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Heart Failure in Patients with Sarcopenia: Systematic Review and Meta-Analysis

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Background: The prevalence of sarcopenia and heart failure (HF) is estimated to be between 8%–34% and 3%–11.8%, respectively. The prevalence of HF in patients with sarcopenia and the prognosis of this association remain unclear. **Methods:** A systematic review was conducted across MEDLINE/PubMed, Embase, CENTRAL, SciELO, and CINAHL databases, with manual searches in Google Scholar and grey literature. Meta-analysis was performed on the gathered results to assess the prevalence of HF in patients with sarcopenia, estimate phenotypes related to left ventricular ejection fraction (LVEF), and evaluate the associated mortality risk. **Results:** Out of 7,080 studies, 16 were selected. In patients with sarcopenia, HF prevalence was 32% (95% confidence interval [CI], 0.07–0.61, $p<0.001$, $I^2=100\%$). Patients with both conditions showed 45.9% (95% CI, 0.34–0.58; $p<0.001$, $I^2=90.69\%$) with reduced LVEF, 10.3% (95% CI, 0.00–0.29; $p<0.001$, $I^2=99\%$) with mildly reduced LVEF, and 29.1% (95% CI, 0.14–0.45; $p<0.001$, $I^2=99\%$) having preserved LVEF. **Conclusion:** HF is highly prevalent in patients with sarcopenia and increases mortality risk.

Key Words: Heart failure, Sarcopenia, Epidemiology, Prevalence, Ejection fraction

INTRODUCTION

Heart failure (HF) is one of the most common chronic diseases in the world, with global prevalence between 1% and 3% in individuals under 60.[1,2] When it comes to individuals over 60 years old, this percentage rises to 11.8%.[1] The latest prevalence projections indicate an increase up to 34% in the next decades.[2] HF presents a mortality rate of 50% within 1 year after hospitalization and a 65% risk of readmission.[1,3]

Prior to the 2020s, the characterization of HF was considered ambiguous and unstandardized. In 2021, international scientific societies came to a consensus. They established a universal definition of HF as "a clinical syndrome with signs and/or symptoms caused by a structural and/or functional cardiac abnormality, supported by at least one of the following: elevated natriuretic peptide levels and/or objective evidence of pulmonary or systemic congestion."[4]

The functional capacity to perform daily tasks is closely related to cardiovascular health. Once this function is compromised, symptoms such as dyspnea and/or exercise intolerance appear, directly impacting the patient's quality of life.[5] However, an exercise tolerance decrease can also be related to muscle strength loss, a consequence of the natural aging process, requiring a distinction between these conditions.[6]

Sarcopenia is the process of muscle loss that affects strength, mass, and quality. It is considered severe in cases of low physical performance.[7] Its prevalence varies according to the diagnostic criteria, requiring physical tests to verify muscle strength and mass loss. The gold standard methods for that are computed tomography (CT) or magnetic resonance imaging (MRI). More affordable acceptable techniques are dual-energy X-ray absorptiometry (DEXA) or bioelectrical impedance analysis (BIA).[7]

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There are several common factors in sarcopenia and HF natural history: the lack of physical activity increases the adrenergic tone, which leads to a phenomenon described as perpetuating HF factor; the rise of insulin resistance; atherosclerosis; inflammaging; hyperactivity of the renin-angiotensin-aldosterone system; mitochondrial dysfunction increasing reactive oxygen species; and endothelial dysfunction. These changes also promote cardiac remodeling, and leading to sarcopenia.[8-10]

Sarcopenia's prevalence in patients with HF has been estimated to be close to 34%, varying from 10% to 69%.[11,12] These high rates indicate the importance of evaluating this condition as one of the causes of functional deterioration in these patients. The prevalence of HF in patients diagnosed with sarcopenia, as well as the main phenotypes and prognosis of this disease association, remains unknown.[13]

In this context, this study presents a systematic review and a meta-analysis of the HF prevalence among individuals with sarcopenia by analyzing the prevalence related to left ventricular ejection fraction (LVEF), and assessing the death risk from this disease association. By doing this, it was possible to understand the impact of this comorbidity association.

MATERIALS AND METHODS

The protocol for this review was registered with PROSPERO (CRD42024531109). The methods followed the recommendations of the Joanna Briggs Institute (JBI)[14] and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guideline.[15]

Inclusion Criteria

All studies that provided the condition to calculate the prevalence of HF in patients diagnosed with sarcopenia, whether a primary outcome, secondary outcome, or supplemental data were included regardless of sex and origin from any setting (outpatient, inpatient, and/or long-term care institutions). Secondary outcomes were the prevalence of each LVEF phenotype in patients with both conditions and the hazard ratio of all-cause mortality.

Sarcopenia, as evidenced by validated methods, was defined as muscle loss that affects strength, mass, or function.[7] For this review, HF was defined by echocardiographic diagnosis and/or increased serum concentrations of BNP (brain natriuretic peptide) or NT-proBNP (N-terminal pro b-type natriuretic peptide), associated with clinical changes.[4] These criteria are properly described (Supplementary Table S1).

Search Strategy

Electronic searches were conducted, restricted to English, Portuguese, and Spanish, in the following databases: MEDLINE/PubMed, Embase, CENTRAL, SciELO, and CINAHL. Hand-searching was also conducted using Google Scholar simultaneously, focusing on related literature and bibliographic references. Gray literature was directly addressed through hand-searching in OpenGrey, MedRxiv, BiorXiv, and WhoLibraryDatabase and indirectly through works indexed in Embase. For broader search coverage, descriptors related to the terms "heart failure" and "sarcopenia" were used (Supplemental Table S2).

Study Selection

Two independent reviewers (P.I.C.C. and J.B.M.D.) conducted a rigorous evaluation of titles and abstracts using the Rayyan tool,[16] followed by pertinent data extraction based on a predefined form in a digital spreadsheet. Discrepancies were resolved by a third independent reviewer (A.A.O.L.). Relevant data extracted included the year of study publication, country, total population, and available data such as age, sex, diagnostic criteria used for sarcopenia and HF, and the prevalence of HF among individuals with sarcopenia. Subgroups of individuals according to outpatient or inpatient settings, available outcomes such as the hazard ratio of death, echocardiographic data, and prevalence according to LVEF were also identified.

Abstracts without complete articles, studies that did not provide population data for prevalence calculation, and those that did not clearly define the diagnoses of HF and sarcopenia or used generic terminology were excluded. Additionally, studies with a sample size smaller than 45 individuals were also excluded after sample calculation applying the Daniel & Cross formula,[17] considering the general prevalence of 3% for HF.[18] The systematic review flowchart was constructed according to PRISMA recommendations (Fig. 1).

Risk of Bias Assessment of Methodological Quality for Observational Studies

Two independent reviewers (P.I.C.C. and J.B.M.D.) assessed the risk of bias using a validity instrument of nine items to evaluate the methodological quality for prevalence studies according to the available information for each included study.[19] A third independent reviewer (A.A.O.L.) resolved the cases of disagreement. The methodological analysis for risk of bias in the selected studies was conducted using the JBI tool (Supplementary Table S3).[19]

Statistical Analysis

The initial data analysis was based on descriptive statistics, propor-

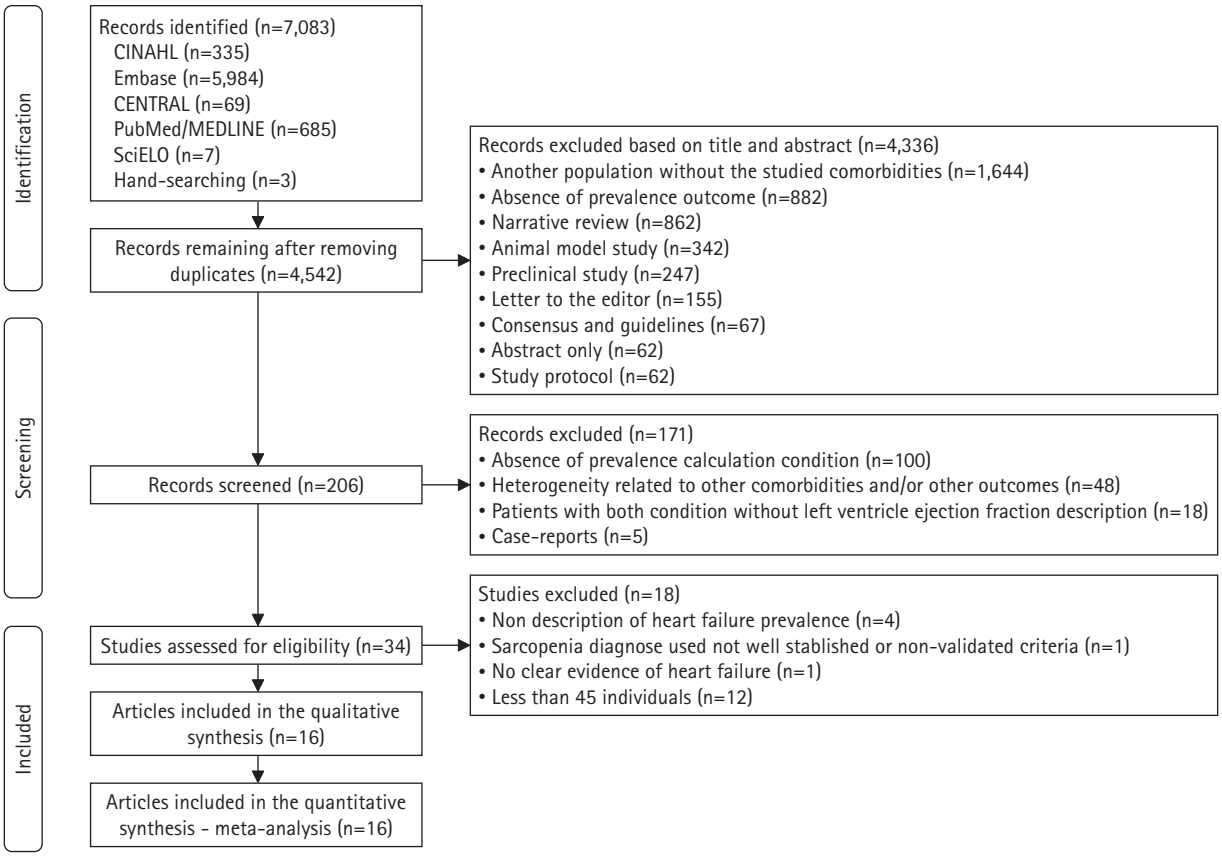

Fig. 1. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram of studies through the review (n=16).

tions, and 95% confidence intervals (CI) calculated from the sample sizes and HF prevalence. Proportions were estimated from the original data of the primary studies, including the total population of patients with sarcopenia. The primary outcome for this revision was the number of patients with HF. Then, these were transformed into prevalence estimated with 95% CI and described as percentages for each study.[19]

The HF pooled prevalence in populations with sarcopenia patients was obtained with meta-analysis, as available in the primary data. This included the proportions of LVEF, classified into subtypes: preserved (heart failure with preserved ejection fraction [HFpEF]), mildly reduced (heart failure with mildly reduced ejection fraction [HFmrEF]) and reduced (heart failure with reduced ejection fraction [HFrEF]). In addition, the pooled prevalence of the all-cause mortality hazard ratio was assessed.

Meta-analyses were performed using the MetaXL add-in version 5.3 (EpiGear International Pty Ltd., Queensland, Australia), an extension of Microsoft Excel.[20] The IVhet model was used for meta-analyses because it provides more conservative confidence intervals than the random-effects model and exhibits one lesser observed variance, irrespective of the heterogeneity degree. This results in more accurate coverage probabilities when addressing heterogeneity.[21]

The I^2 statistic was used to assess heterogeneity among the studies. Considering the result of fewer than 20 studies and the lower statistical power for heterogeneity assessment through I^2 in this context, we opted for the Higgins and Thompson definition, considering low heterogeneity if $I^2 < 25\%$, moderate if $< 50\%$, or high if $> 50\%$.[22]

Sensitivity analyses were conducted by excluding only the inpatient study[23] for the primary outcome to assess the prevalence of HF in outpatient settings and for each desired outcome in sarcopenia patients. An additional sensitivity analysis was performed for the LVEF phenotype prevalence by removing two outliers with larger sample sizes and a 100% prevalence of HFpEF, which overestimated the prevalence of this phenotype.[24] Subgroup analysis was based on diagnostic criteria for sarcopenia, setting, country of origin, and study design.

RESULTS

The systematic review identified 7,080 potential titles, from which

206 full-text articles were read, incorporating 16 studies in the review.[23-38] The systematic review's evidence was described according to the selection criteria and outcomes (Table 1). As demonstrated, the primary studies included patients of both sexes, totaling 20,724 individuals with sarcopenia, of whom 92.86% were outpatients, with an estimated mean age of 62.88 ± 11.53 years. It was possible to assess the sex difference among 9,603 individuals from 10 of the 16 primary studies, based on the available data. There is a low risk of methodological quality bias in the studies, with a Cohen's Kappa coefficient higher than 0.70 among the reviewers (Supplementary Table S3).[39]

The meta-analysis outcomes are described as follows. A prevalence of 32.84% (95% CI, 0.06–0.64; $p < 0.001$, $I^2 = 100\%$) of HF was observed in patients with sarcopenia (Figs. 2, 3). There was a high risk of publication bias, as indicated by funnel plot (Supplementary Fig. S1). It was impossible to perform a sensitivity analysis of inpatients due to a single study identification, with a prevalence of 88.8% (95% CI, 0.85–0.92; $p < 0.05$) for HF diagnosis.[23] The sensitivity analysis (Fig. 2) for the prevalence of HF in outpatients with sarcopenia led to a 32.06% (95% CI, 0.06–0.61; $p < 0.001$, $I^2 = 100\%$).

Subgroup analysis using random-effects model was conducted (Supplementary Fig. S2) for sarcopenia diagnostic criteria and found 76% prevalence of HF (95% CI, 0.40–1.00; $p < 0.001$, $I^2 = 99\%$) in patients from Asia using the Asian Working Group on Sarcopenia criteria, 15% (95% CI, 0.02–0.34; $p < 0.001$, $I^2 = 91\%$) using the European Working Group on Sarcopenia, and 38% (95% CI, 0.30–0.48; $p < 0.001$, $I^2 = 99\%$) using BIA. Analysis for study design demonstrated 34% prevalence in retrospective cohort studies (95% CI, 0.29–0.39; $p = 0.77$, $I^2 = 0\%$), 15% for case-control (95% CI, 0.02–0.34; $p = 0.02$, $I^2 = 91\%$), and 37% for prospective studies (95% CI, 0.14–0.64; $p < 0.001$, $I^2 = 99\%$). The outpatient subgroup had 30% (95% CI, 0.16–0.46; $p < 0.001$, $I^2 = 100\%$). Finally, the prevalence in China was 45% (95% CI, 0.12–0.80; $p < 0.001$, $I^2 = 99\%$) and in South Korea 29% (95% CI, 0.08–0.54; $p < 0.001$, $I^2 = 99\%$).

The meta-analysis of the prevalence of each HF phenotype according to LVEF in individuals with sarcopenia resulted in 96.00% of prevalence for HFpEF (95% CI, 0.00–1.00; $p < 0.001$, $I^2 = 99\%$), 0.5% for HFmrEF (95% CI, 0.00–0.17; $p < 0.001$, $I^2 = 99\%$), and 2.00% for HFrEF (95% CI, 0.00–0.51; $p < 0.001$, $I^2 = 99\%$) (Figs. 2, 4). The studies by Ko et al.[24] and Zhang et al.[30] were removed from the sensitivity analysis as they consisted entirely of patients with HFpEF and accounted for more than half of the population for this outcome, being considered outliers. After the sensitivity analysis the prevalence was estimated by 29.1% for HFpEF (95% CI, 0.14– 0.45; $p < 0.001$, $I^2 = 99\%$), 10.3% for HFmrEF (95% CI, 0.00–0.29; $p < 0.001$, $I^2 = 99\%$) and 45.9% for HFrEF (95% CI, 0.34–0.58; $p < 0.001$, $I^2 = 90.69\%$) (Figs. 2, 4). Lastly, the meta-analysis of the hazard ratio of all-cause mortality in the association of sarcopenia and heart failure was 2.36 (95% CI, 1.86–3.01; $p = 0.99$, $I^2 = 0\%$) (Figs. 2, 5).

DISCUSSION

This study demonstrates a prevalence of 32.84% of HF in patients with sarcopenia. This prevalence is more than 10 times the global prevalence of HF, which is 3%, and nearly three times the global population over 60, which is 11.8%.[1,40] The GLISTEN study has already reported higher prevalences of HF in populations with sarcopenia and its increase with left ventricular mass.[41] Sensitivity analysis showed a 32.06% prevalence of HF in outpatients with sarcopenia. In community settings, isolated HF can reach from 1.4% to 16.1%.[42] Only one study allowed the evaluation of the prevalence of HF among inpatients with sarcopenia, which was 88.8% in this review. Other studies have reported a prevalence rat-

Table 1. Characteristics of the articles included in review (16 studies)

Category	Study, year	Country	Study design	Population		Heart failure prevalence event	Mortality HR (95% CI)
				Setting	Patients with sarcopenia		
Heart failure prevalence in patients with sarcopenia	Bian et al.[23], 2021	China	Cross-sectional	Hospital	n = 259 (F 140/M 119) Age: 69.5 ± 3.5 y	230 (88.9%)	-
	Chang et al.[25], 2015	China	Case-control	Community	n = 92 (F 60/M 32) Age: 79 ± 6 y	23 (25%) -HFrEF: 3 (13.04%) -HFmrEF: 20 (86.96%)	-
	Chang et al.[26], 2017	China	Case-control	Community	n = 120 (F 87/M 33) Age: 80.0 ± 6.1 y	10 (2.2%) -HFpEF: 10 (8.33%)	-
	Hanatani et al.[27], 2021	Japan	Retrospective cohort	Community	n = 108 (F 33/M 75) Age: 73.8 ± 8.6 y	38 (35.19%) -BNP: 56.7 ± 43.48 pg/mL	-

(Continued on the next page)

Table 1. Continued

Category	Study, year	Country	Study design	Population		Heart failure prevalence event	Mortality HR (95% CI)
				Setting	Patients with sarcopenia		
	Jung et al.[28], 2019	South Korea	Retrospective cohort	Community	n = 226 (F 151/M 75) Age: 55.29 ± 8.63 y	76 (33.63%) -LVEF: 67.68 ± 5.31%	-
	Ko et al.[24], 2018	South Korea	Prospective cohort	Community	n = 10,934 (-/-) -	4,690 (42.89%) -HFpEF: 4,690 (100%)	-
	Yoo et al.[29], 2021	South Korea	Prospective cohort	Community	n = 6,907 (F 3,879/M 3,028) Age: 59.39 ± 10.19 y	1,045 (15.13%) -LVEF: 66.76 ± 5.66%	-
	Zhang et al.[30], 2021	China	Prospective cohort	Community	n = 766 (F 294/M 472) Age: 63.17 ± 12.69 y	449 (58.62%) -LVEF: 64.17 ± 5.05% -HFpEF: 449 (100%)	-
LVEF based proportion for patients with sarcopenia and heart failure	Eschalier et al.[31], 2021	France	Prospective cohort	Community	n = 91 (F 37/M 54); Age: 78.2 ± 9.0 y	91 (100%) -LVEF: 42.0 ± 14.4% -HFpEF: 33 (36.7%) -HFmrEF: 15 (16.7%) -HFrEF: 42 (46.7%)	-
	Fujimoto et al.[32], 2023	Japan	Prospective cohort	Hospital	n = 205 (F 65/M 140) Age: 81.76 ± 1.96 y	205 (100%) -LVEF: 40.49 ± 9.52% -HFpEF: 72 (35.61%) -HFrEF: 133 (64.39%)	2.36 (1.68–3.22)[a]
	Katano et al.[33], 2022	Japan	Retrospective cohort	Hospital	n = 335 (F 134/M 201) Age: 73 ± 2.5 y	335 (100%) -LVEF: 45.9 ± 4.93% -HFpEF: 43 (12.83%) -HFmrEF: 169 (50.48%) -HFrEF: 123 (36.72%)	-
	Konishi et al.[34], 2021	Japan	Prospective cohort	Hospital	n = 187 (F 55/M 132) Age: 82 ± 8 y	187 (100%) -LVEF: 44.0 ± 18.0% -HFrEF: 101 (54%) -HFpEF: 86 (46%)	2.2 (1.08–3.75)[b]
	Onoue et al.[35], 2016	Japan	Prospective cohort	Hospital	n = 82 (F 29/M 53) Age: 77.60 ± 5.4 y	82 (100%) -LVEF: 53.8 ± 12.3% -BNP: 182.6 ± 85.5 pg/mL	-
	Saito et al.[36], 2021	Japan	Prospective cohort	Hospital	n = 134 (F 46/M 88) Age: 85.0 ± 1.5 y	134 (100%) -LVEF: 46.0 ± 4.33%	2.33 (1.26–4.31)[c]
	Sato et al.[37], 2024	Japan	Retrospective cohort	Hospital	n = 163 (F 63/M 100) Age: -	163 (100%) -HFpEF: 89 (54.6%) -HFrEF: 74 (45.4%)	-
	Shakuta et al.[38], 2024	Japan	Retrospective cohort	Hospital	n = 115 (F 66/M 49) Age: 76.75 ± 1.72 y	115 (100%) -HFpEF: 48 (40.2%) -HFmrEF: 19 (17.0%) -HFrEF: 45 (42.8%)	2.603 (1.375–4.930)[d]

HFpEF, heart failure with preserved ejection fraction; HFmrEF, heart failure with mildly reduced ejection fraction; HFrEF, heart failure with reduced ejection fraction; BNP, brain natriuretic peptide; LVEF, left ventricle ejection fraction; HR, hazard ratio; CI, confidence interval.

[a]All-cause death adjusted by: age, BMI, systemic arterial hypertension, diabetes, COPD, HF, dementia, cancer, cerebrovascular disease (CVD), and chronic kidney disease (CKD).

[b]All-cause death adjusted by: Meta-Analysis Global Group in Chronic Heart Failure (MAGGIC) risk score, BNP, muscle mass, handgrip strength, and walk-speed.

[c]All-cause death adjusted by: BNP, MAGGIC risk score, and 6-minute walk test.

[d]All-cause death adjusted by: LVEF, sex, BMI, and BNP.

ing from 0.1% to 24.8%[43,44] demonstrating Bian et al.[23] influence as an outlier.

In this analysis, the average age of patients was 62.9 years; however, this value may be underestimated due to the unavailability of data from two primary studies, despite attempts to contact the authors. Two studies in this review included samples of individuals under 60 years old.[28,29] It is important to note that primary sarcopenia is related to aging and can begin at 40 years old, with its prevalence in individuals under 60 years old still being poorly understood.[45,46] It was impossible to estimate different types of sarcopenia in this sample, although, among non-elderly adults, a higher prevalence of secondary sarcopenia would be expected.

The universal classification of HF employs LVEF threshold for classification of HF as follows: reduced ejection fraction (HFrEF) if LVEF < 40%; mildly reduced ejection fraction (HFmrEF) when LVEF is between 41%–49%; improved ejection fraction (HFimpEF) when a baseline LVEF < 40% shows an increase of > 10% with a subsequent measurement of LVEF > 40%; and preserved ejection fraction (HFpEF) with LVEF > 50%.[4]

After conducting the sensitivity analyses, it was observed that among outpatients with sarcopenia associated with HF, the prevalences were 29.1% for HFpEF, 10.3% for HFmrEF, and 45.9% for HFrEF without the description of HFimpEF. One nationwide study found prevalences of 38% for HFpEF, 4% for HFmrEF, 49% for HFrEF, and 9% for HFimpEF, among the entire population with HF.[47] A meta-analysis that evaluated patients with HF and sarcopenia found a 28% prevalence for HFrEF and 18% for HFpEF.[48] As expected, the review found a higher prevalence of HFrEF in patients with sarcopenia, consistent with global reports from general patients.[49]

The hazard ratio of all-cause mortality in the association of sarcopenia and HF was estimated at 2.36 (Figs. 2, 5). A cohort identified the all-cause mortality hazard ratio to be 2.1[50] in patients with HF compared to the general population. Another evidence revealed that HF alone has a mortality hazard ratio of 2.2,[4] with an increase of 1.73[51] for every 10-year increase over the age of 60 and 1.14 increase[51] for every 5% reduction in LVEF below 45%. Previous reviews showed a mortality hazard ratio of 2.28[52] in patients with sarcopenia in intensive care and 1.99[52] in inpatients. Another recent meta-analysis estimated the hazard ratio of death in individuals with sarcopenia overlapping with HF to be 2.06.[48] We speculate that the association of sarcopenia and HF increases the hazard ratio of death from all causes, regardless of LVEF and the outpatient, inpatient, or even intensive care setting.

Subgroup analysis showed a higher prevalence of HF using adapted criteria for sarcopenia based on population characteristics, which can be attributed to an underdiagnosis of HF in patients with sarcopenia, considering that most of the population was from an Asian background. The correct criteria enable an adequate diagnosis and provide an accurate perspective of epidemiological data.[45] Retrospective cohort studies have shown a prevalence of 34%, corroborating the meta-analysis prevalence with low heterogeneity. Other subgroup analyses persist with high heterogeneity or do not reflect any clinical relevance beyond the characteristics of the primary studies.[53]

This study has some limitations. There is high heterogeneity in

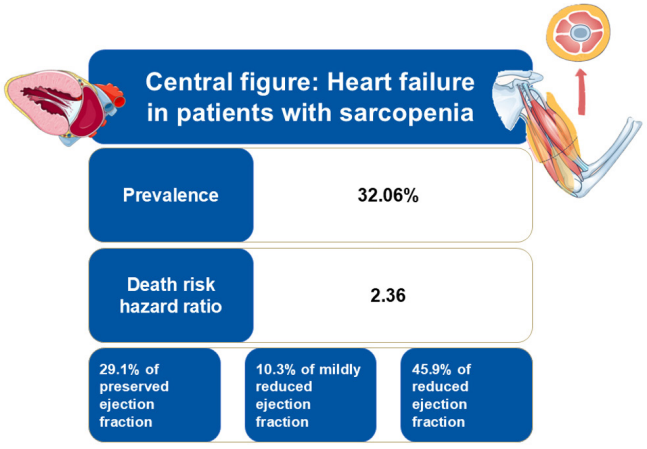

Fig. 2. Central figure of the systematic review with meta-analysis: heart failure in patients with sarcopenia.

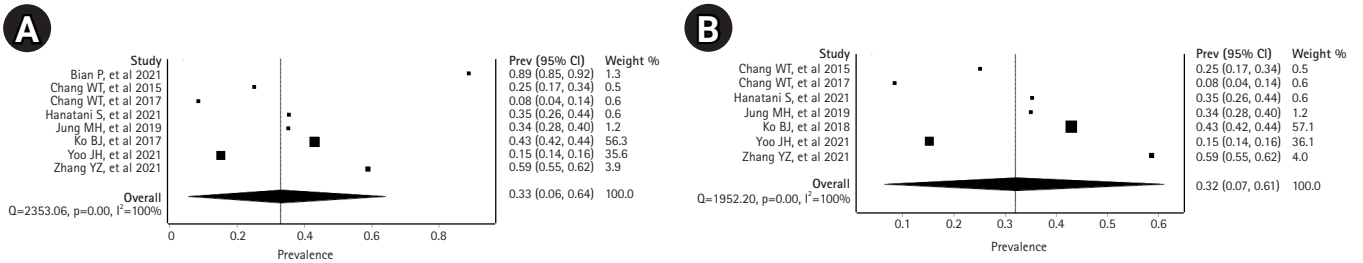

Fig. 3. Sensitive analysis of seven studies that described the prevalence of heart failure in patients with sarcopenia. (A) Meta-analysis of prevalence of heart failure in patients with sarcopenia. (B) Sensitive analysis of prevalence of heart failure in outpatients with sarcopenia.

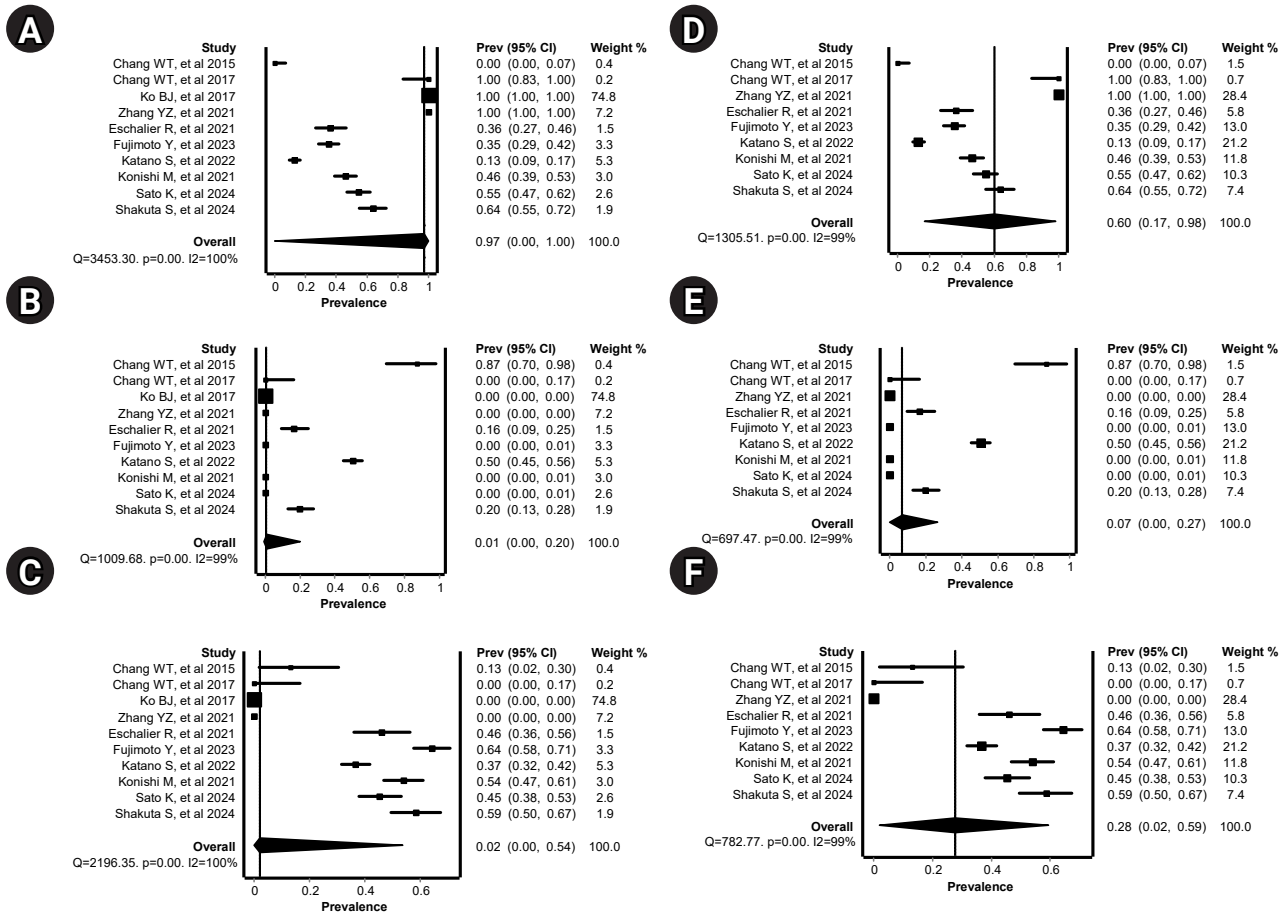

Fig. 4. Meta-analysis of the four studies that described the hazard ratio of death from all-cause in patients with sarcopenia and heart failure: (A) heart failure with preserved ejection fraction (HFpEF) prevalence, (B) heart failure with mildly reduced ejection fraction (HFmrEF) prevalence, (C) heart failure with reduced ejection fraction (HFrEF) prevalence, (D) sensitivity analysis of HFpEF prevalence, (E) sensitivity analysis of HFmrEF prevalence, (F) sensitivity analysis of HFrEF prevalence.

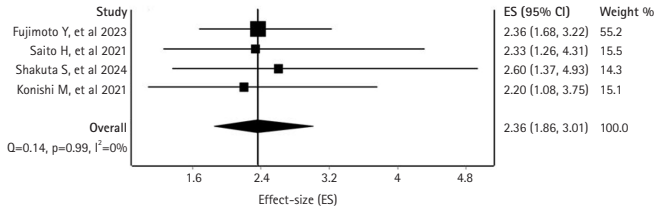

Fig. 5. Meta-analysis of the four studies that described the hazard ratio of death from all-cause in patients with sarcopenia and heart failure.

the outcomes, even using IVhet, which does not reduce the external validity, considering that prevalence studies can reflect population heterogeneity.[54,55] Regardless of the heterogeneity of this analysis, composed exclusively of observational studies, and the high risk of publication bias, there was a low risk of methodological quality bias, as estimated by the JBI tool.[19] It was not possible to estimate the sex-related prevalences of HF and its LVEF phenotypes due to the absence of available data.

The prevalence of HF in patients with sarcopenia remained uncertain until the present study. Considering the importance of identifying sarcopenia as a primary disease and not merely as a comorbidity, we demonstrated a high prevalence of HF among patients with sarcopenia, and this association presents a greater death risk than these conditions individually. It is possible that other conditions, such as aging-related inflammation (inflammaging), pro-inflammatory factors leading to worsening oxidative stress, and progressive physical effort restriction, among others, may predispose to HF as an underlying condition to sarcopenia, which by itself justifies the present study.[10]

Our findings highlight a significant reality, demonstrating that one-third of outpatients with sarcopenia presents HF, and HFrEF is the most prevalent phenotype. Therefore, this study underscores the need for a more thorough investigation of patients with reduced exercise capacity or oligosymptomatic conditions, aiming to

identify both sarcopenia and HF, with special attention to the possibility of HFpEF as another subdiagnosed condition. It's essential to consider that these conditions are typically underdiagnosed and undertreated, and their association results in a higher risk of death.

Numerous factors are inherent to the natural history of sarcopenia and HF. The limitation in physical exertion leads to the hyperactivation of muscle ergoreceptors, increasing adrenergic tone, causing a phenomenon described as perpetuating HF, and downregulating genes related to glucose and lipid metabolism. This contributes to insulin resistance and atherosclerosis, exacerbates inflammaging, a process associated with aging characterized by elevated levels of pro-inflammatory plasmatic substances. These lead to progressive immune dysregulation, hyperactivity of the renin-angiotensin-aldosterone system, mitochondrial dysfunction with increased reactive oxygen species, and endothelial dysfunction. All those changes promote cardiac remodeling, marked by cardiomyocyte atrophy with compensatory hypertrophy of the remaining cells, resulting in sarcopenia.[8-10]

Not all patients with HF got dyspnea from pulmonary congestion and elevated cardiac filling pressures or fatigue caused by low muscle perfusion. Sarcopenia itself appears to reduce exercise intolerance. Studies in patients with both conditions have shown improvements in exercise tolerance with physical training, independent of improvement in cardiac diastolic dysfunction, which lead to the hypotheses of "peripheral" mechanisms that mediate effort intolerance.[5,6]

In conclusion, the prevalence of HF in adults with sarcopenia was estimated at 32%, which is more than 10 times higher than the global population. Among patients with sarcopenia and associated HF, prevalences were 45.9% for HFrEF, 29.1% for HFpEF, and 10.3% for HFmrEF. The diagnosis of HF in patients with sarcopenia presents an all-cause death hazard ratio of 2.36, higher than the mortality rates of these individual conditions. These findings underscore the need for higher-quality primary studies to evaluate further association and impact of HF among individuals with sarcopenia. Healthcare professionals should be vigilant in identifying sarcopenia and the potential association with HF, especially HFpEF, in patients with reduced exercise capacity and oligosymptomatic conditions. These conditions are usually underdiagnosed and related to a worse prognosis.

ACKNOWLEDGMENTS

CONFLICT OF INTEREST

The researchers claim no conflicts of interest.

FUNDING

None.

AUTHOR CONTRIBUTIONS

Conceptualization, PICC; Data curation, PICC, JBMD; Funding acquisition, PICC; Investigation, PICC, MVBM, AAOL, JBMD; Methodology, MVBM, AAOL, JBMD; Project administration, PICC, MVBM, JBMF; Formal analysis, PICC, JBMD, MVBM; Supervision, MVBM; Writing-original draft, PICC, MVBM; Writing-review analysis & editing, PICC, MVBM.

SUPPLEMENTARY MATERIALS

Supplementary materials can be found via https://doi.org/10.4235/agmr.24.0186.

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