness was more prevalent in women than men, while muscle weakness was more prevalent in men in our sample (Lima et al., 2022). These observations may be due to a lower gait speed in women and a more significant age-related decline in muscle mass/strength in men (de Jong et al., 2023). The present study reinforces the relevance of gait speed and the ability to perform activities of daily living in conjunction with symptomatology, muscle mass and muscle strength to identify women at risk for sarcopenia.

Compared to men, older women generally have lower gait speed (Butler et al., 2009; Sialino et al., 2019; Wheaton & Crimmins, 2016). The difference between sexes is clinically relevant since it equals the minimal clinically significant individual differences estimated for gait speed, ranging between 0.03 and 0.05 m/s (Sialino et al., 2019). In this sense, for the same cutoff value, the prevalence of slow gait may likely be higher in women than in men. However, in women than men, gait speed seems more affected by physical inactivity (Izawa et al., 2017) and overweight/obesity (Sialino et al., 2021).

Although several behavioral, hormonal and structural factors have been suggested to explain differences in walking speed between older women and men, it is necessary to go further on this topic (McClelland & Weyand, 2022; Sialino et al., 2021). Women also show lower levels of physical functioning than men (Angulo et al., 2020) and a faster or possibly earlier decline due to menopause (Dugan et al., 2018).

Getting up from a sitting position is a prerequisite for walking and performing activities of daily living, which require more muscle power than muscle strength (Cruz-Jentoft et al., 2019). The 30s-CST is a simple test widely used in clinical and laboratory settings (Jones et al., 1999; Roongbenjawan & Siriphorn, 2020) and can be used to estimate lower limb power (Alcazar et al., 2020; Kirk et al., 2023; Kirk et al., 2020).

The role of muscle strength vs muscle power in sarcopenia has recently been discussed. Lower limb muscle power decreases earlier and faster when compared to muscle strength and seems more strongly associated with disability, hospitalisation and mortality (Kirk et al., 2023; Losa-Reyna et al., 2022). Lower limb muscle power also appears to respond better to resistance exercise interventions in older adults at risk of sarcopenia than handgrip strength (Kirk et al., 2020). Our findings corroborate the literature showing the importance of evaluating the muscle power of the lower limbs in older people (Alcazar et al., 2018). However, this evaluation can take on different formats, including vertical jump power in older people who can perform this test safely (Cawthon et al., 2019).

According to the objective of the work (identification of risk phenotypes), the main limitations concern the methodology for evaluating some variables, namely muscle mass and muscle power of the lower limbs, both estimated and not adequately evaluated. The total SMMI was determined from anthropometric measurements (Lee et al., 2000) and the identification of low SMMI using cutoff values that were established using another method (bioimpedance) and population (Caucasian) (Walowski et al., 2020). The selection of this approach to identify low SMMI was because the magnetic resonance of the whole body validated the equations for estimating SMMI through anthropometric measurements or by bioimpedance. The muscle power of the lower limbs was also estimated from an equation developed for the 30-CST validated by assessments conducted in instrumented leg press and different force platforms (Alcazar et al., 2018; Baltasar-Fernandez et al., 2021), but in samples that may have characteristics different from ours. Another limitation is the cross-sectional design of the investigation, which does not allow for inducing causality. Despite the limitations, this investigation established a risk profile identifying the importance of several sarcopenia markers. More studies are needed to clarify the best approach to anticipate sarcopenia in this population.

In conclusion, the present study showed that SARC-Calf (symptomology), SMMI (muscle mass), and lower limb power (muscle function) might be the primary risk markers for sarcopenia in both men and women in Amazonas, Brazil, with muscle power in the lower limbs supplanting the relevance of muscle mass to the risk of sarcopenia in women but not in men.

6.7 - Reference

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CAPÍTULO 7

Discussão Geral

7.1 - Introdução

Este capítulo pretende sintetizar os principais resultados de cada trabalho desenvolvido para esta dissertação, não se tratando de uma reprodução da discussão dos resultados específicos já feita em seus respetivos capítulos, mas sim de sua interpretação de forma global. São também discutidas questões metodológicas gerais relativas aos estudos apresentados, bem como as suas limitações. Ao final, são fornecidas recomendações para pesquisas futuras.

O objetivo geral desta tese foi identificar o fenótipo da síndrome sarcopênica em pessoas idosas do Amazonas (Brasil). Para alcançarmos este objetivo geral, foram realizados quatros trabalhos. O trabalho 1 analisou o desempenho dos instrumentos SARC-F e SARC-Calf para o rastreamento de sarcopenia em pessoas idosas. O trabalho 2 analisou a prevalência de sarcopenia em pessoas idosas, assumindo como critério para a identificação da sarcopenia a fraqueza muscular ou a lentidão na marcha. O trabalho 3 investigou a relevância da aptidão física para a sintomatologia da sarcopenia e o trabalho 4 visou identificar um fenótipo de risco para sarcopenia e a importância relativa de diversos marcadores: sintomatologia, função muscular, massa muscular, desempenho físico e função física. Todos os trabalhos foram realizados com uma amostra composta por 312 pessoas idosas, 200 do sexo feminino (72,4±8,1 anos) e 112 do sexo masculino (73,1±7,3 anos).

7.2 - Principais resultados da investigação

Em 2018, o *Revised European Working Group on Sarcopenia in Older People* (EWGSOP2) propôs uma definição para sarcopenia de modo a operacionalizar o seu diagnóstico na prática clínica (Cruz-Jentoft et al., 2019). Neste sentido, foi proposto o uso do questionário SARC-F para investigação de sintomas sugestivos de sarcopenia e a aplicação de testes físicos para o diagnóstico de sarcopenia provável (aferição da força de preensão palmar com dinamômetro e teste de sentar e levantar) (Cruz-Jentoft et al., 2019). O SARC-F, assim como as versões afins que dele derivaram, é um instrumento de fácil aplicação para rastreamento precoce da sarcopenia (Malmstrom & Morley, 2013). No entanto, alguns estudos mostraram que sua validade pode ser limitada, tornando-se necessário testar o poder discriminatório da sarcopenia em diferentes populações (Kera et al., 2022).

O primeiro estudo desta investigação teve como objetivo descrever a prevalência da sintomatologia da sarcopenia numa população do interior do estado do Amazonas, na região Norte do Brazil - pessoas idosas residentes na comunidade e investigar o desempenho dos instrumentos mais utilizados para o rastreamento de sarcopenia. Para o efeito analisou-se, o desempenho do SARC-F e SARC-CalF (SARC-F mais circunferência da panturrilha). A maior suspeita de sarcopenia foi observada quando o rastreamento foi feito com o SARC-Calf: a sarcopenia foi detectada em 27,7% dos homens e 40,0% das mulheres, e com o SARC-F em 12,5% dos homens e 21,0% das mulheres, com as mulheres a revelarem uma maior prevalência na sintomatologia.

Tendo como referência a força de preensão manual e a velocidade da marcha, a prevalência de sarcopenia variou entre 15,2% e 75,0% para homens e 27% e 66% para mulheres, sendo a menor prevalência associada à velocidade da marcha e a maior prevalência à preensão manual em ambos os sexos. Das análises realizadas sobre a concordância entre as medidas para a suspeita (sintomas) e a identificação (função muscular) de sarcopenia, os melhores resultados foram observados entre o SARC-Calf e a velocidade de marcha em ambos os sexos. A capacidade preditiva do SARC-Calf foi razoável com valores de sensibilidade e especificidade acima de 50%, considerando um valor de corte de 10,5 pontos tanto para homens como mulheres, ou seja, um valor semelhante ao que é sugerido para a suspeição de sarcopenia noutras populações (SARC-CAlf ≥ 11 pontos).

Estabelecida a prevalência da sintomatologia e a melhor abordagem para sua suspeição na população em estudo pretendeu-se depois identificar a prevalência de sarcopenia baseada nos critérios mais consensuais entre os grupos de trabalho Europeu (EWGSOP) e Americano (SDOC) - a fraqueza muscular e a lentidão na marcha, e investigar igualmente a concordância da prevalência entre esses critérios. Seguindo as diretrizes do consenso europeu EWGSOP2 (Cruz-Jentoft et al., 2019) a prevalência de fraqueza muscular neste estudo foi de aproximadamente 30% considerando a amostra total em homens e mulheres. A prevalência de fraqueza muscular parece ser maior na população idosa do nosso estudo do que em outras regiões do Brasil ou internacionalmente (de Almeida Campos et al., 2020; de Souza Barbosa et al., 2016; Esteves et al., 2020; Fernandes et al., 2021; Oliveira et al., 2020). Por outro lado, a lentidão na marcha foi mais prevalente em mulheres do que em homens idosos, enquanto a fraqueza muscular foi mais prevalente em homens. Nos parâmetros avaliados, a lentidão da marcha (<0,8 m/s) foi mais concordante com a fraqueza muscular em ambos os sexos quando o critério foi o do EWGSOP2 (< 27 kg em homens e < 16 kg em mulheres), ou seja o critério em que a força de preensão absoluta está mais diminuída (Cruz-Jentoft et al., 2019).

Identificados e comparados os dois métodos de referência para identificação da sarcopenia, no terceiro estudo analisou-se as associações entre os sintomas de sarcopenia relatados por meio do questionário SARC-F, ou seja, da percepção da pessoa sobre a sua capacidade para a realização de atividade da vida diária que exijam força muscular, e a sua aptidão física propriamente dita. Os resultados obtidos neste estudo mostraram que a dificuldade em subir escadas foi o sintoma mais relatado por homens (43,7%) e mulheres (42,5%) e a dificuldade de marcha o sintoma menos relatado em ambos os sexos, 17% e 22 %, respetivamente; ou seja, sintomatologia da sarcopenia de acordo com as exigências físicas da tarefa.

Todos os testes da bateria da SFT apresentaram capacidade de discriminar a sintomatologia da sarcopenia, embora alguns testes tenham sido mais preditivos em homens e outros em mulheres. O teste de flexão de braço de 30 segundos (< 11,5 repetições) e o teste de caminhada de 6 minutos (< 408,5 para homens e < 366,0 m para mulheres), foram os testes com maior capacidade de discriminar pessoas idosas com e sem sintomas suspeitos de sarcopenia na população de nosso estudo. Curiosamente, os valores de corte desses testes para suspeita de sarcopenia coincidem com os valores de corte propostos por Rikli & Jones (Rikli & Jones, 2013) para distinguir entre manutenção e risco de perda de independência funcional em pessoas idosas.

Considerando diferentes marcadores da sarcopenia, desde a presença de sintomatologia específica, à fraqueza muscular, lentidão de marcha, aptidão física diminuída, mas também baixa massa muscular, o quarto estudo pretendeu identificar um fenótipo de risco para sarcopenia e analisar a relevância dos marcadores para a definição do fenótipo. Os resultados sugerem a sintomatologia (SARC-Calf), a massa muscular e a potência muscular dos membros inferiores, como os marcadores mais relevantes para um fenótipo de risco de sarcopenia em homens e mulheres, com a potência muscular nos membros inferiores a suplantar a relevância da massa muscular para o risco de sarcopenia em mulheres, mas não em homens.

7.3 - Limitações

Esta dissertação foi composta por 4 estudos. Os estudos científicos não estão isentos de limitações, e para uma melhor compreensão dos resultados, é fundamental que sejam identificadas as principais limitações de cada um. Os estudos foram concebidos a partir de um desenho de investigação transversal. Assim, a análise dos dados não permite inferir causalidade entre as variáveis. Outra limitação está relacionada como a composição da amostra, uma vez que a amostra não é representativa da população do estado do Amazonas. Em terceiro lugar, a heterogeneidade entre os participantes pode introduzir um viés na identificação da sarcopenia devido a diferentes fenótipos físicos (dimensões corporais), favorecendo o aumento da prevalência de fraqueza muscular e lentidão na marcha em nossa amostra. Em quarto lugar, a seleção do instrumento para rastreio de sarcopenia - o SARC-F e SARC-Calf - uma vez que várias abordagens de triagem foram propostas. No entanto, as diferentes abordagens de triagem de sarcopenia apresentam limitações de validação relacionadas à determinação da massa muscular por DXA. Por fim, a estimação da massa muscular a partir de abordagem antropométrica, a menos recomendada, mas a possível quando os recursos são escassos. De salientar, todavia, que as equações utilizadas foram validadas pelos respectivos autores com ressonância magnética (Lee et al., 2000).

7.4 - Forças da investigação

Apesar das limitações, esta dissertação também apresenta pontos fortes. Destacamos o recrutamento, caracterização e investigação com uma amostra peculiar e pouco estudada, cujos participantes vivem em cidades pobres e de difícil acesso no Brasil onde o rastreamento é ainda mais importante para a promoção da saúde e a facilitação da prática clínica. A metodologia utilizada em nosso estudo permitiu identificarmos o desempenho dos dois principais instrumentos de rastreamento de sarcopenia na população idosa residentes no Amazonas, incluindo pontos de corte para a (não) suspeita de sarcopenia (SARC-Calf = 10,5 pts). Este é o primeiro estudo com pessoas idosas que analisou a concordância entre fraqueza muscular e lentidão na marcha para a identificação de sarcopenia. Esta investigação também foi a primeira a estabelecer a conexão entre diversos marcadores de triagem, identificação e confirmação da sarcopenia, ou seja um perfil de risco separadamente para homens e mulheres, pois parece existir algum dimorfismo sexual na manifestação da sarcopenia e consequentemente na sua avaliação.

7.5 - Conclusão, implicações práticas

As principais conclusões estão sobretudo expressas no último estudo onde se investigaram conjuntamente as variáveis analisadas separadamente nos estudos anteriores. Os resultados não são, todavia, generalizáveis e outros estudos necessitam de ser conduzidos em amostras representativas e noutros grupos populacionais. Esta tese evidenciou:

- A importância para ambos os sexos do rastreio da sarcopenia através do SARC-Calf, ou seja, o valor de se adicionar a circunferência da panturrilha a questões sobre a sintomatologia (i.e., capacidade física para as atividades da vida diária e quedas). Coincidentemente, recentemente a Sociedade Brasileira de Geriatria e Gerontologia (SBGG) buscando facilitar e enfatizar o diagnóstico simples e assertivo, a SBGG criou o Manual intitulado “Recomendações para Diagnóstico e Tratamento da Sarcopenia no Brasil” que recomenda o SARC-CalF como instrumento de rastreio de sarcopenia para população idosa brasileira.

- A associação entre a sintomatologia da sarcopenia, a massa muscular e a potência muscular dos membros inferiores em ambos os sexos.
- Uma relevância maior da potência muscular nos membros inferiores e da velocidade de marcha como marcadores da sarcopenia nas mulheres comparativamente aos homens, sendo as mulheres mais afetadas pela sarcopenia do que os homens.
- Uma relevância maior da potência muscular dos membros inferiores comparativamente á força de preensão palmar em ambos os sexos no âmbito da identificação de um fenótipo de sarcopenia.

7.6 - Referências

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Anexos

A.1 – Parecer do comitê de ética

UNIVERSIDADE DO ESTADO DO AMAZONAS - UEA

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Síndrome Sarcopênica - Função Física, Fenótipo e Qualidade de vida em idosos com e sem Estilo de Vida Sedentário

Pesquisador: Alex Barreto de Lima

Área Temática:

Versão: 1

CAAE: 74055517.9.0000.5016

Instituição Proponente: Universidade do Estado do Amazonas-UEA

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 2.281.400

Apresentação do Projeto:

De acordo com o pesquisador:

"Desenho:

Os instrumentos de coleta de dados (avaliação antropométrica, testes de avaliação funcional aplicado ao idoso e questionários) serão aplicados tomando-se por base as políticas públicas dirigidas ao segmento populacional de idosos (Estatuto do Idoso e Política Nacional de Saúde do Idoso) e na Política Nacional. As variáveis de interesse a serem analisadas serão agrupadas em cinco categorias de análise: (1) Examinar relações entre a sarcopenia e a qualidade de vida; (2) Analisar os efeitos do sedentarismo na sarcopenia e na qualidade de vida; (3) Comparar o nível de predição de diversas variáveis do desempenho muscular (força de preensão, levantar e sentar da cadeira, TUG test, SPPB, na massa muscular e na qualidade de vida; (4) Avaliar as propriedades de medida de um questionário de qualidade de vida especifico para a sarcopenia (SarQol) em idosos de Novo Aripuanã, Amazonas; (5) Investigar relações e sobreposições entre a sarcopenia, a fragilidade e a dismobilidade. Essas variáveis coletadas serão tabuladas e analisadas pelo programa Excel 2010 e SPSS versão 20".

Endereço: Av. Carvalho Leal, 1777
Bairro: chapada **CEP:** 69.050-030
UF: AM **Município:** MANAUS
Telefone: (92)3878-4368 **Fax:** (92)3878-4368 **E-mail:** cep.uea@gmail.com

Considerações Finais a critério do CEP:

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_963187.pdf	17/08/2017 13:11:12		Aceito
Projeto Detalhado / Brochura Investigador	PROJETODOUTORADOFMHCEPBRASIL.pdf	17/08/2017 13:09:13	Alex Barreto de Lima	Aceito
Outros	Cartadeanuencia.pdf	31/07/2017 20:56:14	Alex Barreto de Lima	Aceito
Outros	Quest_IPAQ.docx	28/07/2017 00:47:27	Alex Barreto de Lima	Aceito
Outros	SarQol_Idosos.docx	28/07/2017 00:46:55	Alex Barreto de Lima	Aceito
Folha de Rosto	FolhadeRostoassinada.pdf	28/07/2017 00:46:23	Alex Barreto de Lima	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_NA_IDOSOS.pdf	26/07/2017 23:32:24	Alex Barreto de Lima	Aceito
Outros	curriculo_Myrian_faber.pdf	17/07/2017 17:11:33	Alex Barreto de Lima	Aceito
Outros	Curriculo_alex.pdf	17/07/2017 17:10:52	Alex Barreto de Lima	Aceito
Outros	BaptistaCV_January_2017.pdf	15/07/2017 20:29:03	Alex Barreto de Lima	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

MANAUS, 18 de Setembro de 2017

Assinado por:
Manoel Luiz Neto
(Coordenador)

Endereço: Av. Carvalho Leal, 1777
Bairro: chapada **CEP:** 69.050-030
UF: AM **Município:** MANAUS
Telefone: (92)3878-4368 **Fax:** (92)3878-4368 **E-mail:** cep.uea@gmail.com

A.2 – Termo de Consentimento Livre e esclarecido - TCLE

UEA UNIVERSIDADE DO ESTADO DO AMAZONAS

UNIVERSIDADE DO ESTADO DO AMAZONAS
TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Convidamos você a participar como voluntário (a) da nossa pesquisa intitulada: **Síndrome Sarcopênica - Função Física, Fenótipo e Qualidade de vida em idosos com e sem estilo sedentário.** O mesmo tem como responsável o pesquisador **Alex Barreto de Lima**, residente: Rua Ramos Ferreira, 1092, apto 203, Manaus – AM, com o telefone 92-98241-4552 e e-mail: profalexbarreto@hotmail.com
OBJETIVOS GERAL: Analisar as associações entre a composição corporal, o desempenho muscular e a sarcopenia em pessoas idosas de Novo Aripuanã, Amazonas. **ESPECÍFICOS**: Examinar relações entre a sarcopenia e a qualidade de vida; Analisar os efeitos do sedentarismo na sarcopenia e na qualidade de vida; Comparar o nível de predição de diversas variáveis do desempenho muscular (força de preensão, levantar e sentar da cadeira, potência de salto, TUG test, SPPB, na massa muscular e na qualidade de vida; Avaliar as propriedades de medida de um questionário de qualidade de vida especifico para a sarcopenia (SarQol) em idosos de Novo Aripuanã, Amazonas; Investigar relações e sobreposições entre a sarcopenia, a fragilidade e a dismobilidade. **PROCEDIMENTO METODOLÓGICO:** Essa pesquisa terá um estudo exploratório, de caráter descritivo com abordagem qualitativa e quantitativa que utilizará avaliação antropométrica seguindo as diretrizes da *International Society for the Advancement of Kineanthropometry – ISAK*, serão aplicados bateria de testes físicos e questionários. Serão mensuradas a massa corporal, estatura, perímetros musculares e dobras cutâneas. O percentual de gordura corporal será estimado através das equações propostas por Williams et al. (1992) e a massa muscular esquelética pela equação de Lee et.al (2000). Para avaliar desempenho físico dos idosos serão aplicadas a bateria de testes da *Short Physical Performance Battery – SPPB* (GURALNIK et al., 1994), que avalia o equilíbrio estático em pé, a velocidade marcha e a força de membros inferiores e o *TUG Test* (Bohannon, 2006) que avalia a velocidade, agilidade e equilíbrio dinâmico, será avaliada também a força de preensão manual (FPM) por meio de um dinamômetro. Serão aplicados os questionários: *The SarQol* questionnaire (Beaudart et al., 2015) que avalia a qualidade de vida na sarcopenia, o *IPAQ* (*International Physical Activity Questionaire)* versão curta, para avaliar o nível de atividade física dos idosos (Matsudo et al., 2001), o questionário da função física em idosos (RIKLI e JONES, 2013) e o questionário para avaliar a ocorrência de quedas e fraturas. As variáveis serão coletadas, tabuladas e analisadas pelo programa *Microsoft Excel 2010*. **BENEFICIOS**: Os benefícios indiretos deste trabalho para os participantes da pesquisa serão a realização gratuita de exames, a avaliação do risco cardíaco, a avaliação funcional ocorrerão durante essa pesquisa, assim como os benefícios esperados são direcionados à sociedade, à comunidade acadêmica, as equipes multiprofissionais atuantes na área da saúde em Novo Aripuanã com a realização do estudo. O resultado desta investigação permitirá identificar, intervir e modificar comportamentos diretamente ligados a saúde e na manutenção das atividades de vida diária, podendo desenvolver e/ou implementar programas que incentivem hábitos de vida mais saudáveis na população alvo. **POSSÍVEIS RISCOS**: Toda pesquisa com seres humanos envolve riscos, durante a aplicação dos questionários poderá haver modificação das emoções, causada por relacionamento estabelecido entre os sujeitos da pesquisa e os pesquisadores. São riscos com probabilidade de ocorrência transitórios e classificados como tipo I – mínimos e de categoria psicológicos. **ESCLARECIMENTOS ANTES E DURANTE A PESQUISA**: Todos os sujeitos envolvidos na pesquisa terão acesso, a qualquer tempo, às informações sobre os procedimentos, os riscos e os benefícios relacionados à pesquisa. Quaisquer perguntas sobre a metodologia utilizada no projeto ou informações adicionais que se fizerem necessárias serão encorajadas. **LIBERDADE DE RECUSAR OU RETIRAR O CONSENTIMENTO**: A permissão para participar do projeto é voluntária. Portanto, os responsáveis legais estarão livres para negar esse consentimento a qualquer momento, sem que isto traga qualquer tipo de constrangimento ou penalização. **DESPESAS DECORRENTES DA PARTICIPAÇÃO NO PROJETO DE PESQUISA**: Os voluntários estarão dispensados de qualquer despesa ou ressarcimento decorrente do projeto de pesquisa. Todos os participantes da pesquisa estão assegurados ao direito a indenizações e cobertura material para reparação a danos causados pela pesquisa ao participante da pesquisa. **EXPOSIÇÃO DOS RESULTADOS E PRESERVAÇÃO DA PRIVACIDADE**: Os resultados obtidos no estudo deverão ser publicados, independentemente dos resultados encontrados; contudo, sem que haja identificação dos indivíduos que prestaram sua contribuição como sujeito da amostra, respeitando, assim, a privacidade dos participantes conforme rege as normas éticas.
ENDEREÇO DOS PESQUISADORES RESPONSÁVEIS PELO PROJETO

UNIVERSIDADE DO ESTADO DO AMAZONAS
Profº. Mestre Alex Barreto de Lima - endereço: Rua Ramos Ferreira, 1092, apto 203, Manaus - AM - Fone: (092) 982414552
ENDEREÇO DO COMITÊ DE ÉTICA E PESQUISA DA UNIVERSIDADE DO ESTADO DO AMAZONAS - UEA:
Endereço: Av. Carvalho Leal, n 1777, cachoeirinha, CEP 69065-001 **Telefone:** (92) 3878-4368
E-mail: cep.uea@gmail.com **UF:** AM **Município:** MANAUS

CONSENTIMENTO PÓS-ESCLARECIDO

Eu, ____, responsável legal do menor ____, declaro que, após ter sido convenientemente esclarecido pelo pesquisador Alex Lima e ter entendido o que me foi explicado, não havendo mais dúvidas, **AUTORIZO** a participação do menor no projeto de pesquisa.

Impressão Digital

____
Assinatura do participante

____
Assinatura do pesquisador

Eu**,** Alex Barreto de Lima, declaro que forneci todas as informações referentes ao projeto. Em caso de quaisquer dúvidas, favor entrar em contato conosco na: Rua Ramos Ferreira, 1092, apto 203, Manaus - AM - Fone: (092) 982414552

Novo Aripuanã, _______de______________de 2017.

A3 – Questionário socioeconomico

Modelo de Questionário sugerido para aplicação

P.XX Agora vou fazer algumas perguntas sobre itens do domicílio para efeito de classificação econômica. Todos os itens de eletroeletrônicos que vou citar devem estar funcionando, incluindo os que estão guardados. Caso não estejam funcionando, considere apenas se tiver intenção de consertar ou repor nos próximos seis meses.

INSTRUÇÃO: Todos os itens devem ser perguntados pelo entrevistador e respondidos pelo entrevistado.
Vamos começar? No domicílio tem_______ (LEIA CADA ITEM)

ITENS DE CONFORTO	NÃO POSSUI	QUANTIDADE QUE POSSUI 1	2	3	4+
Quantidade de automóveis de passeio exclusivamente para uso particular					
Quantidade de máquinas de lavar roupa, excluindo tanquinho					
Quantidade de banheiros					
DVD, incluindo qualquer dispositivo que leia DVD e desconsiderando DVD de automóvel					
Quantidade de geladeiras					
Quantidade de *freezers* independentes ou parte da geladeira duplex					
Quantidade de microcomputadores, considerando computadores de mesa, laptops, notebooks e netbooks e desconsiderando tablets, palms ou smartphones					
Quantidade de lavadora de louças					
Quantidade de fornos de micro-ondas					
Quantidade de motocicletas, desconsiderando as usadas exclusivamente para uso profissional					
Quantidade de máquinas secadoras de roupas, considerando lava e seca					

Trabalhador Doméstico	NÃO TEM	1	2	3	4+
Quantidade de trabalhadores mensalistas, considerando apenas os que trabalham pelo menos cinco dias por semana					

A água utilizada neste domicílio é proveniente de?	
1	Rede geral de distribuição
2	Poço ou nascente
3	Outro meio

Considerando o trecho da rua do seu domicílio, você diria que a rua é:	
1	Asfaltada/Pavimentada
2	Terra/Cascalho

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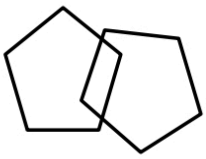
A4 – Mini Mental Test Examination

Mini mental state examination (MMSE)

1. **Orientação Temporal** (Dê 1 (um) ponto por cada resposta correta)
   Que dia é hoje? ________
   Em que mês estamos? ________
   Em que ano estamos? ________
   Em que dia da semana estamos? ________
   Qual a hora aproximada? (considere a variação de mais ou menos uma hora) _______
   Score Orientação Temporal (_____)
2. **Orientação espacial** (Dê 1 (um) ponto por cada resposta correta)
   Em que local nós estamos? (consultório, dormitório, sala - apontando para o chão): ________
   Que local é este aqui? (apontando ao redor num sentido mais amplo: hospital, casa de repouso, própria casa) _____
   Em que bairro nós estamos ou qual o nome de uma rua próxima. _________
   Em que cidade nós estamos? ________
   Em que Estado nós estamos? ________
   Score Orientação Espacial (_____)
3. **Memoria imediata:** Eu vou dizer três palavras e você irá repeti-las a seguir: carro, vaso, tijolo (dê 1 ponto para cada palavra repetida acertadamente na 1ª vez, embora possa repeti-las até três vezes para o aprendizado, se houver erros). Use palavras não relacionadas. **Carro** ________ / **Vaso** ________ / **Tijolo** ________
   Score Memoria imediata (_____)
4. **Cálculo**: Subtração de setes seriadamente (100-7, 93-7, 86-7, 79-7, 72-7, 65). Considere 1 ponto para cada resultado correto. Se houver erro, corrija-o e prossiga. Considere correto se o examinado espontaneamente se autocorrigir.
   Score Cálculo (_____)
5. **Evocação das palavras**: pergunte quais as palavras que o sujeito acabara de repetir - 1 ponto para cada.
   "Veja se consegue dizer as três palavras que lhe pedi há pouco para decorar".
   Carro ________ / **Vaso** ________ / **Tijolo** ________
   Score Memoria de Evocação (_____)
6. **Nomeação**: peça para o avaliado nomear os objetos mostrados (Relógio, caneta) - 1 ponto para cada.
   Score nomeação (_____)
7. **Repetição**: *Preste atenção: vou lhe dizer uma frase e quero que você repita depois de mim*: "Nem aqui, nem ali, nem lá". Considere somente se a repetição for perfeita (1 ponto)
   Score repetição (_____)
8. **Comando**: *Pegue este papel com a mão direita* (1 ponto), *dobre-o ao meio* (1 ponto) *e coloque-o no chão* (1 ponto). Total de 3 pontos. Se o sujeito pedir ajuda no meio da tarefa não dê dicas.
   Score comando (_____)
9. **Leitura**: mostre a frase escrita "FECHE OS OLHOS" e peça para o indivíduo fazer o que está· sendo mandado. Não auxilie se pedir ajuda ou se só ler a frase sem realizar o comando.
   Score leitura (_____)
10. **Frase**: Peça ao indivíduo para escrever uma frase. Se não compreender o significado, ajude com: alguma frase que tenha começo, meio e fim; alguma coisa que aconteceu hoje; alguma coisa que queira dizer. Para a correção não são considerados erros gramaticais ou ortográficos (1 ponto). __________________________
    Score Frase (_____)
11. **Copia do desenho:** mostre o modelo e peça para fazer o melhor possível. Considere apenas se houver 2 pentágonos interseccionados (10 ângulos) formando uma figura de quatro lados ou com dois ângulos (1 ponto pela cópia correta)
    Score Desenho (_____)



Score total (_____)

A5 – Escala de Aptidão Funcional / Questionário SARC-F / SARC-CalF

7

Escala de Aptidão Funcional

Indique a sua capacidade para realizar as seguintes tarefas. Na sua resposta deve indicar se normalmente consegue realizar as atividades mesmo que não as consiga realizar neste momento:

Escala de Aptidão Funcional	Consegue	Consegue com dificuldade ou ajuda	Não consegue
1. Cuidar de si próprio (ex.: vestir-se sozinho)	2	1	0
2. Tomar banho (imersão ou duche)	2	1	0
3. Subir e descer um lance de escadas (até ao 1º andar)	2	1	0
4. Ir à rua e caminhar 100 a 200 m (1-2 quarteirões)	2	1	0
5. Realizar tarefas domésticas leves (cozinhar, limpar o pó, lavar a loiça, varrer)	2	1	0
6. Fazer compras	2	1	0
7. Caminhar cerca de 800 metros (6-7 quarteirões)	2	1	0
8. Caminhar cerca de 1600 metros (12-14 quarteirões)	2	1	0
9. Segurar e transportar cerca de 5kg (ex.: saco cheio de mercearias)	2	1	0
10. Segurar e transportar cerca de 12 kg (ex.: mala de viagem média a grande)	2	1	0
11. Realizar atividades domésticas exigentes (ex.: esfregar o chão, aspirar, varrer o jardim)	2	1	0
12. Realizar atividades muito exigentes (ex.: fazer longas caminhadas, cavar, transportar objetos pesados, andar de bicicleta, fazer ginástica, etc.)	2	1	0

SARCOPENIA- SARC-F / SARC-CALF

	Componente	Pergunta	Pontuação	
1	Força	O quanto de dificuldade você te para levantar e carregar 5kg?	Nenhuma = 0	
			Alguma = 1	
			Muita, ou não consegue = 2	
2	Ajuda para caminhar	O quanto de dificuldade você tem para atravessar um cômodo?	Nenhuma = 0	
			Alguma = 1	
			Muita, ou não consegue = 2	
3	Levantar da cadeira	O quanto de dificuldade você tem para levantar de uma cama ou cadeira?	Nenhuma = 0	
			Alguma = 1	
			Muita, ou não consegue = 2	
4	Subir escadas	Você tem dificuldade para subir um lance de escadas de 10 degraus?	Nenhuma = 0	
			Alguma = 1	
			Muita, ou não consegue = 2	
5	Quedas	Quantas vezes você caiu no último ano?	Nenhuma = 0	
			1-3 quedas = 1	
			4 ou mais quedas =2	
		SARC-F	**Total**	
6	Panturrilha	Meça a panturrilha direita do avaliado	Homens	> 34cm = 0
				≤ 34cm = 10
			Mulher	> 33cm = 0
				≤ 33cm = 10
		SARC-Calf	**Total**	

A6 – Avaliação Antropometrica

Formulário de coleta.pd

FORMULÁRIO PARA COLETA DE DADOS

Dados de identificação				
Nome do sujeito				
Data de nascimento	/ /		/ /	
Data da avaliação	/ /		/ /	
Sexo (masc = 1 ; fem = 2)				
	Medida 1	**Medida 2**	**Medida 1**	**Medida 2**
Medidas Básicas				
Massa Corporal (kg)	,	,	,	,
Estatura (cm)	,	,	,	,
Altura Sentada (cm)	,	,	,	,
Dobras Cutâneas (mm)				
Tríceps	,	,	,	,
Subescapular	,	,	,	,
Bíceps	,	,	,	,
Ilíaca	,	,	,	,
Supraespinhal	,	,	,	,
Abdominal	,	,	,	,
Coxa anterior	,	,	,	,
Panturrilha medial	,	,	,	,
Perímetros (cm)				
Braço relaxado	,	,	,	,
Braço flexionado e tenso	,	,	,	,
Antebraço (porção máxima)	,	,	,	,
Tórax (mesoesternal)	,	,	,	,
Cintura (mínimo)	,	,	,	,
Abdômen (máximo)	,	,	,	,
Quadril (glúteo)	,	,	,	,
Coxa média (medial)	,	,	,	,
Panturrilha (porção máxima)	,	,	,	,

A7 – Aptidão Física

Equilíbrio: Fullerton Advanced Balance Scale (FAB) (Rose et al., 2006)

1. Transpor um banco com 15cm de altura

(0) – Incapaz de colocar o apoio no banco sem perda de equilíbrio ou sem ajuda manual; (1) – Capaz de subir o banco com o membro inferior dominante, mas o outro membro contacta com o banco ou balança a perna, passando ao lado do banco, em ambas as direções; (2) – Capaz de subir o banco com o membro inferior dominante, mas o outro membro contacta com o banco ou balança a perna, passando ao lado do banco, apenas numa direção; (3) – Capaz de colocar corretamente o apoio no banco e transpor o outro apoio em ambas as direções, mas requer supervisão próxima numa ou em ambas as direções; (4) – Capaz de completar corretamente o apoio no banco e transpor o outro apoio, em ambas as direções, em segurança e sem ajuda.

2. Dar 10 passos em linha reta

(0) – Incapaz de completar os 10 passos em linha reta sem ajuda; (1) – Capaz de completar os 10 passos com mais de 5 interrupções; (2) – Capaz de completar os 10 passos, com 3 a 5 interrupções; (3) – Capaz de completar os 10 passos, com 2 ou 1 interrupções; (4) – Capaz de completar os 10 passos, sem ajuda e sem interrupções.

3. Equilíbrio Sobre um apoio

(0) – Incapaz de tentar ou necessita de ajuda para prevenir a queda; (1) – Capaz de elevar o membro inferior sem ajuda, mas incapaz de manter a posição mais de 5 segundos; (2) – Capaz de elevar o membro inferior sem ajuda, e de manter a posição mais de 5 mas menos de 12 segundos; (3) – Capaz de elevar o membro inferior sem ajuda, e de manter a posição mais de 12 mas menos de 20 segundos; (4) – Capaz de elevar o membro inferior sem ajuda, e de manter a posição durante 20 segundos.

4. Permanecer de olhos fechados e a pés juntos numa superfície de espuma

(0) – Incapaz de subir para a superfície de espuma ou de manter a posição, sem ajuda, e de manter os olhos abertos; (1) – Capaz de subir para a superfície de espuma ou de manter a posição, sem ajuda, mas incapaz ou pouco disposto a fechar os olhos; (2) – Capaz de subir para a superfície de espuma ou de manter a posição, sem ajuda, com os olhos fechados durante 10 segundos ou menos; (3) – Capaz de subir para a superfície de espuma ou de manter a posição, sem ajuda, com os olhos fechados mais de 10 segundos e menos de 20 segundos; (4) – Capaz de r de subir para a superfície de espuma ou de manter a posição, sem ajuda, com os olhos fechados durante 20 segundos.

FAB Score Total:

Senior Fitness Test (Rikli & Jones, 2001)

Levantar e sentar na cadeira 30seg	CST	n
Flexão do braço 30seg	ACT	n
Sentar e alcançar o pé	CSAR	cm
Alcançar atrás das costas	BST	cm
Levantar, caminhar, voltar (2,44)	FUG	seg
Andar 6 minutos	6 MWT	m

Dinamometria Manual	1 avaliação	2 avaliação	3 avaliação

Short Physical Performance Battery

Levantar e sentar 5x: _______(seg.)

Levantar, caminhar e voltar 3m	1x	2x	3x
Caminhar 4 metros	1x	2x	3x

Teste Romberg (10 seg em cada posição):