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A Sarcopenia em Idosos: Metodologias de Treinamento Físico e Avaliação Dos Critérios Diagnósticos

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Orientador: Dr. Luis Henrique Telles da Rosa

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Eu não pretendo mais voltar à graduação, e ainda que eu faça um pós-doutorado, eu não serei mais um aluno (pelo menos não oficialmente). Eu considero, portanto, essa tese como o ponto final desta jornada de educação. Foram 28 anos, dos meus 34 de vida, dentro de salas de aula. Fecho essa jornada leve e satisfeito com aquilo que a vida me proporcionou. E que esta jornada que se encerra seja uma bifurcação para diversas outras que ainda estão por vir.

Com isso eu deixo uma mensagem: acreditem na educação. Acreditem no poder que ela dá, e no bem que ela faz. Ela é a cura para os males do mundo. O caminho para um ser humano mais digno, elevado e feliz. É a chave que abre todas as portas. Acreditem em quem acredita na educação, e em quem investe nela. Pavimentem mais caminhos, para que cada vez mais pessoas com poucas oportunidades, como eu, possam chegar até onde eu cheguei.

Só a educação pode mudar o mundo.

RESUMO

Introdução: A sarcopenia vem sendo um problema de saúde mundial, tendo alto custo para sistemas de saúde, e grande impacto na vida do indivíduo idoso. Isso suscitou diversas pesquisas na área, culminando na publicação de diversos consensos de sarcopenia. Porém ainda existem áreas não claras nas pesquisas de sarcopenia, como a padronização da avaliação dos critérios diagnósticos, e os melhores métodos de prevenção e tratamento da síndrome. Esta tese é composta por dois artigos: o primeiro é uma revisão sistemática de revisões sistemáticas, objetivando comparar os resultados entre diferentes métodos de treinamento físico diante dos critérios diagnósticos de sarcopenia; o segundo, um estudo transversal, avaliou idosos com as avaliações propostas pelo EWGSOP, buscando demonstrar as correlações entre os métodos de diagnóstico da sarcopenia. **Métodos**: O estudo 1 é uma revisão sistemática de revisões sistemáticas. Estratégia de busca incluiu MeSH para idosos e sarcopenia, realizada nas principais bases de dados. Os estudos selecionados incluem idosos submetidos a treinamento físico em comparação aos grupos controle. O estudo 2 é transversal, onde idosos foram avaliados para os critérios diagnósticos de sarcopenia recomendados por EWGSOP. **Resultados**: No estudo 1, 494 revisões sistemáticas foram encontradas. Após a triagem, 5 foram incluídos (48 artigos. n=3877). Idade média: 74,02+6,1. 73,44% do sexo feminino. Duração média das intervenções: 17,38 semanas (média: 2,56 sessões semanais). AMSTAR e PRISMA apresentaram alta qualidade metodológica. Meta-análises compararam os resultados das intervenções de treinamento de resistência (RTA) com outras que não a resistência (NRTA). Força de preensão palmar, SMM e velocidade de marcha apresentaram diferenças estatisticamente significativas (DES) favoráveis ao GI. Teste de sentar-e-levantar, RTA mostrou DES favorável ao GI; em NRTA ao GC. O timed-up-and-go não mostrou DES. Já no estudo 2, 78,31% eram mulheres, a média de idade foi de 67,85+5,27 anos. Nas avaliações de força foi encontrada correlação moderada entre preensão manual e PT de quadríceps e alta com PT de isquiotibiais. Avaliações de PT mostraram alta relação entre eles. A MME apresentou alta correlação com a MLG e baixa correlação com CP e CMB. A MLG apresentou alta correlação com todas as avaliações de composição corporal. No desempenho físico, VMU teve correlação moderada com SPPB e alta com TUG. O TUG apresentou baixa correlação com SPPB e VMU. **Conclusões**: O artigo 1 demonstrou que fazer parte de qualquer programa de treinamento pode ser benéfico para sarcopenia em idosos, com TF melhor para força e MME, e modalidades mistas para performance física. Já o estudo 2 demonstrou que o teste de preensão palmar apresenta as melhores correlações e menor custo entre os testes de força muscular, enquanto o teste de sentar e levantar parece não ser adequado para esta variável. Para MME a BIA apresenta as melhores correlações, embora testes mais rápidos e baratos, como a antropometria, sejam uma opção viável. Para a performance física, VMU apresentou as melhores correlações. Os outros testes para esta variável, embora possuam boa correlação entre eles, devem ser adaptados às necessidades do idoso em sarcopenia severa, a fim de avaliar mais fidedignamente.

Palavras-chave: Sarcopenia; Idoso; Exercício Físico; Avaliação Geriátrica; Antropometria; Revisão Sistemática.

ABSTRACT

Introduction: Sarcopenia has been a worldwide health problem, with high cost for health systems, and great impact on older people's life. This gave rise to several researches in the area, culminating in the publication of some consensuses on sarcopenia. However, there are still unclear areas in sarcopenia research, such as the standardization of the evaluation of diagnostic criteria, and the best methods of prevention and treatment of the syndrome. This thesis is composed of two papers: the first is a systematic review of systematic reviews, aiming to compare the results between different physical training methods in view of the diagnostic criteria of sarcopenia; the second, a cross-sectional study, evaluated the elderly with the assessments proposed by the EWGSOP, seeking to demonstrate the correlations between the methods of sarcopenia diagnosis. **Methods**: Study 1 is a systematic review of systematic reviews. Search strategy included MeSH for aging and sarcopenia, performed in the main databases. The selected studies include older adults undergoing physical training compared to control groups. Study 2 is a cross-sectional study, in which the older people were evaluated for the diagnostic criteria for sarcopenia recommended by EWGSOP. **Results**: In study 1, 494 systematic reviews were found. After screening, 5 were included (48 articles. n=3877). Average age: 74.02+6.1. 73.44% female. Average duration of interventions: 17.38 weeks (average 2.56 weekly sessions). AMSTAR and PRISMA showed high methodological quality. Meta-analyses compared the results of resistance training (RTA) interventions with non-resistance (NRTA) interventions. Handgrip strength, SMM and gait speed showed statistically significant differences (SSD) favorable to the IG. Chair test, RTA showed SSD favorable to IG and NRTA to CG. Timed-up-and-go did not show SSD. In study 2, 78.31% were women, the mean age was 67.85+5.27 years. In strength assessments, a moderate correlation was found between handgrip and quadriceps PT and a high correlation with hamstring PT. PT assessments showed a high relationship between them. SMM showed high correlation with FFM and low correlation with CC and MAC. FFM was highly correlated with all body composition assessments. In physical performance, UGS had moderate correlation with SPPB and high correlation with TUG. TUG showed low correlation with SPPB and UGS. **Conclusions**: Article 1 demonstrated that being part of any training program can be beneficial for sarcopenia in the elderly, with RT being better for strength and SMM, and mixed modalities for physical performance. Study 2 showed that the handgrip test has the best correlations and the lowest cost between muscle strength tests, while the sit-and-stand test does not seem to be adequate for this variable. For SMM, BIA has the best correlations, although faster and cheaper tests, such as anthropometry, are a viable option. For physical performance, UGS presented the best correlations. The other tests for this variable, although they have a good correlation between them, must be adapted to the needs of the elderly with severe sarcopenia, in order to assess more reliably.

Keywords: Sarcopenia; Aged; Physical Exercise; Geriatric Assessment; Anthropometry; Systematic Review.

LISTA DE FIGURAS E TABELAS

Contextualização

Artigo original 1

Artigo Original 2

LISTA DE ABREVIATURAS E SIGLAS

Em ordem alfabética.

1RM	One Repetition Maximum ou Uma repetição máxima
AMSTAR	Assessment Of Multiple Systematic Reviews
ASM	Appendicular Skeletal Muscle Mass
AWGS	Asian Working Group on Sarcopenia Bioimpedance Analysis
BIA	Análise De Bioimpedância ou Bioimpedance Analysis
BMI	Body Mass Index
CA	Can’t Answer
CC	Calf Circumference
CG	Control Group
CID	Classificação Estatística Internacional de Doenças e Problemas de Saúde Relacionados
cm	Centimeter ou centímetro
CT	Computerized Tomography
DXA	Raio-X de Dupla Absortometria ou Dual Energy X-Ray Absorptiometry
ECR	Ensaio Clínico Randomizado
ELS	Estela Lopes Scariot
EWGSOP	European Working Group on Sarcopenia in Older People
FFM	Free-fat Mass
GEReab	Grupo De Estudos Em Reabilitação
ICF	Informed Consent Form
IDC	International Statistical Classification of Diseases and Related Health Problems
IG	Intervention Group
IQR	Interquartile Range
Kg	Kilogram ou Quilograma
LFF	Luis Fernando Ferreira
LHTR	Luis Henrique Telles Da Rosa
m	Meter ou Metro
m/s	Metros Por Segundo ou Meter Per Second
MAC	Mid-Arm Circumference
MeSH	Medical Sub-headings
MET	Muscle Endurance Training
MME	Massa Muscular Esquelética
MRI	Magnetic Resonance Imaging
MT	Mixed Modalities Training
mTOR	Mammalian Target of Rapamycin
N	No
n	Sample ou amostra
n/i	Not Informed
NA	Not Applicable
NHANES	National Health And Nutrition Examination Survey
nNOS	Nitric Oxide Synthase Neuron
NRTA	Non-Resistance Training Analysis
PA	Phosphatidic Acid

PRISMA	Preferred Reporting Items for Systematic Reviews And Meta-Analyses
PROSPERO	International Prospective Register of Systematic Reviews
PT	Peak Torque ou Pico de Torque
RCT	Randomized Clinical Trial
RT	Resistance Training
RTA	Resistance Training Analysis
s	Seconds ou Segundos
SD	Standard Deviation
SMM	Skeletal Muscle Mass
SPPB	Short Physical Performance Battery
SRF	Serum Response Factor
SSD	Statistically Significant Differences
PTIE	Peak Torque of Isotonic Eccentric Contraction
TT	Therapeutic Training
TUG	Timed-Up-And-Go Test
UFCSPA	Universidade Federal De Ciências Da Saúde De Porto Alegre Ou Federal University Of Health Sciences Of Porto Alegre
UGS	Usual Gait Speed
UK	United Kingdom
USA	United States of America
VP	Vibrating Platform Training
Y	Yes

SUMÁRIO

1. CONTEXTUALIZAÇÃO

A sarcopenia é uma doença, já reconhecida pela décima edição do Cadastro Internacional de Doenças (CID), caracterizada pela perda de força e massa muscular, além da diminuição da performance física (1, 2).

Diversos grupos de estudos têm se ocupado de aprimorar o entendimento da síndrome, principalmente estudando as formas de avaliar e diagnosticar a síndrome de maneira mais eficaz e assertiva (1, 3-5). Existem também diversos autores que se dispõem a estudar as maneiras de combate da síndrome, visando reduzir o impacto geral da doença sobre a vida dos pacientes acometidos (6-12).

Dentre os consensos para avaliação e diagnóstico da síndrome, se destaca o European Working Group on Sarcopenia in Older People - EWGSOP2 (1), que avalia a síndrome em três níveis: 1) provável sarcopenia, quando há baixa força muscular; 2) sarcopenia, quando há baixa massa muscular esquelética (MME) associada à baixa força e; 3) sarcopenia severa, quando existe uma baixa performance física associada aos dois primeiros critérios diagnósticos.

Sobre as formas de combate, podem ser encontrados alguns estudos com intervenções medicamentosas, principalmente com base hormonal (13), e alimentares, principalmente com sobrecarga proteica (7). Porém nenhuma intervenção parece ser mais eficaz e segura, além de trazer mais benefícios associados e inspirar maior adesão ao tratamento, do que aquelas com exercícios físicos (1, 4).

Os exercícios físicos com ênfase em força, como a musculação, parecem trazer os melhores resultados aos idosos sarcopênico, uma vez que aprimoram os dois primeiros critérios diagnósticos da síndrome. Dentre essas modalidades, no entanto, ainda não é claro qual volume e intensidade devem ser adotados para maximizar seus efeitos, nem mesmo qual é a melhor frequência semanal de treino (9).

Para os indivíduos com sarcopenia severa, modelos de exercícios mistos, no entanto, parecem demonstrar melhores resultados, agregando componentes de força, aeróbios, de flexibilidade e de equilíbrio. Neste ponto, ganha força a vertente que acredita que o treino de força deva ser treinado em velocidades máximas (treino de potência), porém ainda falta lastro teórico para a prescrição de volume, intensidade e frequência das sessões de treinamento (6).

Esta tese, portanto, se ocupou de responder dois dos grandes questionamentos acerca da sarcopenia, através de seus dois artigos originais apresentados.

Em um primeiro momento, tentou-se responder ao seguinte questionamento: existe relação entre os diversos métodos de avaliação propostos para cada um dos critérios diagnósticos?

A tentativa de responder, ao menos em parte, esta pergunta de pesquisa, é apresentada no artigo transversal apresentado nesta tese (artigo Original 2).

Já a segunda pergunta de pesquisa que se tentou responder neste estudo, através de uma revisão sistemática de revisões sistemáticas, com meta-análise, foi a seguinte: Qual a melhor modalidade de exercício físico para diminuir os indicadores de sarcopenia em idosos (Artigo Original 1)?

1.1. A Sarcopenia

A sarcopenia vem sendo tema de discussão nos centros de pesquisa sobre o envelhecimento, desde sua primeira citação, por Rosenberg, em 1989 (14). Porém substancias diferenças no entendimento dessa síndrome foram evoluídas a partir de sua primeira citação.

Por exemplo, quando Rosenberg cunhou o termo sarcopenia, ele se referia tão somente à perda de massa muscular esquelética (MME) devida ao envelhecimento (14). No entanto esse leque se ampliou, não somente quando se trata de MME, mas também quando se fala de envelhecimento.

Hoje em dia diversos consensos para o entendimento da sarcopenia existem, como o Consenso Europeu para Sarcopenia (EWGSOP2) (1), o Consenso Asiático para Sarcopenia (AWGS) (3), e o consenso internacional para idosos com mobilidade limitada imobilidade (5). O principal destes consensos, e que tem estado na vanguarda deste entendimento, no entanto, é o europeu, escrito pelo European Working Group on Sarcopenia In Older People (EWGSOP), publicado pela primeira vez em 2010 (15), e revisado em 2019 (EWGSOP2) (1).

O EWGSOP2 tem conceituado a sarcopenia, desde seu consenso revisado de 2019, como, em um primeiro momento, a baixa força muscular (e não mais a baixa MME). Este critério pode ser avaliado, segundo o consenso, através da força de preensão manual, ou pelo teste de sentar-e-levantar. Outros consensos ainda adotam outros métodos, como a dinamometria isocinética e a subida de escadas. O idoso apresentando baixa força muscular, ele é então diagnosticado com “provável sarcopenia”, exigindo avaliações mais aprofundadas (1).

No aprofundamento destas, o segundo fator avaliado é justamente a MME, que, segundo o EWGSOP2 pode ser avaliada por DXA (Raio-x de dupla absortometria), tomografia computadorizada, ressonância magnética ou bioimpedância. Ainda pode-se encontrar na literatura grupos que avaliam a MME por dobras cutâneas. Este segundo critério diagnóstico tendo apresentado abaixo do ponto de corte conceitua o idoso como sarcopênico (1).

Neste ponto, é preciso ressaltar que a síndrome já é considerada como uma doença, inclusive sendo incluída na décima edição do Cadastro Internacional de Doenças (CID M62.84) desde 2016 (2).

A partir do diagnóstico de sarcopenia, é necessário avaliar a severidade da doença. Esta avaliação se dá pelo status da performance física do idoso, que pode ser avaliada bastante comumente pela velocidade usual da marcha, onde o idoso é caracterizado como severamente sarcopênico quando apresenta velocidade <0,8 m/s. Outras avaliações possíveis para este mesmo critério são a Bateria Curta de Performance Física (SPPB, do original Short Physical Performance Battery), o Timed-up-and-go test (TUG) e o teste de caminhada de 400m (1).

Por outro lado, a sarcopenia, hoje em dia, não é somente reconhecida como uma doença exclusiva do envelhecimento, como foi citada por Rosenberg, 1989. A própria CID cita a sarcopenia como uma síndrome caracterizada por perda progressiva e generalizada de massa e força muscular, além da diminuição do desempenho físico. Diversos estudos demonstram a sarcopenia em indivíduos não idosos, pacientes de diversas patologias, como hepatopatias (16, 17), cardiopatias (18), nefropatias (19), além de ser associada com outras síndromes ou condições, como obesidade (20, 21), osteoporose (22) e fragilidade (6).

1.2 Fisiopatologia da Sarcopenia

Fisiologicamente, é esperado que após a terceira década de vida ocorra uma redução das proteínas contráteis do músculo, e uma substituição por tecidos conjuntivos (principalmente o adiposo). Este processo é irreversível e universal, ainda que existam maneiras de reduzir a velocidade com que este fenômeno ocorre, como uma nutrição adequada e a prática de atividades físicas regulares. Essa redução ocorre principalmente com as fibras do tipo II, uma vez que estas podem ter um declínio de até 50% até os 70 anos de idade (6, 9, 23, 24).

Segundo diversos autores (25, 26), essa redução ocorre quando a balança síntese-degradação muscular pende mais para o lado da degradação, ou seja, os agentes de proteólise são mais abundantes do que os agentes de síntese. Isso pode se dever por diversos fatores, como o envelhecimento celular primário, o desuso, a denervação, o acúmulo de lesões ou mesmo por processos patológicos.

Essa redução de fibras musculares explica, ainda que em parte, a redução da função muscular de indivíduos acometidos pela síndrome. Uma vez que existem menos unidades motoras, a capacidade de produção de força reduz, assim como a habilidade de equilíbrio e endurance muscular (1, 8).

Embora não haja consenso na literatura sobre as causas fisiológicas da sarcopenia, ou mesmo de biomarcadores que possam indicar o aparecimento e evolução da síndrome, alguns sintomas podem influenciar e/ou ser influenciados pela sarcopenia, como o aumento do tecido adiposo, aumento do nível de citocinas pró-inflamatórias, perda de massa óssea, diminuição de níveis hormonais, além das óbvias alterações na placa motora, seja a nível neurológico, ou ainda a nível muscular (1, 3).

Diversos mecanismos podem estar relacionados com o aparecimento e evolução da sarcopenia, e suas contribuições podem variar ao longo do tempo, dependendo das individualidades biológicas e dos hábitos do indivíduo ao longo do tempo. Em algumas pessoas a causa da condição sarcopênica é facilmente identificável. Porém, na maioria dos casos, não há evidências isoladas que possam caracterizar esse quadro. Dessa forma, podemos classificar, na prática clínica, a sarcopenia como sendo primária, que é quando não há outra causa evidente senão o envelhecimento por si só; ou secundária, quando uma ou mais causas são evidentes. Na maioria dos idosos a etiologia da sarcopenia é multifatorial, impossibilitando assim, muitas vezes, a caracterização entre sarcopenia primária e secundária (15).

1.3 Epidemiologia da Sarcopenia

Existem diversas formas da avaliar a sarcopenia, como dito anteriormente, o que faz com que uma avaliação epidemiológica adequada seja impossível de se concretizar, ao menos enquanto não houver uma padronização mais ampla, que a maioria dos pesquisadores adotem como métrica para tais estudos.

É possível verificar, porém, que a prevalência de sarcopenia aumenta conforme a idade dos indivíduos aumenta, ainda que em alguns estudos o desvio padrão seja grande. Por exemplo, Petermann-Rocha et al, 2022, relatou, em uma revisão sistemática, prevalência de 8% a 36% em indivíduos com menos de 60 anos, enquanto houve de 10% a 27% em maiores de 60 (27). Isso vai de encontro ao encontrado em outros estudos, como o de Nakamura et al, 2021 (28), relatou que a prevalência sobe de acordo com o avanço da idade, assim como a maioria dos consensos para sarcopenia relatam o mesmo (1, 3, 5). Isso quer dizer que ainda não há consenso na literatura, embora haja uma forte tendência de avanço da prevalência acompanhando o avanço da idade.

Sobre o gênero, embora saibamos que mulheres sofrem mais com as perdas morfológicas do que os homens, por terem menos massa muscular, e por passarem obrigatoriamente pela menopausa, também não há consenso na literatura sobre as prevalências. Enquanto estudos relatam piores indicadores em homens (8, 27), outros relatam não haver diferenças entre os sexos (11, 28).

Porém é possível perceber que as comorbidades sim têm grande influência sobre a prevalência de sarcopenia, como relatam em seus estudos diversos autores, que trabalham com indivíduos hepatopatas, cardiopatas, nefropatas, frágeis, osteoporóticos e/ ou obesos (16-21, 27).

Sobre a prática de atividades físicas, embora vejamos em diversos artigos que a prevalência de sarcopenia é fortemente afetada por essa variável, ainda não se sabe exatamente quais modalidades podem ser as mais eficazes para o tratamento da síndrome. O fato é que estar inserido em um programa de treinamento de qualquer natureza parece influenciar positivamente na prevalência de sarcopenia (4, 8-12)

Outros fatores parecem influenciar este dado, ainda que existam poucos estudos na área, como a região geográfica em que o idoso vive, suas atividades pregressas, o perfil alimentar de sua comunidade e o perfil de suporte social do meio em que o indivíduo está inserido.

1.4 Consequências da Sarcopenia

A consequência mais relatada pela literatura é a diminuição da função muscular (4, 20). Essa redução, por consequência, altera a produção de força geral, o equilíbrio e a velocidade de reação. Essas valências reduzidas em conjunto podem resultar em um quadro de fraqueza, lentidão e redução da capacidade funcional. Essa funcionalidade reduzida, por sua vez, afeta a capacidade dos idosos para executar atividades da vida diária, tornando o indivíduo dependente e reduzindo a percepção da qualidade de vida do idoso, o que pode levar a consequências mais sérias, como a morte (21, 29-31). Outro fator de mortalidade que parece estar relacionado com a diminuição da funcionalidade do idoso é o número de quedas. Essas quedas podem levar a fraturas, principalmente as de quadril, a hospitalização e, finalmente, a morte (32-34).

Como consequência também da perda de massa muscular, e da disfuncionalidade que a acompanha, pode haver uma redução da atividade física e nas capacidades aeróbia e anaeróbia. Esta inatividade reduz o processo anabólico do músculo, levando a uma redução ainda maior do desempenho, e a mais inatividade, criando um ciclo interdependente. Em alguns casos, essa inatividade pode levar a deficiências físicas (23, 35, 36). Uma perda de massa muscular a ponto relevante pode prejudicar a adaptação metabólica do indivíduo a situações de estresse e doenças (37, 38). Existem também evidências que ligam o processo catabólico e inflamatório, decorrentes do envelhecimento e/ ou da sarcopenia, à perda de massa óssea (39, 40).

Também podemos observar que algumas consequências do envelhecimento e, por subsequência, da sarcopenia, não estão relacionadas somente à perda de massa muscular, podendo ser consequência secundárias às alterações no músculo, ou que afetam a balança síntese x degradação proteica. Em idosos, observa-se em estudos que analisaram a imagem do músculo (41) que, ao mesmo tempo que diminui a área de secção transversa do ventre muscular, há uma substituição e preenchimento desses espaços por tecido conjuntivo, principalmente por tecido conjuntivo adiposo. Estudos demonstram que indivíduos idosos com perda de massa muscular acentuada, não têm uma redução de peso relevante, uma vez que o peso muscular perdido significa um valor aumentado de gordura visceral, subcutânea e intramuscular (4, 23, 42). Sabe-se também que idosos com uma massa maior de gordura são mais propensos a desenvolver tolerância reduzida à glicose e diabetes. A sensibilidade reduzida à insulina ocorre em mais de 40% dos indivíduos com mais de 60 anos, e 16% deles desenvolvem o quadro completo de diabetes. Também têm sido relatado que a diabetes do tipo II é um sério problema de saúde que afeta grande parte dos idosos (43).

Enquanto a redução da sensibilidade hepática à insulina pode ser um componente de resistência à insulina em pessoas idosas, o principal mecanismo para o desenvolvimento de resistência à insulina resulta da disfunção metabólica muscular (44). Foi dito anteriormente, neste texto, que as citocinas estão relacionadas com a redução da massa corporal magra nos idosos. Considerando que a maior parte das citocinas inflamatórias são derivadas de adipócitos, um aumento na proporção de gordura corporal pode aumentar o risco de uma elevada resposta inflamatória (45-50).

Porém, mesmo após as evidências das causas e consequências da sarcopenia sobre o idoso, ainda se faz difícil uma inferência de o que é causa, e o que é consequência, ou se estes fatores estão todos inter-relacionados, e interdependem-se entre si (1, 4). Para exemplificar este "ciclo vicioso", Hunter et al, 2014 (51), propõe um círculo não direcional, cujos pontos chave são o envelhecimento e a perda do estilo de vida independente, demonstrado na figura 1.

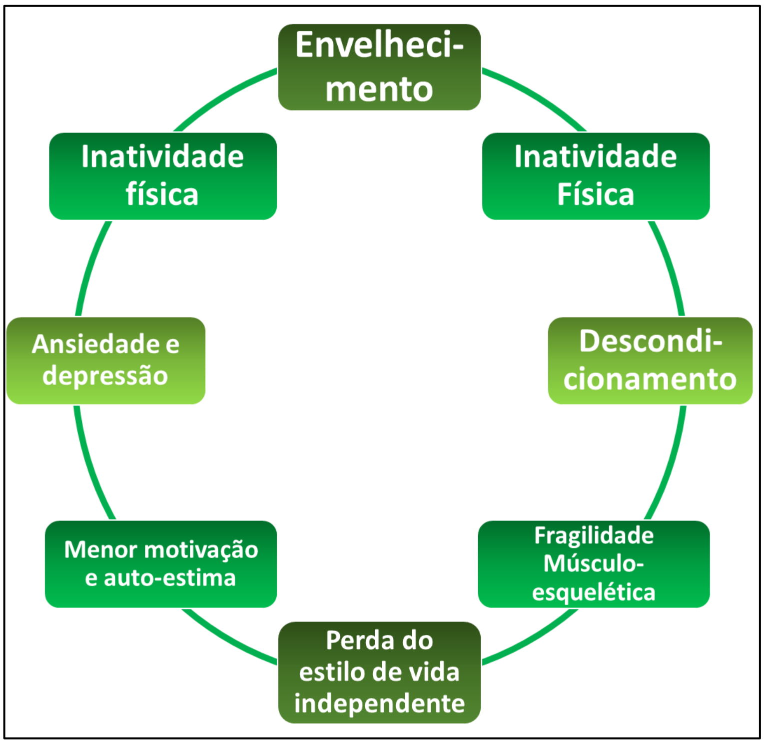

Figura 1 - Esquema do ciclo dos fatores relacionados à incapacidade funcional nos idosos (Adaptado de Hunter et al, 2004 (51)).

1.5 Métodos de Combate

Diversas intervenções são listadas na literatura com o objetivo de combater a síndrome, seja na prevenção ou na redução da progressão de seus critérios diagnósticos. Dentre os estudos, destacam-se intervenções dietéticas, suplementação vitamínica e até mesmo alguns ensaios sobre intervenções medicamentosas, entre outras técnicas

(7, 52-54). No entanto, nenhuma intervenção parece trazer melhores resultados e menores riscos do que as intervenções que utilizam exercícios físicos (1).

Dentre esses estudos, uma grande variedade de modelos de treinamento é utilizada, como treinamento de força, aeróbico, mobilidade, combinado, práticas esportivas e até algumas técnicas de fisioterapia. Centenas de estudos já foram publicados sobre o tema, facilitando a tomada de decisão dos profissionais de saúde sobre a sarcopenia em idosos (1), mas ainda são necessários estudos que combinem, resumam e analisem as intervenções em um único local, a fim de tomar decisões mais simples e rápidas, pois não há consenso na literatura sobre quais modalidades podem trazer os melhores resultados.

Mesmo entre revisões sistemáticas, com estratégias e objetivos de busca semelhantes, não se encontra consenso sobre o efeito da atividade física nos critérios de sarcopenia (8-12). As revisões sistemáticas de revisões sistemáticas parecem um passo natural nessa construção, comparando e contrastando os resultados, fornecendo evidências mais robustas para uma tomada de decisão mais precisa, segura e eficaz (55), podendo ser o futuro nos estudos sobre os métodos de intervenção sobre a sarcopenia. E, é claro, mais ensaios clínicos randomizados devem ser desenvolvidos, ampliando o leque de modalidades disponíveis para o tratamento da síndrome (4).

2 OBJETIVOS

Como dito, esta tese se constitui de dois artigos diferentes, e por isto possui dois objetivos diferentes.

2.1 Objetivo: Artigo de Revisão (Artigo Original 1)

Comparar os resultados de diferentes modalidades de exercícios físicos sobre os critérios diagnósticos de sarcopenia em idosos.

2.2 Objetivo: Artigo Transversal (Artigo Original 2)

Verificar a relação entre os métodos de avaliação para os critérios diagnósticos de sarcopenia em idosos.

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4 ARTIGO ORIGINAL 1

Artigo publicado no periódico Archives of Gerontology and Geriatrics em dezembro de 2022 (classificação Qualis A1 – Fator de impacto em 2022 de 4.163).

The Effect of Different Exercise Programs on Sarcopenia Criteria in Older People: A Systematic Review of Systematic Reviews with Meta-analysis.

Short Title: Exercises Programs for Sarcopenia in Older People

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Highlights.

- For older adults, being included in any physical training program is beneficial for sarcopenia criteria.
- For strength and skeletal muscle mass, being on a resistance-emphasis training program seems to be best.
- For physical performance, being part of a training program with multiple modalities, such as resistance, cardiorespiratory endurance and balance, seems to bring better results.
- In RCTs with physical exercise interventions for older people, aiming to reduce sarcopenia rates, standards in training programs are lacking.
- As well as there is a lack of standardization on the assessment of sarcopenia levels, although there are consensuses that standardizes this factor.

ABSTRACT

Objective: To compare the results of different modalities of physical exercises on the sarcopenia diagnostic criteria in older people. **Methods**: Systematic review of systematic reviews. Search strategy included older people and sarcopenia MeSH, performed at mainly databases. Selected studies include older adults, submitted to physical training (IG) compared to control groups (CG). Quantitative analyses with the inverse variance statistic method (random effects). The effect measures mean difference. Heterogeneity measured with Q-Test. **Results**: 494 systematic reviews found. After screening, 5 were included (48 papers. n=3877). Mean age: 74,02±6,1. 73,44% female. Mean interventions duration: 17,38 weeks (average: 2,56 weekly sessions). AMSTAR and PRISMA showed high methodological quality. Meta-analyses compared results of resistance training interventions (RTA) with other than resistance (NRTA). Handgrip strength, SMM and gait speed showed statistically significant differences (SSD) favorable to IG. Chair stand test, RTA showed SSD favorable to the IG, and NRTA to CG. The timed-up-and-go do not showed SSD. **Discussion**: The SMM and strength showed better results in RTA. Both valences can be trained with similar volume and training intensity, which can modify muscle volume and strength. Physical performance obtained better results in NRTA. For severely sarcopenic, training including more than one valence may be best. In sarcopenia diagnosis most studies do not take into account the consensuses of standardization, making hard the larger groups analysis. **Conclusion**: Being part of any training program can be beneficial for sarcopenia in older people, with RT better for strength and SMM, and mixed modalities for physical performance.

Keywords: Sarcopenia; Aged; Physical Exercise; Systematic Review.

BACKGROUND

Sarcopenia has been considered one of the geriatric syndromes with the greatest influence on the independence of the older people, in addition to being a risk factor for falls, frailty, the appearance of other syndromes and even for mortality of the individuals over 65 years old (1-5). This syndrome, which is even registered in the IDC-10 (6), has been recognized by the main authors in the area (7-10) as multifactorial, depending on muscle strength (probable sarcopenia), skeletal muscle mass (diagnosis of sarcopenia) and physical performance (severe sarcopenia).

Several interventions are listed in the literature aiming to combat the syndrome, whether in prevention or in reducing the progression of its diagnosis criteria. Among the studies, dietary interventions, vitamin supplementation, and even some trials on drug interventions, among other techniques (11-14), stand out. However, no intervention seems to bring better results and lower risks than interventions that use physical exercises (15).

Among these studies, a widely variety of training models are used, such as strength training, aerobic, mobility, combined, sports practices, and even some physiotherapy techniques. Hundreds of studies have been published on the subject, facilitating decision-making by health professionals regarding sarcopenia in older people (15), but studies are still needed that combine, summarize and analyze the interventions in a single place, in order to make decision making simpler and faster, since there is no consensus in the literature about which modalities can bring the best results.

Even among systematic reviews, with similar search strategies and aims, there was no consensus on the effect of physical activity on sarcopenia criteria (16-20). Therefore, systematic reviews of systematic reviews seem a natural step in this construction, comparing and contrasting the results, providing more robust evidence for a more accurate, safe and effective decision-making (21).

This study systematically reviewed systematic reviews of physical exercise interventions to sarcopenia in older people, aiming to compare the results of different modalities of physical exercises on the diagnostic criteria of sarcopenia in the older people.

METHODS

This study is a systematic review of systematic reviews, designed following the recommendations of the Cochrane Collaboration To Intervention Systematic Reviews

Book (22) and the PRISMA Statement (23). Also, are registered in PROSPERO 2022, under the code CRD42022343689.

Is important to notice that, however this is not a systematic review of interventions, but a systematic review of systematic reviews of interventions, there are no guidelines to this kind of study. So, we choose to use the Cochrane Collaboration as a guideline to conduct this review, and the recommendations by Smith et al, 2011 (21), "Methodology in conducting a systematic review of systematic reviews of healthcare interventions". In addition, all criteria included in PRISMA Statement (23) were met.

Search Strategy

The selection of eligible papers originally occurred in august 2021, on following databases: Medline (via PubMed), Embase, PEDro, Cochrane and Lilacs. The search terms used included the MeSH 'sarcopenia' and its subheadings; 'Aged' and its subheadings; and the filter for 'systematic review'. The search strategy used on Medline and Embase databases is available in appendix 1.

In order to search for new papers published between the first analysis, and the end of this paper production, the search strategy was renewed in June 2022. None new papers matching the eligibility criteria strategy were found.

All articles found in this phase were organized in the reference management software EndNote, version X4.

Eligibility Criteria

Only systematic reviews (including or not meta-analyses) of controlled clinical trials of sarcopenia with human patients or volunteers were included. Non-systematic reviews, overviews, clinical trials and reviews of non-clinical investigations were excluded. All articles were evaluated by two blinded authors for its inclusion or not (LFF and ELS).

In addition, only articles that followed the PICO of this study was included.

Population: Adults over 60 years, male or female, sarcopenic or at risk of, with or without comorbidities.

Intervention: Any kind of physical or kinesiotherapy activity, such as resistance or cardiorespiratory training, sports, combined training, among others, since not combined with other interventions, such as dietary or pharmaceutical approaches, in order to reduce the risk of bias regarding the exercise interventions.

Comparison: Have at least a second group, subjected to a different training model, another intervention, a combined intervention, or a control group.
Outcome: Studies that analyzed or evaluated the results of physical exercise interventions in their outcomes, as long as these results were related to some of the sarcopenia indicators, according to the EWGSOP2 (15): strength, physical performance and/ or skeletal muscle mass.

Studies Selection

The studies selection has occurred in two phases, by two blinded and independent reviewers (LFF and ELS). On first phase were analyzed title and abstracts. When selected for at least one reviewer, the articles were maintained on the list. On the second phase were read the selected full texts papers. Having disagreement between reviewers, a third reviewer was necessary (LHTR).

Methodological quality assessment

After the final selection, two independent examiners assessed the selected studies regarding the quality of the review report using the AMSTAR instruments (Assessment of Multiple Systematic Reviews) (24) and PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) statement (25). During the quality assessment of the report of the selected reviews, eventual disagreements between the examiners were resolved through discussion until consensus, or by a third reviewer decision.

Data Extraction

The data extraction was executed by two independent reviewers following standardized forms. The following data was collected, when available: Authors, publish year, sample, patient kind, gender, mean of age, intervention model, training model, protocol, duration, outcome, mean and standard deviation pre and post intervention (meta-analysis).

Also, the meta-analysis data from Talar, 2021 (26) was not presented in the original paper or in the supplementary material, but it was kindly provided by the authors, after asked by e-mail.

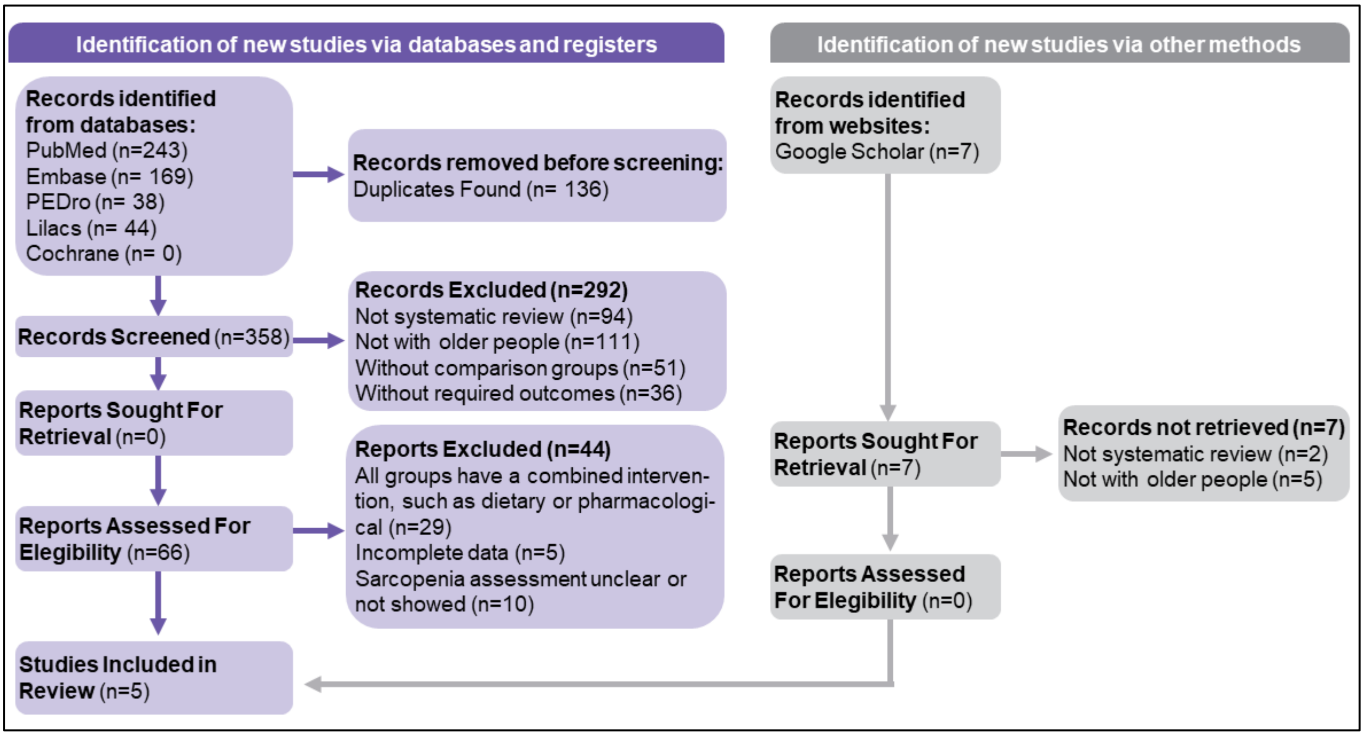


Figure 1. Flowchart of included studies.

Synthesis and data analyses

To quantitative analyses was employed the statistic method of Inverse Variance, with analysis model in Random Effects, and the effect measures Mean Difference. The heterogeneity assessment of studies was made with the Cochran's Q Test, and the inconsistency with I^2 Test, which values of <50% were considered as low heterogeneity, <75% moderate heterogeneity, and $\geq$75% high heterogeneity (27, 28). A p value lower than 0,05, and confidence interval of 95% was considered statistically significant. All analyses were conducted in Software Review Manager, version 5.3.

RESULTS

After the selection of studies, five were included in the analysis: Bao, 2020 (16); Escriche-Escuder, 2021 (17); Talar, 2021 (18); Vliestra, 2018 (19) and; Wu, 2021 (29). 67 studies were included in the 5 reviews selected, totalizing 4.231 subjects. Is important to notice that, at first, 67 studies have been accessed across the five included reviews, but only 32 of them appeared in only one review. 13 of them appeared in 2 reviews, and 3 appeared in three reviews. In this way, the final sample was composed by 48 studies, that includes 3.877 subjects.

Was not found agreement among the selected reviews aiming the sarcopenia diagnosis criteria. While Escriche-Escuder et al, 2021 (17), found significant results for performance, minor results for strength, and no results for SMM, Bao, 2020 (16), and Wu, 2021 (29), found important results for strength and performance, but not for SMM, and Talar, 2021 (18), and Vliestra, 2018 (19), found significant results for the three indicators. In table 1 is possible to see the conclusions found in each study.

The complete list of all studies found after the search strategy, and before the selection, can be accessed in appendix 2.

Methodological quality assessment

As can be seen in figures 2 and 3, the studies showed high methodological quality, both in the AMSTAR and in the Prisma statement. In the AMSTAR assessment (figure 1), the studies showed an average of 8.2 positive points, out of 11 possible, with 74.58% of positive responses.

In the Prisma statement, which is broader and assesses more points in the studies, the average of positive points was 22.4 out of 27 possible, totaling an average of 83% of positive responses, emphasizing the high methodological quality of the studies included in this review. In the supplementary material (appendix 3) it is possible to view the complete Prisma statement table, including the pages where the specific points can be found in the selected studies.

Reviews, Sample and Training Methods Characteristics

According to table 1, 48 studies were included in the 5 reviews selected, totalizing 3.877 subjects. Also is possible to see all the details of included studies, such as aim, search strategy and individuals included.

A list of all references included in the selected reviews, along with this citation, can be accessed at appendix 4.

In table 2, is possible to observe the characteristics of the samples of the studies included in the reviews. The total mean age of the samples was 74,02$\pm$6,1 years, and most individuals were female, totaling 73,44% (n=2.847). In addition, the criteria for diagnosing sarcopenia in the analyzed individuals did not always follow the precepts of the EWGSOP, AWGS, or any other consensus. 11 papers defined sarcopenia following EWGSOP recommendations, 5 defined by AWGS and 23 evaluated using only skeletal muscle mass cutoff points. Besides, another nine methods of definition were found across studies.

In table 3 are summarized the data from the training methodologies applied to the intervention groups. The mean duration of interventions was 17,38 weeks, with an average of 2,56 weekly sessions, with 57,4 minutes per session.

As a method of approach to training, there was also high variation, but was possible to observe studies that adopted resistance training exercises with weight lifting, body weight resistance, the use of rubbers and/ or springs, and also RT on a vibrating platform. Also were identified some programs based on aerobic exercises, balance and stretching or even combined programs. Summarizing, were found 30 studies that submitted their samples to some kind of resistance training, 13 that conducted mixed models training, combining more than one modality on their program, three in a vibrating platform, one realized an endurance training program with low loads, and one realized a therapeutic home-based training.

a)

Study	1	2	3	4	5	6	7	8	9	10	11	Score (Y/N)
Bao, 2020 (8)	N	Y	Y	NA	N	N	Y	Y	Y	Y	Y	7/3
Escriche-Escuder, 2021 (9)	N	Y	Y	NA	N	N	Y	Y	Y	Y	Y	7/3
Talar, 2021 (10)	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	10/1
Vliestra, 2018 (11)	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	9/2
Wu, 2021 (12)	N	Y	Y	NA	N	Y	Y	Y	Y	Y	Y	8/2

b)

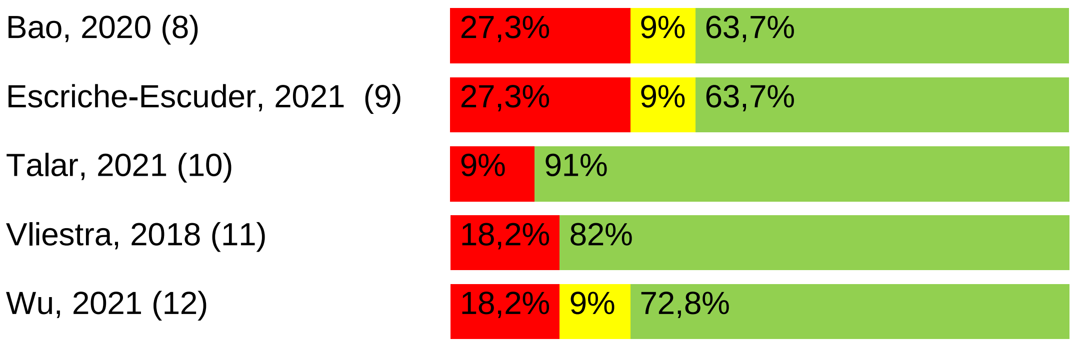


Figure 2. AMSTAR quality assessment of sistematic Reviews. a) assessment table, where Y: yes; N: no; CA: can't answer; NA: not applicable. b) assessment percentage graphic, where red is no; yellow is not applicable and; green is yes.

a)

Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Score (Y/N)
Bao, 2020 (8)	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	21/6
Escriche-Escuder, 2021 (9)	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	24/3
Talar, 2021 (10)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	24/3
Vliestra, 2018 (11)	Y	Y	Y	N	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	20/7
Wu, 2021 (12)	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	23/4

b)

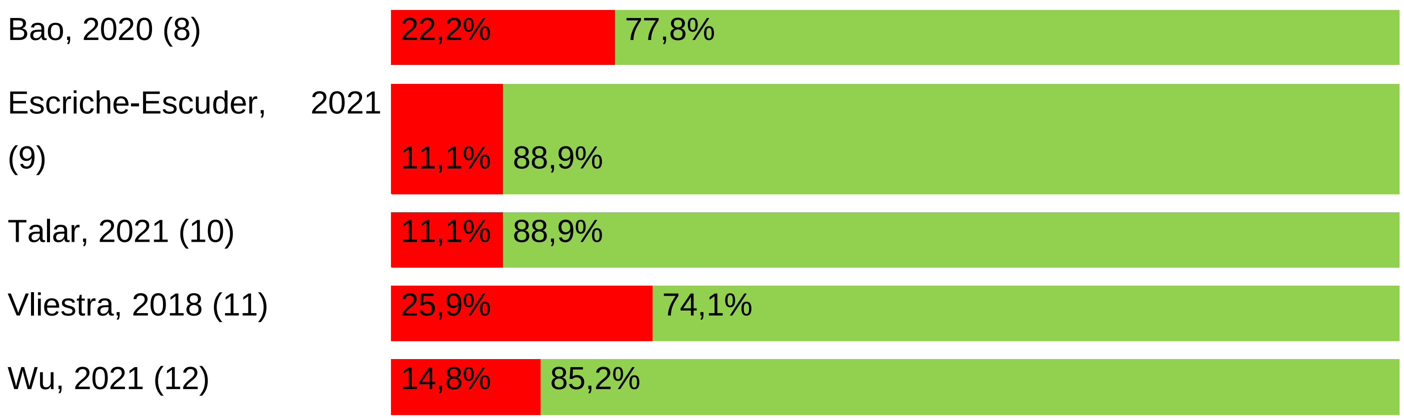


Figure 3. Assessment of preferred reporting items for systematic reviews and meta-analysis (PRISMA) statement. a) assessment table, where Y: yes; N: no. b) assessment percentage graphic, where red is no and green is yes.

Table 1. Summary table of scope of reviews in a systematic review of reviews.

Review, Year	Aim (participants)	Search strategy	Conclusions	N° of studies included	Total n° of participants
Bao, 2020 (16)	To evaluate the available literature related to the effects of exercise interventions/ programs on muscle mass, muscle strength and physical performance in older adults with sarcopenia.	from January 1990 to July 2019 was conducted using PubMed, EMBASE, MEDLINE and the Web of Science. The search included the keywords 'sarcopenia', 'sarcopenic', 'exercise', 'physical' and 'training'	Exercise programs showed overall significant positive effects on muscle strength and physical performance but not on muscle mass in sarcopenic older adults.	22	1041
Escriche-Escuder, 2021 (17)	To summarize and synthesize the evidence about the effect of exercise on muscle mass, strength and physical performance in older adults with sarcopenia according to the EWGSOP criteria.	RCTs or non-randomized interventional studies, examining whether exercise could improve sarcopenia compared or not compared to any other treatment in older adults with sarcopenia; Studies in which sarcopenia was diagnosed according to the EWGSOP definition and diagnosis of sarcopenia, either its first version or its recent update; RCTs and non-randomized interventional studies that included any exercise programs.	The present systematic review showed an effect of exercise on physical performance and muscle strength but an inconsistent effect on muscle mass.	7	235
Talar, 2021 (18)	To gather the evidence of RCT examining the effects of RT programs lasting ≥8 weeks on strength, physical function and body composition of adults ≥65 years old diagnosed with pre-sarcopenia, sarcopenia, pre-frailty, or frailty.	The search strategy combined terms related to the population (e.g., sarcopenia, frailty) and intervention (e.g., resistance training, strength training).	RT should be considered as a highly effective preventive strategy to delay and attenuate the negative effects of sarcopenia and frailty in both early and late stages.	25	2267
Vliestra, 2018 (19)	To systematically assess the effects of exercise interventions on body composition and functional outcomes in older adults with sarcopenia.	sarcopenia, aged, elderly, older adults, physical therapy, exercise, training, muscle strength and muscle mass.	Exercise interventions significantly improved strength, balance and SMM.	6	480

Wu, 2021 (29)	to examine all the evidence and clarify the effects of VT on muscle mass, muscle strength and physical performance in elderly patients with sarcopenia.	(sarcopeni* OR muscular atrophy OR muscle weakness OR muscle mass OR fat free mass OR lean body mass OR lean mass OR body composition OR hand strength OR grip strength) AND (aged OR aging OR seniors OR elderly OR older) AND (vibration OR whole-body vibration OR whole-body vibration training OR vibration exercise OR vibration platform OR vibratory therapy OR vibratory plate OR sham therapy OR Wbv OR low intensity vibration OR LIV OR VbX OR WBVT).	Vibration therapy could be a prospective strategy for improving muscle strength and physical performance in older adults with sarcopenia.	7	208

Table 2. Characteristics And Diagnostic Criteria For Sarcopenia.

Review Reference	Original Reference	n total (int.)	Age (±SD)	Sex Female (%)	Diagnostic Criteria For Sarcopenia
Talar, 2021	Aas, 2019	22 (n/i)	79 ±	68,18	SPPB for functional capacity
Escriche-escuder, 2021	Alencar Silva, 2018	15	70,7 ± 8	n/i	EWGSOP
Escriche-escuder, 2021	Balachandran, 2014	17 (9)	71,3 ± 8	94	EWGSOP
Talar, 2021, Wu, 2018 e Vliestra, 2018	Bellomo, 2013	40 (n/i)	73 ± 7	75	Criteria of the CDCP
Talar, 2021	Binder, 2002	91 (n/i)	78 ± n/i	54,94	Measures with established predictive validity for disability and mortality in older adults-at least two out of three frailty criteria.
Talar, 2021	Cadore, 2014	24 (n/i)	85 ± n/i	70,83	Fried's criteria for frailty
Bao, 2020 e Talar, 2021	Cebria, 2018	28 (11)	81,75 ± 6,96	30,72	SMM/Weight ≤ 0.93 for men and ≤ 0.57 for women
Talar, 2021	Chan, 2012	117 (n/i)	72 ± 7	41,02	CCSHA_CFS_TV

Wu, 2018	Chang, 2018	17 (17)	82,12 ± 8,19		29,41	SMI (kg/kg) cutoff for males 10.75 kg/m2, and females 6.75 kg/m2; grip strength cutoff 26 kg for male and 18 kg for females; walking speed cut-off value 0.8 m/s.
Bao, 2020 e Talar, 2021	Chen, 2017	30 (15)	68,83 ± 3,3		83,33	SMM/Weight ≤ 32.5% for men and ≤25.7% for women
Bao, 2020 e Talar, 2022	Chen, 2018	33 (17)	67,48 ± 4,29		100	AWGS
Bao, 2020	Chiu, 2018	64 (33)	79,9 ± 7,8		50	SMM/Weight < 37.15% for men and < 32.26% for women
Escriche-escuder, 2021	De Freitas, 2019	n/i (n/i)	n/i ± n/i		n/i	EWGSOP
Escriche-escuder, 2021	Del Campo-Cervantes, 2019	n/i (n/i)	n/i ± n/i		n/i	EWGSOP
Talar, 2021	Fiatarone, 1994	100 (n/i)	85 ± 13		63	Boston FICSIT
Bao, 2020	Hamaguchi, 2017	15 (7)	60,51 ± 2,4		100	EWGSOP
Bao, 2020	Huang, 2017	35 (18)	69,2 ± 4,94		100	SMM/Weight < 27.6 %
Bao, 2020 e Talar, 2021	Liao, 2017	46 (25)	67,32 ± 5,2		100	EWGSOP
Bao, 2020	Liao, 2018	56 (33)	67,35 ± 5,23		100	SMM/Weight < 27.6 %
Talar, 2021	Lichtenberg, 2019	43 (n/i)	72 ± n/i		n/i	FrOST
Bao, 2020	Mafi, 2019	30 (14)	68,47 ± 2,78		0	ASM/Height2 < 10.75 kg.m-2
Wu, 2018	Miller, 2018	15 (15)	58,2 ± 6,4		100	ALM/BMI cutoff values 0.789 for male and 0.512 for female
Wu, 2018	Pietrangelo, 2009	9 (9)	75,3 ± 6,9		55,55	SMI (kg/m2) by DXA < 2 SD of a young reference group
Bao, 2020 e Vliestra, 2018	Shahar, 2013	35 (19)	79,9 ± 4,92		27,69	ASM/Height2 < 10.75 kg.m-2 for men and 6.75 kg.m-2 for women
Escriche-escuder, 2021	Stoever, 2018	n/i (n/i)	n/i ± n/i		n/i	EWGSOP
Bao, 2020	Vasconcelos, 2016	28 (14)	72 ± 4		100	Handgrip strength≤ 21 kg
Talar, 2021	Vikberg, 2019	70 (n/i)	70 ± n/i		54,28	EWGSOP
Bao, 2020 e Talar, 2021	Yamada, 2019	16 (8)	84,3 ± 5,37		58,93	AWGS
Talar, 2021	Gené Huguet, 2018	173 (n/i)	80 ± n/i		64,73	Fried’s criteria for pre-frailty

Talar, 2021	Kim, 2011	155 (n/i)	75 ± n/i	100	ASM/height 2 less than 6.42 kg/m2, knee extension strength less than 1.01 Nm/kg, BMI less than 22.0 kg/m
Talar, 2021 e Bao, 2020	Park, 2017	50 (25)	74,1 ± 6,15	100	SMM/Weight < 25.1 %
Bao, 2020 e Talar, 2021	Zhu, 2018	77 (40)	73,39 ± 6,92	75,32	AWGS
Talar, 2021	Binder, 2005	15 (n/i)	78 ± n/i	44,66	Measures with established predictive validity for disability and mortality in older adults-at least two out of three frailty criteria.
Talar, 2021	Clegg, 2014	84 (n/i)	79 ± n/i	71,42	HOPE program
Bao, 2020 e Talar, 2021	Hassan, 2016	41 (20)	85,9 ± 7,5	64,44	EWGSOP
Bao, 2020, Talar, 2021 e Vliestra, 2018	Kim, 2012	78 (39)	78,85 ± 2,84	100	ASM/Height2 < 6.42 kg/m2
Bao, 2020 e Vliestra, 2018	Kim, 2013	64 (32)	68,6 ± 5,54	100	ASM/Height2 < 6.42 kg/m2
Bao, 2020	Kim, 2016	69 (35)	81,25 ± 4,68	100	SMM/Height2 < 5.67 kg.m-2
Bao, 2020, Vliestra, 2018 e Talar, 2016	Maruya, 2016	40 (26)	68,96 ± 5,76	55,77	AWGS
Talar, 2021	Ng, 2015	246 (n/i)	65 ± n/i	61,38	5 CHS criteria for frailty
Talar, 2021	Serra-prat, 2017	172 (n/i)	70 ± n/i	56,39	Fried’s criteria for frailty
Talar, 2021	Zech, 2012	69 (n/i)	79,5 ± 14,5	126,08	Fried’s criteria for frailty
Wu, 2018	Zhu, 2019		65 ± n/i	76,99	AWGS
Bao, 2020	Wei, 2017	80 (60)	75,75 ± 5,42	70	ASM/Height2 < 8.87 kg.m-2 for men and 6.42 kg.m-2 for women
Vliestra, 2018	Wei, 2017	80 (60)	75,75 ± 5,42	n/i	ASM/Height2 < 8.87 kg.m-2 for men and 6.42 kg.m-2 for women
Wu, 2018	Wei, 2017	80 (60)	75,75 ± 5,42	n/i	ASM/Height2 < 8.87 kg.m-2 for men and 6.42 kg.m-2 for women
Bao, 2020 e Escriche-escuder, 2021	Piastra, 2018	72 (35)	69,95 ± 2,73	100	EWGSOP

Bao, 2020, Talar, 2021 e Escriche-Escuder, 2021	Tsekoura, 2018	54 (36)	72,87 ± 7,02	87,3		EWGSOP

n: population; int.: n of intervention group; n/i: not informed; SD: Standard Deviation; SPPB: Short Physical Performance Battery; EWGSOP: European Working Group on Sarcopenia in Older People; AWGS: Asian Working Group on Sarcopenia in Older People; ASM: Appendicular Skeletal Muscle Mass; SMM: Skeletal Muscle Mass;

Table 3. Training Model Characteristics.

Review Reference	Original Reference	Training Model	Each session duration (minutes)	Weekly Sessions	Intervention duration (weeks)	Another training information
Talar, 2021	Aas, 2019	RT	30	n/i	10	30 min of heavy-load RT training
Escriche-escuder, 2021	Alencar Silva, 2018	RT	75	3	12	Resistance training with elastic tubes
Escriche-escuder, 2021	Balachandran, 2014	RT	n/i	n/i	15	3 sets of 10–12 repetitions using 70% of their 1RM on each machine before moving to the next exercise (interval 1–2 min).
Talar, 2021, Wu, 2018 and Vliestra, 2018	Bellomo, 2013	RT	n/i	3	12	RT with the intensity 60–80% of maximum force on muscle strength and balance confidence, 10–12 repetitions for 3 sets.
Talar, 2021	Binder, 2002	RT	n/i	3	36	PRT to increase muscle strength and FFM, 1RM
Talar, 2021	Cadore, 2014	RT	n/i	2	12	Multicomponent exercise program composed of upper and lower body RT with progressively increased loads (8–10 repetitions, 40–60% of 1RM) with balance and gait retraining.
Bao, 2020 and Talar, 2021	Cebria, 2018	RT	40	3	12	5 min warm-up, 20-30 min resistance exercises with workload and 5 min cool down.
Talar, 2021	Chan, 2012	RT	n/i	3	48	RT, dominant leg extension power.
Wu, 2018	Chang, 2018	RT	n/i	3	12	Resistance Whole-body vibration

Bao, 2020 and Talar, 2021	Chen, 2017	RT	60	2	8	PRT, 8–12 repetitions, upper and lower limb training, kettlebell weight training: kettlebell swing, kettlebell deadlift, kettlebell goblet squat, squat lunge, kettlebell row, single arm kettlebell row, biceps curl, triceps extension, two-arm kettlebell military press, Turkish get up and dynamic workout, 60–70% of 1RM.
Bao, 2020 and Talar, 2022	Chen, 2018	RT	60	2	8	Progressive resistance training
Bao, 2020	Chiu, 2018	RT	60	2	12	60-min warm-up, muscle resistance training and relaxation stage.
Escriche-escuder, 2021	De Freitas, 2019	RT	n/i	2	16	In the first four weeks, all subjects executed the same protocol (three sets of 12–15 RM with 60–90 sec of rest between sets, 2 days/wk). From the fifth week, the LP group performed 10 RM at weeks 5 to 8, 8 RM at weeks 9 to 12, and 5 RM at weeks 13 to 16. NP group maintained the same repetitions zone (12–15 RM)
Escriche-escuder, 2021	Del Campo-Cervantes, 2019	RT	n/i	3	12	n/i
Talar, 2021	Fiatarone, 1994	RT	n/i	3	10	PRT of the hip and knee extensors, 80% of 1-RM.
Bao, 2020	Hamaguchi, 2017	RT	60	2	6	60 min training program comprised five exercises (squats, front lunges, side lunges, calf raises, and toe raises).
Bao, 2020	Huang, 2017	RT	55	3	12	10 min warm up, 40 min elastic resistance exercises and 5 min cool down
Bao, 2020 and Talar, 2021	Liao, 2017	RT	40	3	12	Elastic PRT using Theraband products, 35–40 min, 3 sets and 10 repetitions for each exercise.
Bao, 2020	Liao, 2018	RT	55	3	12	10 min warm up, 40 min elastic resistance exercises and 5 min cool down
Talar, 2021	Lichtenberg, 2019	RT			28	A consistently supervised single-set training on resistance exercise machines using intensifying strategies.
Bao, 2020	Mafi, 2019	RT	55	3	8	10 min warm-up, 45 min resistance training.
Wu, 2018	Miller, 2018	RT	n/i	1	n/i	Resistance Whole-body vibration
Wu, 2018	Pietrangelo, 2009	RT	n/i	3	12	Strength local vibration
Bao, 2020 and Vliestra, 2018	Shahar, 2013	RT	50	2	12	10 min warm up, 30 min resistance exercises using Thera-Bands, and 10 min cool-down.
Escriche-escuder, 2021	Stoever, 2018	RT	n/i	2	16	Progressive resistance training, increasing to 80% to 85% of maximum strength with 3 sets of 8 to 12 repetitions.

Bao, 2020	Vasconcelos, 2016	RT	60	2	10	60 min progressive resistance exercise program
Talar, 2021	Vikberg, 2019	RT	n/i	3	10	RT programs to increase muscle function and muscle mass using participants' body weight and suspension bands.
Bao, 2020 and Talar, 2021	Yamada, 2019	RT	30	2	12	30 min of bodyweight RT with slow movement speeds, trunk flexion, hip flexion, hip extension, hip abduction, hip adduction, knee extension and ankle plantar flexion.
Talar, 2021	Gené Huguet, 2018	RT		3	24	RT program of exercises, 10 repetitions rising to 15.
Talar, 2021	Kim, 2011	RT	60	2	12	60 min of comprehensive physical fitness and muscle mass enhancement training program with PRT.
Talar, 2021 and Bao, 2020	Park, 2017	MT	80	5	24	RT combined with aerobic exercises, 50–80 min, elastic band exercises (elbow flexion, wrist flexion, shoulder flexion, lateral raise, chest press, revere flies, side band, dead lift, squad, leg press, ankle plantar flexion), with progressive repetitions.
Bao, 2020 and Talar, 2021	Zhu, 2018	MT	60	1	24	5-10 min warm up and cool down routine, 20-30 min chair-based resistance exercises using Thera-Bands, and 20-min aerobic exercises (90 min group chair-based RT using Thera-bands, and 20 min aerobic exercises, one-home session weekly, gait speed, twice per week.)
Talar, 2021	Binder, 2005	MT	22 exercises	3	36	22 exercises that focused on flexibility, balance, coordination, speed of reaction, strength, 65% of 1RM, 1 to 2 sets of 6 to 8 repetitions of knee extension, knee flexion, seated bench press, seated row, leg press, biceps curl, after 4 weeks 3 sets of 8 to 12 repetitions performed at 85% to 100% of 1RM, endurance training using treadmills, stationary bicycles, aerodyne bicycles or rowing machines at 65–70% of VO2peak.
Talar, 2021	Clegg, 2014	MT	n/i	5	12	RT to improve mobility and function.
Bao, 2020 and Talar, 2021	Hassan, 2016	MT	60	2	24	60 min progressive resistance and balance training.
Bao, 2020, Talar, 2021 and Vliestra, 2018	Kim, 2012	MT	60	2	12	5 min warm up, 30 min strengthening exercise, 20 min balance and gait training and 5 min cool down.
Bao, 2020 and Vliestra, 2018	Kim, 2013	MT	60	2	12	60 min of stretching, muscle strengthening, balance and gait training.
Bao, 2020	Kim, 2016	MT	60	2	12	60 min warm-up, weight/machine training, stationary bicycle aerobic exercise, and chair/standing exercise.
Bao, 2020, Vliestra, 2018 and Talar, 2016	Maruya, 2016	MT	n/i	n/i	24	home exercise programs, combining walking with lower limb resistance exercises.

Talar, 2021	Ng, 2015	MT	90	2	24	Moderate, gradually increasing intensity, 90 min of duration, included RT integrated with functional tasks and balance training involving functional strength and sensory input.
Talar, 2021	Serra-prat, 2017	MT	70	4	48	30–45 min of aerobic exercises and 20–25 min of RT, strengthening exercises with balance and coordination.
Talar, 2021	Zech, 2012	MT	45	2	36	20 min of balance exercises and 25 min of muscle strength and muscle power exercises using RT machines.
Wu, 2018	Zhu, 2019	MT	90	2	24	90 min group chair-based RT using Thera-bands, and 20 min aerobic exercises, one-home session weekly, gait speed.
Bao, 2020	Wei, 2017	VP	n/i	3	12	Whole-body vibration training with 14,400 vertical vibrations
Vliestra, 2018	Wei, 2017	VP	n/i	3	12	Whole-body vibration training with 14,400 vertical vibrations
Wu, 2018	Wei, 2017	VP	n/i	3	12	Whole-body vibration training with 14,400 vertical vibrations
Bao, 2020 e Escriche-escuder, 2021	Piastra, 2018	MET	25	2	36	5 min warm-up, 20 min muscular districts with low weight loads
Bao, 2020, Talar, 2021 e Escriche-Escuder, 2021	Tsekoura, 2018	TT	60	2	12	60 min comprehensive progressive group exercise program or home therapeutic exercises

RT: Resistance training; MT: mixed modalities training; VP: Vibrating platform training; MET: Muscle endurance training; TT: Therapeutic training; n/i: not informed.

Meta-analysis

In order to compare different ways to assess the three sarcopenia indicators, were selected only recommended assessments by the EWGSOP2, 2019 (15), and that appear in, at least, 2 reviews.

In that way, were performed the meta-analysis, in strength: handgrip strength and five chair stands time; in muscular quality or quantity: appendicular skeletal muscle or total body muscle mass, and; in physical performance: usual gait speed and timed up-and-go test; always comparing the intervention group (IG) with a control group (CG).

Furthermore, in order to compare the results of the different training models, the meta-analyses are presented in two ways: 1) including only individuals who underwent resistance training (resistance training analysis – RTA), and; 2) including individuals submitted to all other training models, except resistance training (non-resistance training analysis – NRTA).

Is important to notice that in usual gait speed, was not compared the methods to get this data, but only the speed calculated by the original papers (meter per second), due the variation to obtain this data. Among the most used tests were the 6-minute walk test, the 4-meter walk test and the 400m walk test.

In addition, in the evaluation of SMM, was used the differences in gain and/or loss of this variable, regardless of the assessment method. Among the most common, was possible observe assessments in DXA (dual energy x-ray absorptiometry), CT (Computerized Tomography) and BIA (Bioimpedance Analysis).

Meta-analysis 1 – Muscle Strength

1.342 individuals were included In handgrip strength assessment analysis (IG=689; CG=653), being 602 in RTA (IG=305; CG=297) and 740 in NRTA (IG=384; CG=356). Statistically significant differences were found in all analyses, favorable to the trained groups. While the RTA returned a value of $p<0.0001$, with high heterogeneity ($I^2=90\%$), the NRTA showed a more discreet difference, with $p=0.001$, and moderate heterogeneity ($I^2=57\%$).

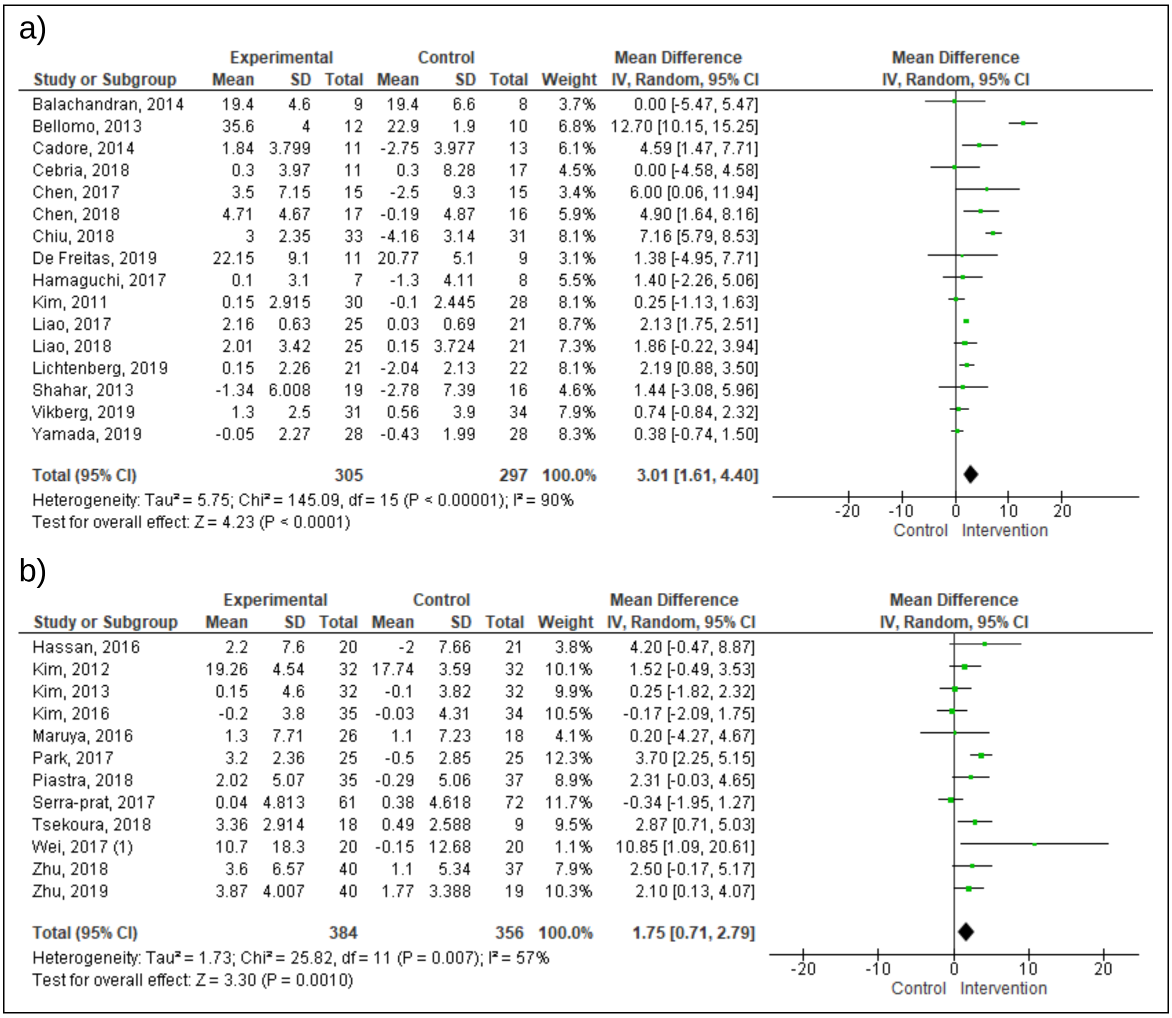


Figure 4. Forest plot of the differences and their effect size between intervention and control groups on handgrip strength, where: a) only resistance training (RTA) and; b) non-resistance training (NRTA).

The chair stand test analysis was the only opposite difference between the groups that trained resistance, and those that underwent other training modality, and included 629 individuals (IG=346; CG=283).

In the RTA were included only three studies, totalizing 294 individuals (IG=144; CG=150). Was found statistically significant difference, favorable to the trained groups, and low heterogeneity (p=0.001 and I²=13%). In other hand, in the NRTA, which included 335 individuals (IG=202; CG=133) the difference, although statistically significant (p=0.02), despite the high heterogeneity (I²=87%), was favorable to the control groups.

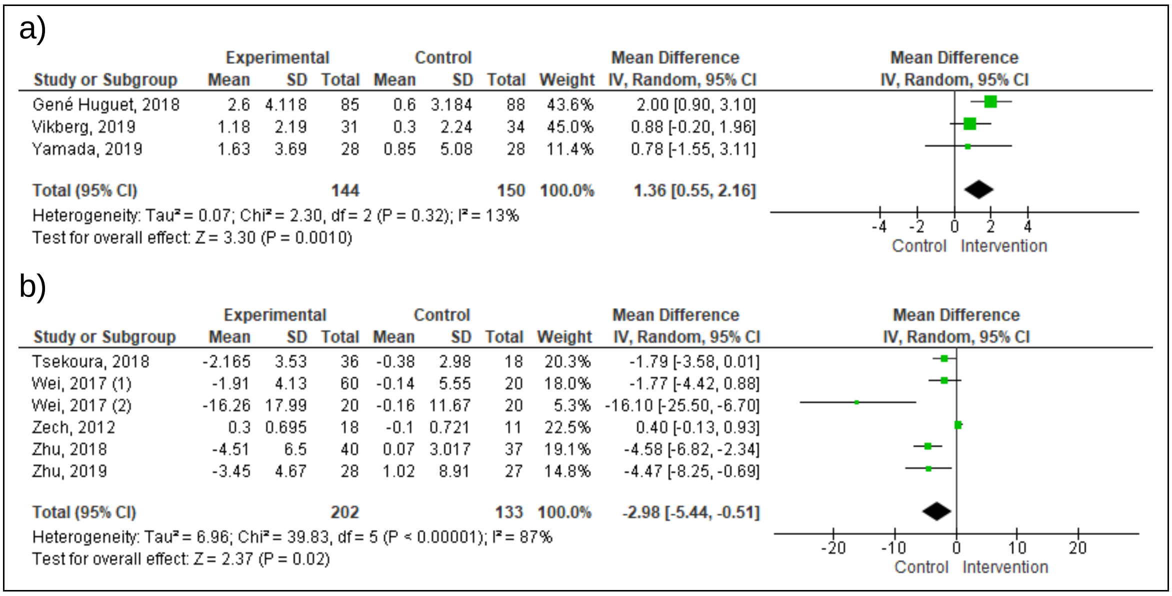
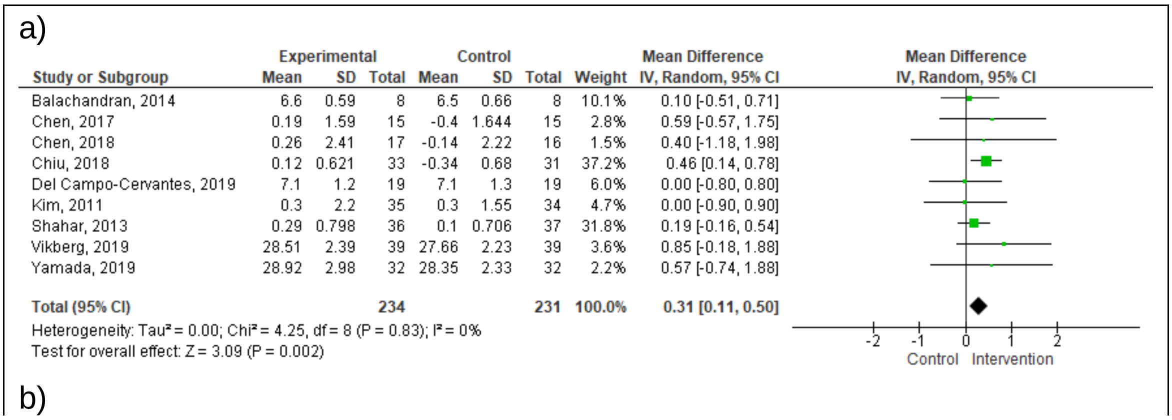


Figure 5. Forest plot of the differences and their effect size between intervention and control groups on five chair stands time, where: a) only resistance training (RTA) and; b) non-resistance training (NRTA).

Meta-analysis 2 – Muscle Mass

The skeletal muscle mass assessment showed a statistically significant difference in favor of the trained groups. It was possible to see a statistically significant difference in favor of the trained groups, with an advantage for the RTA (p=0.002) in relation to the NRTA (p=0.02). Heterogeneity, although low in both, was lower in the RTA than in NRTA (I²=0% and I²=36%, respectively).

In the SMM assessments 859 individuals were included (IG=436; CG=423), being 465 in RTA (IG=234; CG=231) and 394 in NRTA (IG=202; CG=192).



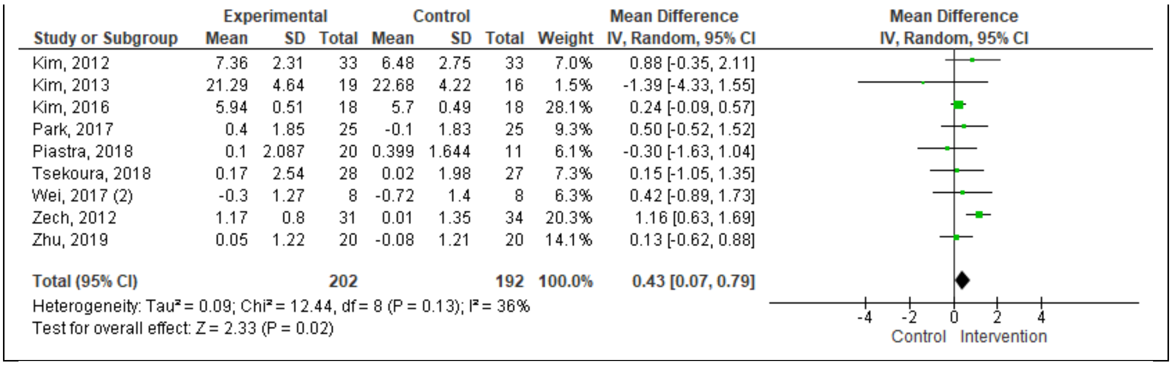
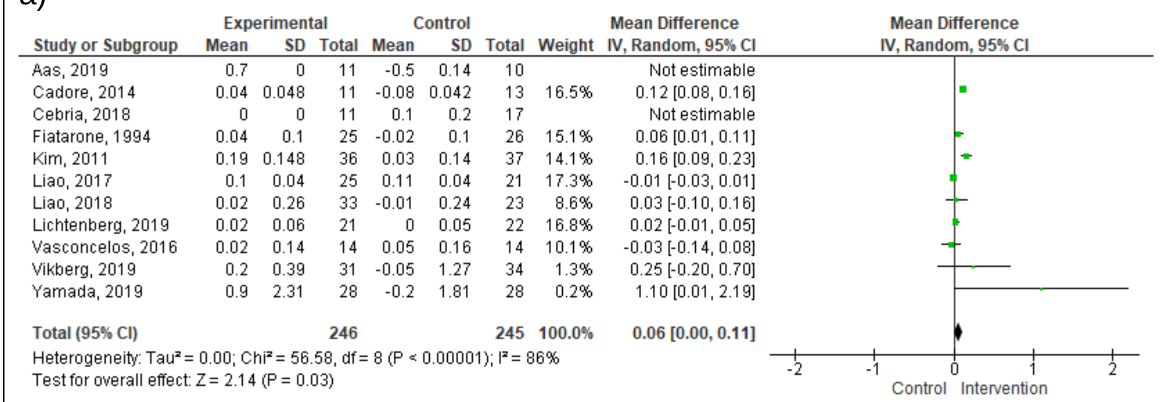


Figure 6. Forest plot of the differences and their effect size between intervention and control groups on skeletal muscle mass, where: a) only resistance training (RTA) and; b) non-resistance training (NRTA).

Meta-analysis 3 – Physical Performance

In the usual gait speed, a statistically significant difference was found in the analyzes of all groups, favorable to the trained groups, being IG=677 and CG=620. The NRTA seemed to have a greater difference than the RTA ($p<0.0001$ and $p= 0.03$, respectively). Furthermore, the RTA showed high heterogeneity ($I^2=86\%$) and the smallest sample (n=491; IG=246; CG=245), while the NRTA showed moderate heterogeneity ($I^2=65\%$), with a larger sample (n=834; IG=442; CG=392).

a)



b)

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
Hassan, 2016	0.04	0.3	20	-0.05	0.19	21	6.1%	0.09 [-0.06, 0.24]
Kim, 2012	1.5	0.23	39	1.22	0.23	39	8.9%	0.28 [0.18, 0.38]
Kim, 2013	1.36	0.3	32	1.26	0.2	32	7.6%	0.10 [-0.02, 0.22]
Kim, 2016	0.2	0.2	35	0.1	0.2	34	9.4%	0.10 [0.01, 0.19]
Maruya, 2016	1.46	0.2	26	1.42	0.17	14	8.0%	0.04 [-0.08, 0.16]
Ng, 2015	1.1	1.395	48	0.7	1.255	50	0.9%	0.40 [-0.13, 0.93]
Park, 2017	0.15	0.21	25	-0.04	0.21	25	8.0%	0.19 [0.07, 0.31]
Serra-prat, 2017	0.1	0.126	61	0	0.126	72	12.5%	0.10 [0.06, 0.14]
Tsekoura, 2018	0.26	0.15	36	0.01	0.13	18	10.5%	0.25 [0.17, 0.33]
Wei, 2017 (1)	1.05	0.16	20	1.02	0.17	20	8.9%	0.03 [-0.07, 0.13]
Zech, 2012	0.2	0.481	20	-0.2	0.368	11	2.4%	0.40 [0.10, 0.70]
Zhu, 2018	0.16	0.18	40	0.1	0.171	19	9.3%	0.06 [-0.03, 0.15]
Zhu, 2019	0.16	0.31	40	0.11	0.25	37	7.5%	0.05 [-0.08, 0.18]
Total (95% CI)			**442**			**392**	**100.0%**	**0.13 [0.08, 0.18]**

Heterogeneity: Tau² = 0.00; Chi² = 34.66, df = 12 (P = 0.0005); I² = 65%
Test for overall effect: Z = 4.96 (P < 0.00001)

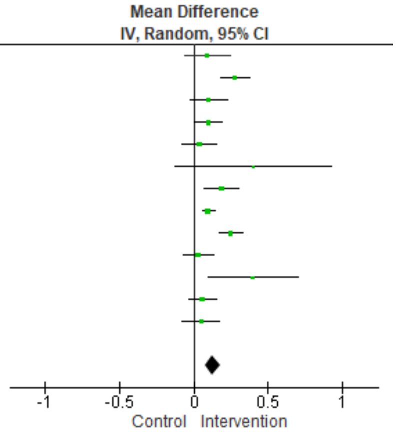


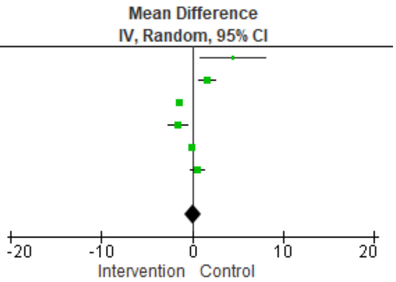
Figure 7. Forest plot of the differences and their effect size between intervention and control groups on usual gait speed, where: a) only resistance training (RTA) and; b) non-resistance training (NRTA).

The timed-up-and-go included 1.052 individuals (IG=558; CG=494). This performance test not showed a statistically significant difference for none of the analysis (p=0,94 on RTA, and p=0,46 on NRTA). Also, that analyses showed the higher heterogeneity among all analysis (I²=96% for all), which may be affected the results.

a)

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
Cadore, 2014	1.1	5.028	11	-3.4	3.78	13	5.0%	4.50 [0.89, 8.11]
Gené Huguet, 2018	1	2.689	85	-0.6	3.56	88	17.6%	1.60 [0.66, 2.54]
Liao, 2017	-1.39	0.24	25	0.03	0.26	21	21.3%	-1.42 [-1.57, -1.27]
Liao, 2018	-1.65	1.58	33	-0.05	2.42	23	16.3%	-1.60 [-2.73, -0.47]
Mafi, 2019	0.22	0.21	14	0.28	0.23	16	21.3%	-0.06 [-0.22, 0.10]
Vikberg, 2019	1.33	1.44	31	0.78	1.87	34	18.4%	0.55 [-0.26, 1.36]
Total (95% CI)			**199**			**195**	**100.0%**	**0.03 [-0.89, 0.96]**

Heterogeneity: Tau² = 1.04; Chi² = 199.37, df = 5 (P < 0.00001); I² = 97%
Test for overall effect: Z = 0.07 (P = 0.94)



b)

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
Clegg, 2014	-10.4	6.4	40	-39.1	9.06	30	9.2%	28.70 [24.90, 32.50]
Kim, 2011	1.78	0.961	30	-0.45	1.254	28	11.8%	2.23 [1.65, 2.81]
Kim, 2012	7.03	1.34	32	8.88	20.9	32	5.8%	-1.85 [-9.11, 5.41]
Kim, 2013	-1.78	1.48	32	0.45	1.92	32	11.7%	-2.23 [-3.07, -1.39]
Serra-prat, 2017	1.3	1.92	61	1.3	2.247	72	11.8%	0.00 [-0.71, 0.71]
Tsekoura, 2018	-1.48	1.93	36	0.13	1.71	18	11.6%	-1.61 [-2.62, -0.60]
Wei, 2017 (1)	11.32	1.72	20	12.38	3.21	20	11.3%	-1.06 [-2.66, 0.54]
Wei, 2017 (2)	-1.47	2.61	60	0.1	3.01	20	11.4%	-1.57 [-3.05, -0.09]
Wei, 2017 (3)	-15.08	13.43	20	0.69	11.64	20	5.4%	-15.77 [-23.56, -7.98]
Zhu, 2019	-2.51	4.92	28	0.44	6.75	27	9.9%	-2.95 [-6.08, 0.18]
Total (95% CI)			**359**			**299**	**100.0%**	**0.92 [-1.53, 3.36]**

Heterogeneity: Tau² = 13.08; Chi² = 336.34, df = 9 (P < 0.00001); I² = 97%
Test for overall effect: Z = 0.73 (P = 0.46)

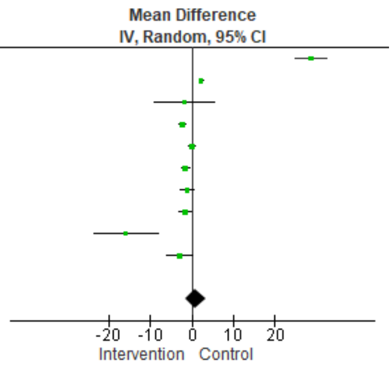


Figure 8. Forest plot of the differences and their effect size between intervention and control groups on timed up-and-go test, where: a) only resistance training (RTA) and; b) non-resistance training (NRTA).

The table 4 summarize all results across the meta-analyses, showing all data presented in each one of five assessments showed.

DISCUSSION

MUSCLE MASS AND STRENGTH

As showed in the meta-analyses, the resistance training presented best results in muscle strength and mass than the other training methodologies applied.

According to some authors (9, 16, 30, 31), the muscle strength is not only affected by the quantity of muscle mass only, but for some other variables, as angle of pennation, neural adaptation, and even the delivery of energetic substrates. However, even though strength and SMM have no direct relationship in their results, both indicators can be affected with some similar training variables within resistance training.

According to the position stand for RT, by ACSM, 2009, both for adults (30) and for older people (32), in order to achieve adequate muscle hypertrophy, resistance training should be performed with 1RM percentages between 70-85%, in 1-3 sets per exercise, of 8-12 repetitions per set. In order to achieve a significant improvement in strength, the same authors recommend a training program of 45-80% of 1RM, also with 1-3 sets per exercise, with 5-12 repetitions per set, both 1-4 weekly sessions. It means that both strength and hypertrophy can be worked in similar way. Fragala et al, 2019 (31), in its position statement to RT in older adults, recommends almost the same: 70-85% of 1RM, 2-3 times per week, with 2-3 sets per exercise. And so it is in most of the literature in the area.

This hypothesis is supported by the current knowledge about the physiology of the proliferation of cellular proteins in the skeletal striated muscle. This phenomenon occurs mainly due to mechanical overload. Several pathways, such as serum response factor (SRF), nitric oxide synthase neuron (nNOS), and phosphatidic acid (PA) can activate the cell nucleus, or the mammalian target of rapamycin (mTOR), one of the main proteins responsible for muscle cell growth and, in some cases, proliferation. All these pathways may be activated by mechanical overload, and promote structural modifications in the muscle, such as increased cross-sectional area, and modification of the pennation angle of the fibers (33, 34)

However, according to ACSM (30, 32) and Fragala et al (31), inadequate overloads, with volume stimuli and training intensity outside the preconized by the literature, may not generate the expected physiological response when it comes to muscle cell growth. In this study data, few reports of the percentage of 1RM applied in training were found, making it impossible to calculate an average (only five out of 30 RT program showed its percentage of 1RM).

Furthermore, positive results were also found in strength gain (except in the sit-to-stand test) and muscle mass in the groups that trained other modalities than not RT. The strength gain can be explained In a study by Egan e Zierath, 2013 (34), where the authors were able to find mitochondrial hypertrophy and hyperplasia in muscle cells, particularly in type II fibers, in just six weeks of cardiorespiratory training. This improved the oxidative capacity and delivery of energy substrates to the muscle, thus improving its function, explaining, therefore, the strength gains of all groups analyzed in this study.

Table 4. Meta-analyses summary of results.

Test	Studies included	IG (n)	CG (n)	Total (n)	Tau²	Chi²	df (p)	I²	Z	p
	Studies Characteristics				**Heterogeneity**				**Overall Effect**	
Handgrip Strength										
Total	28	689	653	1342	4,14	173,69	37 (<0,00001)	84%[a]	5,3	<0,00001*
RTA	16	305	297	602	5,75	145,09	15 (<0,00001)	90%[a]	4,23	<0,0001*
NRTA	12	384	356	740	1,73	25,82	11 (0,007)	57%[b]	3,3	0,001*
Five Chair Stands Time										
Total	9	346	283	629	3,13	54,22	8 (<0,00001)	85%[a]	1,4	0,16
RTA	3	144	150	294	0,07	2,3	2 (0,32)	13%[c]	3,3	0,001*
NRTA	6	202	133	335	6,96	39,83	5 (<0,00001)	87%[a]	2,37	0,02*
Skeletal Muscle Mass										
Total	18	436	423	859	0	17,21	17 (0,44)	1%[c]	4,55	<0,00001*
RTA	9	234	231	465	0	4,25	8 (0,83)	0%[c]	3,09	0,002*
NRTA	9	202	192	394	0,09	12,44	8 (0,13)	36%[b]	2,33	0,02*
Usual Gait Speed										
Total	24	677	620	1297	0,03	571,43	22 (<0,00001)	96%[a]	4,2	<0,0001*
RTA	11	246	245	491	0	56,58	8 (<0,00001)	86%[a]	2,14	0,03*
NRTA	13	442	392	834	0	34,66	12 (0,0005)	65%[b]	4,96	<0,00001*
Timed Up-And-Go Test										
Total	16	558	494	1052	2,37	565,55	15 (<0,00001)	97%[a]	0,92	0,36
RTA	6	199	195	394	1,04	199,37	5 (<0,00001)	97%[a]	0,07	0,94
NRTA	10	359	299	658	13,08	336,34	9 (<0,00001)	97%[a]	0,73	0,46

IG: intervention group; CG: control group; RTA: resistance training groups; NRTA: non-resistance training groups; [a]high heterogeneity; [b]moderate heterogeneity; [c]low heterogeneity; *Statistically significant.

It is difficult, nonetheless, to find articles that support muscle mass gain in aerobic training. Is possible to find in the literature even some articles that contradicts the use of aerobic training for sarcopenia combat. Ferreira et al, 2022 (35), in a cross-sectional study, showed that be inserted in an aerobic training program, or be sedentary, do not affect the sarcopenia prevalence among older women.

However, most of the trainings used by the analyzed studies were not with this emphasis (only one was). Most of them included, if not an adequate program of RT, some form of this modality. We, then, hypothesize that these mixed modalities may have influenced the results of SMM, although we recommend that more studies can better report the effect of physical training modalities, other than RT, on SMM.

It is also important to highlight the results obtained in the sit-to-stand test. While the groups that trained RT obtained important results, the groups that trained other modalities obtained worse results than their respective controls. According to several authors (10, 16, 18, 31), RT is more effective in improving power output than other modalities, such as aerobic exercise, balance, stretching or combined training. The power output (strength plus speed) should be part of a regular training program for older populations, with higher speeds in the concentric phase, at 40-60% of 1RM (31).

Increasing the power output, consequently, the time to perform the sit-to-stand test will reduce, since that is precisely what this test measures: how fast an individual can sit in and out of a chair five times.

Also, the variability of training models across the clinical trials, and the lack of precepts listed by the main authors in the area of training for the elderly, the non-standardization in volume and intensity, all aimed at increasing strength and muscle mass, may be the explanation for, in some cases, the control group have showed better results than the intervention group.

PHYSICAL PERFORMANCE

Although the TUG did not show statistically significant differences in any of the meta-analyses, perhaps because it is a more complex test (9), the usual gait speed showed important differences between the trained groups and their respective controls.

The usual gait speed showed statistically significant results in all analyses, but the most important changes were found in NRTA. According to some authors (36, 37), RT, when following the precepts listed in the literature, has the ability to improve strength and muscle mass, but balance, capacity for activities of daily living, muscular endurance and cardiorespiratory capacity are more important valences for physical performance than strength and quantity of SMM.

Also, according to Cadore et al, 2013 (38), a training program that combines valences such as resistance, aerobics, balance and flexibility may be more important for frail or severely sarcopenic elderly people. This may explain, albeit in part, why the elderly submitted to training modalities other than RT obtained better physical performance results than those submitted to RT.

About the TUG, no significant differences were found in the meta-analyses. According to EWGSOP2, 2019, the more complexes tests, as TUG and SPPB, although have a good reliability and relationship with the physical performance in older individuals, they can be affected by others variables, as dementia, gait and balance disorders (15).

As the studies included in the analyzes do not report assessments of balance or cognition, no conjecture can be made to explain these results, other than to suggest that future studies can further explore the effect of physical training modalities in front of more complex tests of physical performance.

SARCOPENIA DIAGNOSIS

Regarding the diagnosis of sarcopenia, although there are some consensuses that standardize the assessment and definition of sarcopenia (7, 9, 10), what is still seen in clinical trials in the area is a high variability of these tests and cut-off points, making a broader systematic evaluation impossible, such as was the aim of the present study.

According to a wide systematic review conducted by EWGSOP and IWGS, 2014 (10), when a study is proposed to evaluate sarcopenia in older populations, the ideal is to prioritize assessments with high reliability and reproducibility. However, most tests considered gold standard, or even with great comparability with them, are expensive and difficult to access (15), which made the consensuses remove these tests from their list of valid evaluations for the diagnosis of sarcopenia.

CONCLUSION

This study demonstrated that, for the evaluated samples, a physical training program was able to improve strength, muscle mass and performance, in sarcopenic or not sarcopenic elderly, thus reducing the indicators of this syndrome.

The muscle mass and the muscle strength seems to be best enhanced with a resistance training program, although there are good results with other methods of physical training.

Still, the physical performance showed best results with other methodologies of physical training that not resistance training, although the RT also showed good results in this variable.

It can still be seen that there is a high variability in the prescription of training models, especially in terms of volume and intensity of training sessions.

Finally, high variability and lack of standardization were also observed with regard to the assessment of sarcopenia indicators, and even the cutoff points for characterization and diagnosis of sarcopenia among the elderly submitted to these tests.

LIMITATIONS

The lack of standard among the RCTs reflects on the systematic reviews, making hard the meta-analysis of the studies, although the high quality of the SR. The number of series, repetitions, types of exercises and training progress are the biggest differences among the RCTs.

In order to reduce this variation, we advise to new RCTs can be designed following the literature precepts and standardization of methodologies, with progression, volume and intensity more suitable for each aim.

Also is important to notice that are no pattern in the assessment of the sarcopenia, even though there is some consensus in the field. These consensuses, like the EWGOSP, IWGS, AWGS, among others, defines very well the characterization of sarcopenia, and its stages. But within the sarcopenia consensus itself, the authors suggest several valid forms of assessment, making the choice of assessments on RCTs varied and unrivaled among them.

Thus, we advise that new consensuses on sarcopenia should address some standardization, even if this is difficult for the clinic practice, but that at least in the fields of research, so the researchers can compare results, replicating the assessment methods.

CONFLICT OF INTERESTS

The authors of this article declare that there is no conflict of interest or any kind of founding for their realization.

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Appendix 1. Search Strategy

MedLine (Via PubMed):

("sarcopenia"[MeSH Terms] OR "sarcopenia"[All Fields]) AND ("aged"[MeSH Terms] OR "aged"[All Fields] OR ("aging"[MeSH Terms] OR "aging"[All Fields] OR "ageing"[All Fields]) OR ("aged"[MeSH Terms] OR "aged"[All Fields] OR "elderly"[All Fields] OR "elderlies"[All Fields] OR "elderly s"[All Fields] OR "elderlys"[All Fields]) OR ("older"[All Fields] OR "olders"[All Fields]))

Embase:

'sarcopenia'/exp OR sarcopenia AND ([aged]/lim OR [very elderly]/lim) AND 'systematic review'/de

Appendix 2 – Complete list of all studies found after the search strategy.

The papers will appear in first author alphabetic order, in the same format that was downloaded from databases. The duplicates were already deleted.

1. Poster Abstracts of the 11th Annual BTOG Conference 2013. Lung Cancer, v. 79, n., p., 2013.
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Appendix 3. Prisma Statement pages report.

Question	Bao, 2020		Escriche-Escuder, 2021		Talar, 2021		Vliestra, 2018		Wu, 2021	
1	Y	1	Y	1	Y	1	Y	1	Y	1
2	N	0	Y	1	N	0	Y	1	Y	1
3	Y	1-2	Y	1-2	Y	1-2	Y	1-2	Y	2
4	Y	2	Y	2	Y	3	N	0	N	0
5	Y	2	Y	2	Y	2	N	0	Y	2
6	Y	2	Y	2	Y	3	N	0	N	0
7	Y	2	Y	2	Y	2-3	Y	2	Y	3
8	N	0	N	0	Y	26	N	0	Y	3
9	Y	2	Y	ap. C	Y	2-3	Y	2	Y	3
10	Y	2	Y	3	Y	3	Y	3	Y	3
11	Y	2	Y	3	Y	3	Y	3	Y	3
12	Y	4	Y	3	Y	3	y	3	Y	3
13	Y	4	Y	3	Y	3-4	y	3	y	3
14	Y	4	Y	3	Y	3-4	y	3	Y	3
15	Y	8	Y	4	Y	4-5	y	10	Y	5
16	N	0	N	0	N	0	N	0	N	0
17	Y	4	N	0	Y	4	Y	2	Y	4
18	Y	3	Y	3	Y	4	Y	2-3	Y	4
19	Y	4	Y	3	Y	3	y	3	Y	3
20	Y	5-7	Y	5	Y	7-24	Y	11-13	Y	7-10
21	Y	5-7	Y	5	Y	15-24	Y	11-13	Y	7-10
22	Y	8	Y	4	Y	4-5	y	10	Y	5
23	N	0	Y	7	N	0	Y	13	N	0
24	Y	8-9	Y	5-9	Y	24-26	Y	12-13	Y	6-10
25	N	0	Y	9	Y	25	N	0	Y	10
26	Y	9	Y	9	Y	26	Y	13	Y	10
27	N	0	Y	9	Y	26	N	0	Y	10

N: no; Y: yes; ap: appendix.

Appendix 4. References included in the selected reviews.

The references are presented by order of appearance in each review, following the original citation form from the systematic reviews. The duplicate and triplicate studies will appear only once.

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5 ARTIGO ORIGINAL 2

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Title: Comparison Of Diagnostic Criteria For Sarcopenia In Older People: Cross-Sectional Study

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ABSTRACT

Background: Sarcopenia has been subject of study for some years, been defined by some international consensuses. A lack of pattern in ways to assess the syndrome, with a great variability of methods and cutoff points, used to make harder the data compilation in systematic reviews, with meta-analyses. **Objective**: to compare the methods for evaluating sarcopenia in older people, demonstrating the relationship of each test with its peers for the same criteria diagnostic. **Methods**: Cross-sectional study, where older people were assessed for: muscle strength, by handgrip and isokinetic dynamometers; body composition, by BIA, skinfolds, mid-arm and calf circumferences; physical performance by six-minute walk test, TUG and SPPB. The qualitative variables were expressed in absolute and relative frequency, the quantitative were presented in mean+SD, median and IQR. The correlations were assessed by Spearman's Correlation Coefficient, accepted as low when r>0,1; moderate when r>0,3, and; high when r>0,5. The p-value <0,05 was adopted as significant. This study was approved by UFCSPA Research Ethics Committee, and volunteer read and sign the ICF. **Results:** 78.31% were women, the average age was 67,85+5,27 years. In strength assessments was found moderate correlation between Handgrip and quadriceps PT, and high with hamstrings PT. PT assessments showed high relation between them. SMM showed a high correlation with FFM, and a low correlation with CC and MAC. FFM showed high correlation with all body composition assessments. In physical performance, UGS had moderate correlation with SPPB and high with TUG. TUG showed low correlation with SPPB. UGS. **Discussion and Conclusion**: For strength, handgrip showed the best correlation, even needing more prospective studies. The chair stand test did not show relationship with other techniques, and it may be because of other variables than strength only, as balance and power output. For body composition, BIA showed the best correlations, as expected. Skinfold, calf circumference and MAC could be a good choice for this criterion, because they have good correlation, low cost, and are fast to develop. For physical performance, UGS seems to be the best assessment, although SPPB and TUG showed some correlations. Is important to note that, for these criteria, the choice of assessment method may affect the result of sarcopenia severity.

Key-words: Sarcopenia; Aged; Geriatric Assessment; Anthropometry; Kinanthropometry.

BACKGROUND

Sarcopenia has been subject of large areas of study for some years now, even having been included in the IDC, in 2016 (1). Currently, there are some major consensuses that define the syndrome assessment and diagnosis, such as the European Working Group of Sarcopenia In Older People – EWGSOP (2, 3), the Asian Working Group on Sarcopenia - AWGS (4), the International Working Group on Sarcopenia - IWGS (5) and the limited mobility consensus (6). The main consensus, which has been at the forefront of studies on the subject, however, is the EWGSOP (3).

Most consensuses, nevertheless, are still under construction, as is the knowledge about sarcopenia itself (3, 4). Today the EWGSOP2, leading authors in the field of sarcopenia assessment and diagnosis, defines probable sarcopenia as low muscle strength (assessed by handgrip or chair stand test); sarcopenia as low strength combined with low skeletal muscle mass (assessed by DXA, CT, MRI or BIA); and the severe form of the syndrome with the combination of the two previous indicators, plus low physical performance (assessed by usual gait speed, SPPB, 400m walk test or TUG). However, even those authors highlight on their works that still lack more studies about the assessment and diagnosis of sarcopenia (3).

Due to the great variability of the possible assessments, there is also a difficulty in the literature in replicating the information, and even in summarizing the epidemiological data of the disease. Several systematic reviews in the area have reported difficulties even in running meta-analyses, given the variation in assessment models, cut-off points and diagnostic criteria adopted (5, 7-9).

This study, therefore, aim to compare the methods for evaluating sarcopenia in older people, demonstrating the relationship of each test with its peers for the same diagnostic criteria.

MATERIALS AND METHODS

This study is a part of the randomized clinical trial developed by the Rehabilitation Studies Group of the Federal University of Health Sciences (GEReab – UFCSPA) and followed all the methodological precepts listed in the original study from which it came.

Study Design

Cross-sectional, observational study. The individuals included in this study were part of the RCT, as previously mentioned. For this study, however, only the evaluations of the volunteers were used, and they are demonstrated in a transversal way. In other words, there is no comparison on the evolution of patients in relation to the intervention to which they were submitted, nor are they divided into the groups to which they were originally randomized. Was used the evaluations only, and each evaluation composes, in this study, an individual, counting for the final sample.

Research Place

Federal University of Health Sciences of Porto Alegre (UFCSPA) with older volunteers from invitations made by various means, such as digital media, printed invitations delivered by mail, telephone calls and contacts with other research projects at UFCSPA that involved older people.

Ethical Procedures

This study was submitted and approved by UFCSPA research ethics committee, registered under the number CAAE 66091417.5.0000.5345, and with an approval letter numbered 3.335.461.

In addition, all volunteers read and signed the free and informed consent form, in which all volunteer research subjects were presented to the risks and benefits of being included in a research project of this nature.

Inclusion Criteria

To be included as a sample in this project, the individual must be considered older, that is, be 60 years of age or older, as established by Brazilian Law Nº 8.842/1994, being a resident of the city of Porto Alegre, Rio Grande do Sul, being aware of all the protocols to which they will be submitted and signing the Free and Informed Consent Form (ICF).

Exclusion Criteria

Older people who did not want to participate in the project, and/or with physical, cognitive or metabolic disabilities were excluded from the study, as described below:

• People with physical, cognitive or sensory disabilities that make the individual unable to participate in the assessments proposed by this study;

• Older people undergoing a postoperative process, of any nature, or who are undergoing physical therapy rehabilitation of any nature;

Older people classified in the initial assessment as “high risk” for physical exercise, presenting cardiovascular, pulmonary or metabolic disorders, or one or more cardiovascular signs and symptoms were also excluded from the study. Inclusion and exclusion criteria were identified through the first assessment, before the randomization process.

Sample Calculation

According to data from the study by Balachandran et al, 2014 (10), the sample calculation was performed considering a standard deviation of 1.45 points and a difference to be detected of 1.2 points in the SPPB, still establishing the power of the study at 80%, a confidence level in 95% and significance level set at 5% ($p \leq 0.05$), adding the sample size by 20% for possible segment losses, should be 22 patients per group. As the original study had two groups, the n calculated for this study was 44 individuals.

Procedure for data collection and Evaluations

The evaluations were carried out at UFCSPA, by trained professionals. For the original project, participants underwent a series of assessments, including level of physical activity, sarcopenia, body composition, functional capacity, muscle quality, quality of life, semiquantitative food frequency questionnaire and cytokine analysis.
For this study, however, the following assessments are presented:

Muscle strength: assessed by handgrip (Jamar hydraulic hand dynamometer - Sammons Preston Rolyan, IL, USA), which data are presented in Kg. The patients position and test realization followed the recommended by the American Society of Hand Therapy (11) and; isokinetic dynamometry (Biodex System pro 4 - Biodex Medical Systems Inc., NY, USA), which data are presented in Newton.meter (N.m). The patient positioning and protocol to assess were following Kannus et al, 1994 (12). Are presented only assessments of peak torque by isotonic eccentric contraction (PT) of quadriceps and hamstrings in movements of knee extension and flexion.

Skeletal muscle mass: assessed by Bioimpedance Analysis - BIA (Maltron BF-906 Body Fat Analyzer, Maltron International Ltd, Essex, UK). The patient’s preparation and positioning followed the recommended by the European Society for Clinical Nutrition and Metabolism (13). The data collected was the impedance resistance, and the SMM was calculated using the formula proposed by Janssen et al, 2000 (14); and skinfolds (Scientific Adipometer Top Tec II. Cescorf, Porto Alegre, Brazil). Triceps, suprailiac, subscapularis, midaxillary, thigh and calf skinfolds were collected, and the fat-free mass (FFM) was calculated using the formula proposed by Pereira et al, 2013 (15);

Physical performance: assessed by usual gait speed, trough the 6-minute walk test, conducted following recommendation by Enright et al, 2003 (16). The data was reached dividing the meters walked by 360 seconds (six minutes); The timed-up-and-go test, following the recommended by Podsiadlo et al, 1991 (17), which data are presented in seconds to finish the test, and; The Short Physical Performance Battery, according to the Brazilian Portuguese version (18), which data are presented in points, been 1 the minimum, and 12 the maximum.

Also, other variables are presented in this work, as the calf circumference and mid-arm circumference (MAC) (19).

Statistical Analysis

The description of qualitative variables was expressed in absolute and relative frequency. The results of the quantitative variables are presented in mean and standard deviation (SD), median and interquartile range (IQR). Data were tested for normality by Shapiro-Wilk's test, and the correlations were assessed by Spearman's Correlation Coefficient. The correlation, presented with r_s, was accepted as low when r>0,1; moderate when r>0,3, and; high when r>0,5, following the recommendations by Cohen, 1992 (20). The p-value <0,05 was adopted as significant. The analyzes were performed in the statistical software SPSS (IBM SPSS Statistics for Windows, Version 25.0. IBM Corp., Armonk, NY, USA).

RESULTS

Table 1 demonstrates the characteristics of the sample evaluated. Of the 83 assessments, 78.31% were women (n=65). In addition, the average age verified was 67,85+5,27 years, which shows an average of young older people.

Regarding the diagnostic criteria for sarcopenia, according to the EWGSOP2, the sample presented, on average, assessments above the cut-off points proposed by EWGSOP2 (3) for handgrip strength, SMM, usual gait speed, TUG and SPPB.

Table 1. Descriptive Data Analysis

	Variable	n	Mean±SD	Median	IQR
Sample Charac-teristics	Gender (female)	65 (78,31%)[2]			
	Age	81	67,82±5,29	65,87	63,61-70,6
	BMI (Kg/m²)	81	29,01±4,35	29,27	26,34-31,46
Strength	Handgrip strength (Kg)[1]	79	31,29±9,08	30	25-34
	PT Quadriceps	30	138,36±47,12	128,5	110,1-166
	PT Hamstrings	30	110,17±40,39	103,15	77,8-142,8
	Sit-to-stand test[3]	77	3,06+1,02	3	2-4
Body Composi-tion	SMM by BIA (Kg)[1]	77	13,55±2,8	12,75	11,82-14,92
	FFM by skinfolds (Kg)	63	49,82±8,18	48,73	44,52-55,94
	Calf circumference (cm)	63	36,94±3,25	37	35-39,5
	MAC	81	19,23±10,62	23,41	20,81-25,92
Physical Perfor-mance	Usual gait speed (m/s)[1]	81	1,26±0,36	1,33	1,18-1,44
	TUG Time (s)[1]	72	6,89±1,39	6,7	6-7,67
	SPPB (points)[1]	81	10,47±2,61	11	10-12

Where: n: sample; SD: Standard deviation; IQR: interquartile range; [1]Assessments recommended by EWGSOP2 to assess sarcopenia in older people; [2]Data presented in absolute and relative frequency; [3]Data extracted from SPPB test, been the third field of analysis in this instrument; SMM: Skeletal muscle mass; BIA: Bioimpedance analysis; Kg: kilogram; FFM: Fat-free mass; BMI: Body mass index; m: meter; cm: centimeter; MAC: Mid-arm circumference; s: seconds; TUG: Timed-up-and-go test; SPPB: Short physical performance battery; PT: peak torque of isotonic eccentric contraction

The following table present the correlations between the variables. As many data were returned in the analyses, only those recommended by EWGSOP2, or that showed some correlation with sarcopenia diagnostic criteria were included. The other data can be found in Appendix 1.

In Table 2, we can see the correlations between the evaluations for the same diagnostic criterion: In strength assessments all data showed correlation between themselves. Handgrip strength showed moderate correlation with quadriceps peak torque, and high with hamstrings peak torque. Both peak torque assessments showed good relation between them.

SMM showed a high positive correlation with FFM, and a low correlation with calf circumference and MAC. The fat-free mass showed high correlation with all body composition assessments: MAC and calf circumference, showing that this data could be the most reliable to assess body composition.

In physical performance, all three assessments recommended by EWGSOP2 and presented here showed some correlation. UGS had moderate correlation with SPPB and high with TUG, while TUG showed low correlation with SPPB.

To understand those data are still needed some clarification about the results showed. In general, is expected that the individual has higher results. For example, to have more SMM is good, as is show more handgrip strength, or gait speed. However, one data is expected to have lower results: the TUG test, when is measured the time to complete the track. So, to have completed in less time is a good outcome. In this way, is expected that good correlations with this assessment are negative.

Table 2. Correlations Across the Sarcopenia Assessments.

CORRELATIONS	p-value	r_S
MUSCLE STRENGTH		
Handgrip Strength X Peak Torque# Quadriceps	0,008*	0,491[2]
Handgrip Strength X Peak Torque# Hamstrings	<0,00001*	0,711[3]
Handgrip Strength X Sit-to-stand test	0,587	0,063
Peak Torque# Quadriceps X Peak Torque# Hamstrings	<0,00001*	0.745[3]
Peak Torque# Quadriceps X Sit-to-stand test	0,580	0,109
Peak Torque# Hamstrings X Sit-to-stand test	0,757	0,061
BODY COMPOSITION		
Skeletal Muscle Mass X Calf Circumference	0,035*	0,268[1]
Skeletal Muscle Mass X Mid-arm Circumference	0,044*	0,231[1]
Skeletal Muscle Mass X Free-fat Mass	<0,00001*	0,565[3]
Free-fat Mass X Mid-arm Circumference	<0,00001*	0,668[3]
Free-fat Mass X Calf Circumference	<0,00001*	0,801[3]
PHYSICAL PERFORMANCE		
Usual Gait Speed X SPPB	0,003*	0,326[2]
Usual Gait Speed X TUG	<0,00001*	-0,631[3]
TUG X SPPB	0,046*	-0,236[1]

Where: p-value and r_S by Spearman Correlation; *statistically significant correlation; [1]low correlation; [2]moderate correlation; [3]high correlation; TUG: timed-up-and-go test; #peak torque of isotonic eccentric contraction; SPPB: short physical performance battery.

DISCUSSION

Strength

All relationships between strength assessments were statistically significant, except for the sit-and-stand test, which showed no significant correlation not only with strength assessments, but with any test presented in this work.

According to some authors (21, 22), handgrip tests have a good association, comparability and reliability when compared with the gold standard of strength assessment, the isokinetic dynamometry, particularly in older people groups. This can explain why the isokinetic dynamometry is no longer recommended by the EWGSOP2, since the revised consensus, in 2019 (3). If there is a faster and cheaper test, there would be no reason to use its gold standard, if not for method comparisons, like this work.

It is important to highlight that some authors have some longitudinal studies. According to Ostolin et al, 2021 (22), the handgrip test has a good comparability with isokinetic dynamometry in cross-sectional studies, but the same does not occur over time, in prospective studies. The hypothesis for this statement is that, when older people are trained, over time they have a more significant improvement in the musculature of the knee flexors and extensors, when compared to the palmar grip muscle groups. As in older people not undergoing interventions, over time the tendency is that more strength is lost in the muscles of the lower limbs than in the upper limbs (22).

Meanwhile, the chair stand test, although it has a good relationship with the strength following some authors, and is listed as one of the valid tests for sarcopenia by the main consensuses (3, 4), its relationship with muscle strength may depend of other factors, such as balance, familiarity with the test, impairment of the lower limbs, among others (3). Also, this test is integrant part of the SPPB test, one of the main tests to evaluate performance listed by the EWGSOP and AWGS (3, 4). Thus, the sit-and-stand test could be better understood as a functional test, and not just a test of strength. However, it did not present significant correlations with any test in this study, either strength or physical performance. This may be due to the excellent results in this test by most of the elderly who performed it. We hypothesize that for this result, with generally high results in older dwelling people, a larger sample might be needed in order to demonstrate a significant correlation with any other test.

Body Composition

In this work, SMM assessed by BIA showed low correlation with CC and MAC, while FFM measured by skinfolds showed high correlation with SMM, MAC and CC.

The SMM, assessed by BIA, showed a good correlation with the FFM, assessed by skinfolds. Although this second type of assessment was taken from the 2019 review of the European consensus for sarcopenia (3), this assessment appears to be valid for measuring this variable, although, of course, we did not have a gold standard to compare with both measures. According to Bruyere et al, 2016 (23), anthropometric assessments are the most used in clinical practice, representing about 57.5% of clinical assessments of body composition, as it is an instrument that is easy to apply, fast and inexpensive (23). However, according to Beaudart et al, 2016 (24), with advancing age, skinfolds may lose their power to predict skeletal muscle mass, as better comparisons with DXA are still needed a definition, in addition to more accurate cut-off points for this purpose (24).

Another interesting finding was the correlation, albeit low, of CC and MAC with SMM, and high correlation of those both variables with FFM. Calf circumference has been widely used in sarcopenia assessments for some time, and is even a valid screening measure for the AWGS (4). Kawakami et al, 2020 (25), compared the correlation of CC with BIA (presented in this work) and with the gold standard for evaluating this variable, DXA, finding a good correlation for both, concluding that this variable can be a simple, inexpensive, quick and reliable substitute for body composition assessments in sarcopenia.

The mid-arm circumference has lately been used as a predictor for several negative health outcomes, mainly by the National Health and Nutrition Examination Survey (NHANES) (26), such as mortality (26), insulin resistance (27), arterial hypertension (28), among others, but this variable has been rarely used for risk assessment in sarcopenia. As demonstrated in this work, there is a correlation between this measure and other assessments for body composition, such as BIA and skinfolds. Although the results were discreet, and with a not so expressive sample, evidence supports that this measure can be a better predictor for certain health outcomes, even better than widely used body composition assessments, such as BMI (29). Therefore, we advise that new studies be developed using this measure, aiming at sarcopenia as a central theme.

Performance

In this work, UGS presented moderate correlation with SPPB, and high correlation with TUG test. The TUG test also showed low correlation with SPPB.

According to EWGSOP2 (3), the UGS is the simplest and most reliable measure to assess physical performance, in addition to being the most used measure in studies in the area of sarcopenia. SPPB and TUG are also recommended as being highly reliable for the assessment of physical performance (3, 4). However, in this part of the evaluation of sarcopenia, the aim is to diagnose the severity of the syndrome, and this may depend on several factors, according to the characteristics of the patient.

For example, the UGS is a simple measure to obtain, and does not depend on a great understanding on the part of the patient, like the TUG and SPPB, thus favoring the patient with cognitive deficits or comprehension difficulties (3). The TUG is a more complex test, which assesses the ability to sit and stand up from a chair, and to walk not only in a straight line, but also to make a 180º turn when walking, and a 180º turn when sitting (17). This involves other parameters such as balance, cognition, fear of falling and mobility (30). The SPPB, the most complex of the tests, is also the most complete, as it encompasses all the variables mentioned above, plus a variable of strength and power output, the test of sitting and standing up five times (18). Because it is so comprehensive, it is considered by some authors as the best predictor of negative outcomes for the health of the elderly, such as the risk of falls, immobility and mortality (31, 32).

It is important to note that most consensuses, including the EWGSOP2 (5), determine gait, power, and endurance tests, together or alone, to assess older people physical performance, but do not recommend any isolated balance test, such as the Berg Balance Scale (3-6). In this study, this instrument demonstrated a correlation with UGS ($p=0{,}002$; $rs=0.347$) and TUG ($p=0{,}034$; $rs=-0.250$), albeit modestly, and it can be explored more deeply by future studies as a valid instrument to assess physical performance in elderly people in suspicion of severe sarcopenia, since this test has good correlation with the same TUG and UGS outcomes, such as risk of immobility and falls, and even as an indicator of mortality (33).

This demonstrates that there are differences at the core of these assessments and, although they have a good correlation according to several authors (3-6), including the results found in this work, the literature needs to better define which of these tests is for which type of patient, in order to avoid using a test that does not correctly encompass the severity of the syndrome, overestimating the results, or that meets the specific deficits of the patients, underestimating the results.

CONCLUSION

For muscle strength in sarcopenia assessment, the most comparable test is the handgrip strength, having also the best cost-benefice among those available to assess this criterion. Also, the sit-to-stand test seems not have a good correlation with the gold standard, or even with the handgrip strength measurement, for this sample. The isokinetic dynamometer, although have good relations with other tests, those relations are not so good as handgrip, and this test is very more expensive than its comparison.

For SMM assessment, the evaluation by BIA stands out as the most reliable assessment among those presented in this work. However, is important to highlight that cheaper and faster assessments as FFM assessment with skinfolds, calf circumference and MAC have some good correlations with this technique, making those good options to population studies, with huge samples, or even to clinic assessments in public health, which tends to be in a short time and space, and with limited resources.

To assess the physical performance in sarcopenia, as is widely known in literature, the UGS is the one that showed most correlations with other techniques. Besides, this variable can be obtained with fast and cheap tests, and that can be made in any space or place. The TUG, however showed some correlations with the PP tests, presented best correlation with strength and body composition tests than with PP tests. The SPPB test showed moderate correlation with UGS, and low with TUG, and none significant correlation with any other test. This raises a question about the reliability of those two tests when compared with other PP assessment techniques.

Also is important to highlight that those correlations across diagnostic criteria showed good results, meaning that some techniques can be comparable between themselves to assess sarcopenia. For example, SMM and FFM showed high correlations with PP and strength tests; UGS and TUG showed the same when compared with body composition and strength tests, and; all three strength tests presented here showed the same with PP and body composition assessments.

LIMITATIONS

We did not have access to any test with higher accuracy and specificity for SMM assessment, as DXA, MRI or CT, making the comparisons to this criteria a less reliable evidence. Also, the fact of the sample be small can reduce the power of statistical tests presented here.

So, we advise new wide studies, with higher samples, and using all the gold-standards tests available to each variable, comparing them with other techniques.

CONFLICT OF INTERESTS

The authors of this article declare that there is no conflict of interest.

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Appendix 1. Table of all correlations found (part 1 of 2).

	AGE		BMI		SMM		CC		FFM		AAC		UGS		TUG	
	p-value	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**
AGE			0,086	0,192	0,751	-0,037	0,185	0,169	0,077	0,225	0,263	-0,126	0,018	-.262*	0,118	0,186
BMI	0,086	0,192			0,088	-0,196	0,000	.792**	0,000	.633**	0,004	.320**	0,048	-.220*	0,005	.327**
SMM	0,751	-0,037	0,088	-0,196			0,035	.268*	0,000	.565**	0,044	.231*	0,000	.522**	0,000	-.512**
CC	0,185	0,169	0,000	.792**	0,035	.268*			0,000	.801**	0,000	.500**	0,639	0,060	0,775	0,039
FFM	0,077	0,225	0,000	.633**	0,000	.565**	0,000	.801**			0,000	.668**	0,039	.261*	0,303	-0,139
AAC	0,263	-0,126	0,004	.320**	0,044	.231*	0,000	.500**	0,000	.668**			0,176	0,152	0,165	-0,165
UGS	0,018	-.262*	0,048	-.220*	0,000	.522**	0,639	0,060	0,039	.261*	0,176	0,152			0,000	-.631**
TUG	0,118	0,186	0,005	.327**	0,000	-.512**	0,775	0,039	0,303	-0,139	0,165	-0,165	0,000	-.631**		
HS	0,909	0,013	0,512	0,075	0,000	.552**	0,003	.364**	0,000	.564**	0,004	.319**	0,000	.444**	0,000	-.435**
SPPB a	0,027	-.246*	0,623	-0,055	0,676	0,048	0,764	0,039	0,494	0,088	0,255	0,128	0,000	.398**	0,503	-0,080
SPPB b	0,037	.239*	0,218	-0,142	0,926	0,011	0,463	-0,095	0,389	-0,111	0,163	-0,161	0,403	0,097	0,112	-0,189
SPPB c	0,118	-0,180	0,716	-0,042	0,212	0,145	0,714	-0,048	0,437	0,101	0,041	.234*	0,306	0,118	0,237	-0,141
SPPB t	0,092	-0,188	0,380	-0,099	0,161	0,161	0,640	-0,060	0,549	0,077	0,076	0,198	0,003	.326**	0,046	-.236*
BERG	0,061	-0,209	0,004	-.313**	0,202	0,147	0,527	-0,081	0,897	0,017	0,076	0,198	0,002	.347**	0,034	-.250*
TPIEQ	0,244	-0,220	0,159	-0,264	0,000	.690**	0,612	-0,121	0,146	0,337	0,411	0,156	0,001	.576**	0,003	-.543**
TPIEH	0,732	-0,065	0,825	-0,042	0,000	.790**	0,222	0,286	0,005	.606**	0,260	0,212	0,000	.667**	0,006	-.519**

Where: p-valor and rs: correlation by Spearman test; BMI: body mass index; SMM: skeletal muscle mass; CC: calf circumference; FFM: fat-free mass; AAC: arm average circumference; UGS: usual gait speed; TUG: timed-up-and-go test; HS: handgrip strength; SPPB: short physical performance battery (a: balance tests; b: gait speed test; c: sit-to-stand 5 times test; t: total points in SPPB test); TPIEQ: tork peak isotonic eccentric of quadriceps muscles; TPIEH: tork peak isotonic eccentric of hamstrings muscles.

Appendix 1. Table of all correlations found (part 2 of 2).

	HS		SPPB a		SPPB b		SPPB c		SPPB t		BERG		TPIEQ		TPIEH	
	p-value	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**	**p-value**	**r_s**
AGE	0,909	0,013	0,027	-.246*	0,037	.239*	0,118	-0,180	0,092	-0,188	0,061	-0,209	0,244	-0,220	0,732	-0,065
BMI	0,512	0,075	0,623	-0,055	0,218	-0,142	0,716	-0,042	0,380	-0,099	0,004	-.313**	0,159	-0,264	0,825	-0,042
SMM	0,000	.552**	0,676	0,048	0,926	0,011	0,212	0,145	0,161	0,161	0,202	0,147	0,000	.690**	0,000	.790**
CC	0,003	.364**	0,764	0,039	0,463	-0,095	0,714	-0,048	0,640	-0,060	0,527	-0,081	0,612	-0,121	0,222	0,286
FFM	0,000	.564**	0,494	0,088	0,389	-0,111	0,437	0,101	0,549	0,077	0,897	0,017	0,146	0,337	0,005	.606**
AAC	0,004	.319**	0,255	0,128	0,163	-0,161	0,041	.234*	0,076	0,198	0,076	0,198	0,411	0,156	0,260	0,212
UGS	0,000	.444**	0,000	.398**	0,403	0,097	0,306	0,118	0,003	.326**	0,002	.347**	0,001	.576**	0,000	.667**
TUG	0,000	-.435**	0,503	-0,080	0,112	-0,189	0,237	-0,141	0,046	-.236*	0,034	-.250*	0,003	-.543**	0,006	-.519**
HS			0,758	0,035	0,339	0,110	0,587	0,063	0,182	0,152	0,335	-0,110	0,008	.491**	0,000	.711**
SPPB a	0,758	0,035			1,000	0,000	1,000	0,000	0,000	.468**	0,001	.369**	0,076	0,329	0,221	0,230
SPPB b	0,339	0,110	1,000	0,000			0,077	-0,203	0,067	0,210	0,503	-0,078	0,076	0,329	0,221	0,230
SPPB c	0,587	0,063	1,000	0,000	0,077	-0,203			0,000	.859**	0,652	-0,052	0,580	0,109	0,757	0,061
SPPB t	0,182	0,152	0,000	.468**	0,067	0,210	0,000	.859**			0,386	0,098	0,133	0,281	0,230	0,226
BERG	0,335	-0,110	0,001	.369**	0,503	-0,078	0,652	-0,052	0,386	0,098			0,811	-0,046	0,530	0,119
TPIEQ	0,008	.491**	0,076	0,329	0,076	0,329	0,580	0,109	0,133	0,281	0,811	-0,046			0,000	.745**
TPIEH	0,000	.711**	0,221	0,230	0,221	0,230	0,757	0,061	0,230	0,226	0,530	0,119	0,000	.745**		

Where: p-valor and rs: correlation by Spearman test; BMI: body mass index; SMM: skeletal muscle mass; CC: calf circumference; FFM: fat-free mass; AAC: arm average circumference; UGS: usual gait speed; TUG: timed-up-and-go test; HS: handgrip strength; SPPB: short physical performance battery (a: balance tests; b: gait speed test; c: sit-to-stand 5 times test; t: total points in SPPB test); TPIEQ: tork peak isotonic eccentric of quadriceps muscles; TPIEH: tork peak isotonic eccentric of hamstrings

Appendix 2. Normality tests.

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	p-valor
AGE	0,176	81	0,000	0,883	81	0,000
Body Mass Index	0,087	81	0,195	0,950	81	0,003
Skeletal Muscle Mass	0,228	77	0,000	0,881	77	0,000
Calf Circumference	0,115	36	.200*	0,965	36	0,299
Fat-free Mass	0,159	63	0,000	0,943	63	0,006
Arm Average Circumference	0,319	81	0,000	0,717	81	0,000
Usual Gait Speed	0,185	81	0,000	0,782	81	0,000
Timed-up-and-go Test	0,126	72	0,007	0,968	72	0,068
Handgrip Strength	0,193	79	0,000	0,903	79	0,000
SPPB a (balance)	0,511	81	0,000	0,315	81	0,000
SPPB b (gait speed)	0,540	77	0,000	0,192	77	0,000
SPPB c (sit-to-stand 5 times)	0,276	77	0,000	0,805	77	0,000
SPPB total points	0,281	81	0,000	0,563	81	0,000
BERG	0,440	81	0,000	0,307	81	0,000
TPIE Quadriceps	0,133	30	0,186	0,957	30	0,265
TPIE Hamstrings	0,127	30	.200*	0,922	30	0,030

Where: SPPB: short physical performance; TPIE: peak torque of isotonic eccentric.

6 CONCLUSÃO GERAL

Sobre os critérios diagnósticos de sarcopenia, foi possível observar que, para a avaliação da força muscular na sarcopenia, o teste mais comparável é a força de preensão palmar, tendo também o melhor custo-benefício entre os disponíveis para avaliar este critério. Além disso, o teste de sentar e levantar parece não ter uma boa correlação com o padrão-ouro, ou mesmo com a medida da força de preensão palmar, para esta amostra. O dinamômetro isocinético, embora tenha boas relações com outros testes, essas relações não são tão boas quanto a de preensão manual, sendo este teste muito mais caro que seu comparativo.

Para avaliação de MME, a avaliação por BIA se destaca como a avaliação mais confiável dentre as apresentadas neste trabalho. No entanto, é importante destacar que avaliações mais baratas e rápidas como a avaliação da massa magra avaliada através de dobras cutâneas, a circunferência da panturrilha e a circunferência média do braço apresentam algumas boas correlações com esta técnica, tornando-se boas opções para estudos populacionais, com grandes amostras, ou mesmo para avaliações clínicas em saúde pública, que tende a ser em pouco tempo e espaço, e com recursos limitados.

Para avaliar a performance física na sarcopenia, como é amplamente conhecido na literatura, a velocidade da marcha é a que mais apresentou correlações com outras técnicas. Além disso, esta variável pode ser obtida com testes rápidos e baratos, e que podem ser feitos em qualquer espaço ou local. O teste SPPB apresentou correlação moderada com a velocidade marcha e baixa com TUG. Isso levanta uma questão sobre a confiabilidade desses dois testes quando comparados com outras técnicas de avaliação de performance física.

Já sobre os métodos de enfrentamento da síndrome através de exercícios físicos, esta tese demonstrou que, para as amostras avaliadas, um programa de treinamento físico foi capaz de melhorar a força, massa muscular e performance, em idosos sarcopênicos ou não sarcopênicos, reduzindo assim os indicadores dessa síndrome.

A massa muscular e a força muscular parecem ser melhor aprimoradas com um programa de treinamento de força, embora haja bons resultados com outros métodos de treinamento físico. Ainda assim, o desempenho físico apresentou melhores resultados com outras metodologias de treinamento físico que não o treinamento de força, embora o TF também tenha apresentado bons resultados nesta variável. Verifica-se ainda que existe uma grande variabilidade na prescrição dos modelos de treino, sobretudo em termos de volume e intensidade das sessões de treino.

Por fim, também foi observada alta variabilidade e falta de padronização na avaliação dos indicadores de sarcopenia, e até mesmo nos pontos de corte para caracterização e diagnóstico de sarcopenia entre os idosos submetidos a esses testes.

7 IMPACTOS DO TRABALHO

Este trabalho visou aprofundar os conhecimentos da sarcopenia, através de uma construção de estudos do GEReab, que vem da ordem de estudos transversais, ensaios clínicos, revisões sistemáticas, e revisões de revisões. Entendemos o assunto sarcopenia como um dos mais importantes da área da gerontologia, uma vez que a literatura tem bem definido que esta síndrome traz um grande custo dos pontos de vista pessoal, social e econômico (1).

Assim, com o ensaio clínico randomizado conduzido pelo GEReab, que deu como frutos diversos artigos, como os apresentados nos anexos desta tese, além do segundo artigo original aqui apresentado. Este ECR ainda vai ser reconduzido, após a pausa dada, por decorrência da pandemia de COVID-19. Visamos dar continuidade a este entendimento, contribuindo não só para a comunidade em que está inserido, mas para a toda a comunidade acadêmica que se beneficia das descobertas trazidas por estudos deste tipo. Este ensaio clínico, inserido na capital de um dos estados com maior expectativa de vida do país, ainda visa contribuir para o entendimento sobre as formas de enfrentamento da síndrome através da atividade física, tentando compreender melhor os mecanismos das modificações que cada modalidade de exercício traz aos indivíduos analisados, podendo fazer ajustes, e trazer à luz da ciência o conhecimento coletado na prática.

Já o primeiro artigo componente desta tese, uma revisão sistemática de revisões sistemáticas, é uma das primeiras deste modelo produzidas no meio acadêmico. Este tipo de estudo tenta compilar informações, deixando o conhecimento mais robusto e fidedigno, facilitando assim a tomada de decisão por parte do profissional de saúde que pretende inserir o idoso sarcopênico (ou em risco de sarcopenia) em um programa de exercícios físicos visando a redução dos indicadores da síndrome, melhorando assim, não só os indicadores de sarcopenia deste indivíduo, mas todos os indicadores que sofrem influência desta síndrome, como a qualidade de vida, o risco de quedas, de desenvolvimento de outras síndromes e/ou comorbidades.

8 ANEXOS

8.1 Anexo I. Resumo do artigo: Comparação da frequência do diagnóstico entre as versões do Consenso Europeu de Sarcopenia: Estudo transversal.
Artigo Proveniente do ECR original do GEReab.

Comparação da frequência do diagnóstico entre as versões do Consenso Europeu de Sarcopenia: Estudo transversal

(Submetido ao periódico Archives of Gerontology and Geriatrics)

Patrícia da Silva Klahr, Luis Fernando Ferreira, Cislaine Machado de Souza, André Ferreira D'Avila, Guilherme Pedroso da Silva, Bruno Marcon, Marcelo Emerim Brígido Oliveira, Luis Henrique Telles da Rosa.

RESUMO

Introdução: A sarcopenia é a perda de massa muscular associada a perda de força e/ou perda de função muscular, resultando em redução da funcionalidade e da qualidade de vida, que acomete predominantemente idosos. **Objetivo**: Comparar a aplicação dos critérios e diretrizes das duas versões do Consenso Europeu de Sarcopenia, para o diagnóstico e classificação, em uma amostra de idosos da comunidade. **Método**: Estudo transversal, com 82 avaliações de idosos de 60 anos ou mais, voluntários residentes na comunidade, da cidade de Porto Alegre, realizadas ao longo dos anos de 2018, 2019 e 2020. Os idosos foram avaliados por profissionais treinados e classificados segundo os critérios dos dois Consensos a fim de mostrar as diferenças entre os dois modelos de classificação. **Resultados**: Nos testes físicos como TUG, tanto homens quanto mulheres realizaram o teste abaixo de 7,21 segundos. Em média os idosos conseguiram caminhar no TC6 mais que o percentual predito para eles. Apenas 3 mulheres tiveram a velocidade da marcha menor do que 0,8 m/s. Na avaliação da força os idosos conseguiram, em média, o percentual predito. No SPPB poucos tiveram performance intermediária, a maioria apresentou alta performance. **Conclusão**: A aplicação dos critérios do EWGSOP2 e novos pontos de corte, reduziram a capacidade de diagnosticar a sarcopenia na amostra de 8,5% para 3,7% (p=0,034). Embora pequena a amostra, a redução é significativa e expressa que a mudança de critérios mesmo utilizando pontos de corte menores, para amostra em análise, trouxe impacto no sentido de não diagnosticar precocemente.

Palavras-Chave: Envelhecimento; Sarcopenia; Capacidade funcional; Qualidade de vida.

8.2 Anexo II. Resumo do artigo: Efeito de dois programas de exercícios físicos sobre a força, funcionalidade e qualidade de vida em idosos de Porto Alegre: Ensaio clínico randomizado

Artigo Proveniente do ECR original do GEReab.

Efeito de dois programas de exercícios físicos sobre a força, funcionalidade e qualidade de vida em idosos de Porto Alegre: Ensaio clínico randomizado

(Submetido ao periódico PLOS One)

Patrícia da Silva Klahr, Luis Fernando Ferreira, Cislaine Machado de Souza, André Ferreira D'Avila, Guilherme Pedroso da Silva, Bruno Marcon, Marcelo Emerim Brígido Oliveira, Luis Henrique Telles da Rosa.

RESUMO

Introdução: O organismo do idoso, de uma maneira geral, sofre impactos com o processo do envelhecimento, podendo resultar em alterações no organismo como um todo, e o exercício tem sido comumente utilizado pelos profissionais da saúde como forma de intervenção para a atenuação e prevenção de alterações no processo de envelhecimento. **Objetivo**: Comparar o efeito de dois programas de diferentes modalidades de exercícios físicos sobre a força, funcionalidade e qualidade de vida em idosos de Porto Alegre. **Método**: Ensaio clínico randomizado, cegado e com intenção de tratar, do qual participaram 31 idosos, sendo 16 no grupo que treinou força (G1) e 15 no grupo que treinou Pilates solo (G2), com duração de aproximadamente 1 hora, e frequência de 3 vezes na semana ao longo de 12 semanas, com avaliações a cada 4 semanas do treinamento. Para mensurar a força foi realizado o teste de preensão manual e o dinamômetro isocinético (Biodex) para força de flexão e extensão de joelho. Para funcionalidade foi avaliado o TUG, SPPB, Berg e TC6 e para qualidade de vida o questionário SF-36. **Resultados**: Apesar dos idosos melhorarem gradativamente no desfecho da força, não houve diferença estatisticamente significativa intragrupo ou intergrupos. Quanto a funcionalidade houve diferença estatisticamente significativa (p=0,010) no percentual predito do teste de caminhada de seis minutos entre os grupos na avaliação 4, onde o G1 percorreu 126,51□10,28% e o G2 percorreu 112,11□5,99%. Quanto a qualidade de vida, apesar da melhora em todos os domínios, apenas no domínio de Aspectos Emocionais houve diferença estatisticamente significativa (p=0,017), sendo entre os grupos G1 e G2 nos momentos de Avaliação 1 e Avaliação 3, sendo respectivamente 72,92□32,70 e 55,56□41,25, e 77,78□28,87 e 100,00□0,0.

Conclusão: Não houve diferença significativa na força quando comparamos os grupos. Na funcionalidade G1 apresentou maior percentual predito do teste de caminhada de 6 minutos quando comparado ao G2. Na qualidade de vida, no domínio de aspecto emocional G2 conseguiu superar o G1 apesar de inicialmente o G1 ter valores significativamente maiores.

Palavras-chave: envelhecimento; treinamento de resistência; técnicas de exercício e de movimento (Método Pilates); Capacidade funcional; qualidade de vida.

8.3 Anexo III. Resumo do artigo: Efeitos do treinamento de força e método Pilates no equilíbrio dinâmico, capacidade física e qualidade de vida em pessoas idosas: um ensaio clínico randomizado
Artigo Proveniente do ECR original do GEReab.

Efeitos do treinamento de força e método Pilates no equilíbrio dinâmico, capacidade física e qualidade de vida em pessoas idosas: um ensaio clínico randomizado

(Submetido ao periódico RBCEH)

Cislaine Machado de Souza, Luis Fernando Ferreira, Patrícia da Silva Klahr, André Ferreira D'Avila, Mariana Wieczorek, Luis Henrique Telles da Rosa.

O estudo teve como objetivo comparar o efeito de diferentes modalidades de exercício sobre o equilíbrio dinâmico, capacidade física e qualidade de vida. Participaram deste ensaio clínico randomizado 15 idosos, com idade igual ou superior a 60 anos. O grupo 1 realizou treino de força (GF) e Grupo 2 exercícios baseados no método Pilates (GP). Foram avaliados para o comportamento do equilíbrio dinâmico Timed Up and Go (TUG) e para capacidade física o Teste de caminhada de 6 minutos (TC6). A qualidade de vida (QV) foi avaliada pelo questionário (SF-36). Em relação ao equilíbrio e capacidade física podemos observar melhora no resultado de TUG e TC6, após as quatro semanas de intervenção no GP. Não foram encontradas diferenças significativas na comparação entre GF e GP. Na qualidade de vida, os critérios de estado geral de saúde e vitalidade tiveram melhora estatisticamente significativa no GF e GP. Conclui-se que para os idosos avaliados em 4 semanas de treinamento, não houve diferença estatisticamente significativa em comparação aos grupos para as variáveis equilíbrio dinâmico e capacidade física. Ambos os exercícios de força e método Pilates apresentam melhora significativa em critérios avaliados na qualidade de vida.

Palavras-chave: Envelhecimento, Equilíbrio postural, Capacidade física, Qualidade de vida, Treinamento físico.

8.4 Anexo IV. Carta de aprovação do comitê de ética em pesquisas da UFCSPA

UNIVERSIDADE FEDERAL DE CIÊNCIAS DA SAÚDE DE PORTO ALEGRE

Plataforma Brasil

PARECER CONSUBSTANCIADO DO CEP

DADOS DA EMENDA

Título da Pesquisa: O EFEITO DE UM PROGRAMA DE EXERCÍCIOS FÍSICOS SOBRE A MAGNITUDE DA SARCOPENIA EM IDOSOS DE PORTO ALEGRE: UM ENSAIO CLÍNICO RANDOMIZADO

Pesquisador: Luis Henrique Telles da Rosa

Área Temática:

Versão: 3

CAAE: 66091417.5.0000.5345

Instituição Proponente: Universidade Federal de Ciências da Saúde de Porto Alegre

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 3.335.461

Apresentação do Projeto:

Trata-se de uma emenda justificando a entrada de dois pesquisadores para auxiliar no treinamento e nas avaliações.

Objetivo da Pesquisa:

Não se aplica.

Avaliação dos Riscos e Benefícios:

Não se aplica.

Comentários e Considerações sobre a Pesquisa:

A emenda encaminhada justifica a entrada de dois pesquisadores devido à complexidade dos turnos e horários de disponibilidade do local de treinamento. O cronograma sofreu alterações, registradas nas informações básicas. Os pesquisadores informam, ainda, que houve perda de participantes por questões externas ao projeto, o que justificaria a extensão do prazo.

Considerações sobre os Termos de apresentação obrigatória:

A carta ao CEP justifica as alterações, e estas estão registradas noas Informações Básicas da Plataforma.

Recomendações:

Não se aplica.

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UF: RS **Município:** PORTO ALEGRE
Telefone: (51)3303-8804 **E-mail:** cep@ufcspa.edu.br

Conclusões ou Pendências e Lista de Inadequações:

Não há pendências.

Considerações Finais a critério do CEP:

De acordo com o parecer do Relator.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_1347934_E1.pdf	02/05/2019 12:55:35		Aceito
Outros	CartaCEP.pdf	09/05/2017 20:56:11	Luis Henrique Telles da Rosa	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TermoAnuenciaResponsavel.pdf	09/05/2017 20:54:59	Luis Henrique Telles da Rosa	Aceito
Projeto Detalhado / Brochura Investigador	NovoProjetoSarcopenia.pdf	09/05/2017 20:53:27	Luis Henrique Telles da Rosa	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	NOVOTCLE.pdf	09/05/2017 20:47:51	Luis Henrique Telles da Rosa	Aceito
Outros	Termodecompromisso.pdf	09/03/2017 08:13:36	Luis Henrique Telles da Rosa	Aceito
Outros	DesenhoECR.jpg	27/01/2017 11:39:55	Luis Henrique Telles da Rosa	Aceito
Folha de Rosto	FolhaRostoSarcopenia.pdf	27/01/2017 11:28:15	Luis Henrique Telles da Rosa	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

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PORTO ALEGRE, 20 de Maio de 2019

Assinado por:
Luciane Dalcanale Moussalle
(Coordenador(a))

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