University of Groningen

Prevalence of Frailty in Brazilian Older Adults

Melo, R C; Cipolli, G C; Buarque, G L A; Yassuda, M S; Cesari, M; Oude Voshaar, R C; Aprahamian, I

Published in:
The Journal of Nutrition, Health & Aging

DOI:
[10.1007/s12603-020-1398-0](https://doi.org/10.1007/s12603-020-1398-0)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2020

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Melo, R. C., Cipolli, G. C., Buarque, G. L. A., Yassuda, M. S., Cesari, M., Oude Voshaar, R. C., & Aprahamian, I. (2020). Prevalence of Frailty in Brazilian Older Adults: A Systematic Review and Meta-analysis. *The Journal of Nutrition, Health & Aging*, 24(7), 708-716. <https://doi.org/10.1007/s12603-020-1398-0>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

PREVALENCE OF FRAILTY IN BRAZILIAN OLDER ADULTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

R.C. MELO¹, G.C. CIPOLLI², G.L.A. BUARQUE¹, M.S. YASSUDA^{1,2},
M. CESARI³, R.C. OUDE VOSHAAR⁴, I. APRAHAMIAN⁵

1. Universidade de Sao Paulo, Brazil; 2. Universidade Estadual de Campinas, Brazil; 3. Università degli Studi di Milano, Italy; 4. University of Groningen, University Medical Center Groningen, The Netherlands; 5. Faculdade de Medicina de Jundiaí, Brazil. Corresponding author: R.C. Melo, Universidade de Sao Paulo, Brazil, ruth.melo@usp.br

Abstract: *Objectives:* Frailty is characterized by a functioning decline in multiple systems accompanied by an increase in individual's vulnerability to stressors. It appears to be higher in low and middle-income countries compared with high-income ones. This study aimed to evaluate the prevalence of frailty in non-institutionalized Brazilian older adults. *Design:* a systematic review and meta-analysis study. *Setting:* Cross-sectional and prospective data from Brazil. *Participants:* non-institutionalized adults aged 60 and older. *Methods:* Electronic searches were performed in PubMed/MEDLINE, LILACS, SCOPUS and Web of Science, considering the studies published between March 2001 and July 2018, using a combination of the following terms and correlates: "elder" AND "frail" AND "prevalence" AND "Brazil". Two independent reviewers selected studies according to the inclusion criteria. Disagreements were resolved by a third reviewer (title/abstract) and by consensus. Studies with samples ≥ 221 subjects were considered for meta-analysis. *Results:* 28 studies were included, while 18 had the data meta-analyzed. The majority of studies (61%) included older adults only from the Southeastern region. The number of subjects ranged from 53 to 5,532 individuals ($N = 17,604$) and the average age ranged from 65.6 to 85.5 years. The overall prevalence of frailty was 24%. When considering the different assessment methods, the prevalence was lower for frailty phenotype (16%) compared with other criteria (40%). Regarding sex, the prevalence of frailty was similar for women (28%) and men (25%). The prevalence of frailty was higher in older adults recruited from health care services (30%) compared to community ones (22%). *Conclusion:* In Brazil, the overall prevalence of frailty in non-institutionalized older adults is higher than observed from more developed countries. However, it may vary according to the assessment methods and settings.

Key words: Frailty, prevalence, epidemiology, aged.

Introduction

The term frailty is broadly defined as a clinical state in which there is a decline in functioning across multiple systems accompanied by an increase in an individual's vulnerability to stressors (1, 2). Frailty is associated with many negative health outcomes at older age (3), such as disabilities (4), recurrent falls (5), institutionalization (6), and even death (7); as well as greater costs to health care services (8).

The prevalence of frailty increases with age and is higher in women (9–11). In addition, it appears to be higher in low and middle-income countries compared to those with higher-income. Whereas in high-income countries frailty ranges between 9.9 (physical frailty) to 13.6% (broad frailty definition) (9), other authors estimated that frailty prevalence in low and middle-income ranged from 12.7 (physical frailty) to 35.9% (broad frailty definition) (11). This wide variation in prevalence rates reported in the literature is partly explained by differences in the studies' characteristics, including geographic regions, operationalization of frailty status, frailty cut-offs, recruitment age and socio-economic conditions (10, 11).

Brazil is the world's 6th largest country by population and size with over 200 million inhabitants (12). The number of people over 60 years has been increasing exponentially in Brazil. In the last 10 years, the number of older adults increased almost 30%. Presently, Brazil has over 29 million older adults, which represent almost 14% of the total population. In addition,

the number of the oldest old, the specific portion of the population that commonly suffers with frailty, is also increasing along with the life expectancy in Brazil (13–15).

For developing countries such as Brazil, which are aging rapidly and under conditions of socioeconomic and regional disparities, the increasing proportion of older adults imposes challenges for both the health and social systems (16). Although some aging indicators have increased in the last decades, social inequalities still persist in Brazil, which might be partly attributed to the continuity of the unequal distribution of resources among groups with different educational levels (13, 17). Alves and colleagues (13), for example, showed that Brazilian older adults with lower education live more years with frailty, reinforcing the need of public health policies to prevent and manage frailty among older adults at risk.

Despite being a challenge to analyze prevalence data on frailty, mainly because of different associated factors and assessment methods (10, 11), this kind of information is important for the care of the older population. Moreover, since we observed a heterogeneous prevalence of frailty in low to middle-income countries and socioeconomic factors may be predictive in frailty, better understanding of huge middle-income countries such as Brazil is of utmost importance. The scientific community is aware of the importance of recognizing frailty among older adults. However, evidence that would enable the establishment of national policies to assess and manage frailty are scarce in Brazil, and other similar countries

(18, 19). Therefore, a systematic review and meta-analysis were performed to summarize the available epidemiological data on the prevalence of frailty, pre-frailty and robustness/non-frailty, according assessment methods, sex, and setting, among non-institutionalized Brazilian older adults.

Method

The current systematic review and meta-analysis were conducted in accordance with the of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline (20). The protocol of this study was registered with PROSPERO International Prospective Register of Systematic Reviews (CRD42018098709).

Data sources and search strategy

An electronic database search was conducted to identify relevant frailty studies involving Brazilian community-dwelling older adults. PubMed/MEDLINE, LILACS, SCOPUS and Web of Science online databases were searched, and all studies published between 1st March 2001 and 30 July 2018 were considered for analysis. This inception date was chosen because the term frailty was first introduced by Fried and colleagues (21) in a paper published on the same date. The search string included (elder OR elderly OR older OR seniors) AND (frail OR frailty) AND (prevalence OR incidence) AND (Brazil). When available in the databases, filters were applied to ensure that only published papers in the selected language (i.e., English, Portuguese and Spanish) with human participants were included in the search results. Additionally, other studies were searched through references of initially selected studies in the search. The full search strategy is provided in Appendix 1.

Inclusion and Exclusion criteria

Studies were included in this systematic review if they: 1) were cross-sectional or prospective studies, 2) were conducted in Brazil, 3) involved non-institutionalized older adults (60 years old and over), 4) used validated tools, scales or criteria to assess frailty and 5) included prevalence data. Studies that involved older adults with specific diseases, residents of long-term care facilities and hospitalized patients were excluded. If multiple studies were available from the same cohort, the study with the largest sample and most informative of the sample was included in the review.

Study Selection

After the exclusion of duplicate publication, the titles and the abstracts of retrieved studies were screened for inclusion criteria by two independent researchers (G.C.C. and G.L.A.B.). In case of disagreement between them regarding the eligibility, a third researcher (R.C.M.) was consulted. Subsequently, full texts of potential studies were analyzed in more detail for meeting eligibility by the two researchers (G.C.C. and R.C.M.) independently. In this phase, disagreement between the two

researchers was solved through discussion and consensus. The agreement between the two researchers was high with a kappa value of 0.82 (95%CI = 0.68 – 0.95).

Data Extraction

Data from the final list of eligible studies were extracted and entered in a spreadsheet (Microsoft Excel 2011) by one of the reviewers. Another reviewer cross-checked the information for accuracy. Any discrepancies were resolved by discussion and consensus among the reviewers. Three main categories of data were extracted: characteristics of the study (first author, year, type, region of Brazil), characteristics of the subjects (sample size, sexes, mean age, educational levels and frailty prevalence) and methodological details (instrument used, exclusion by low performance in cognitive test and inclusion of proxy informants). The data extraction strategies were pilot tested in 10 studies and refined during the entire process. If it was necessary, the first authors were contacted by email for further information.

Quality Assessment

Quality of the studies was assessed using JBI Critical Appraisal Checklist for studies reporting prevalence (22). This checklist is composed of nine items, which evaluates the studies considering the following requirements: sample frame appropriateness, recruitment appropriateness, sample size, descriptions of subjects and setting, coverage of data analysis, ascertainment and measurement of the condition, the thoroughness of reporting statistical analysis, and the adequacy and management of the response rate. The quality of all studies was rated twice independently by two researchers out of a total of three researchers. Discrepancies were discussed among all three researchers until consensus was reached. The responses were scored 0 for “No and not reported” and 1 for “Yes”. The final score was calculated based in the percentage of fulfillment of the checklist. As there are no established cut-offs from the literature for the quality classification, the quality assessment score was reported but it was not used for the selection of studies for the present review. The details of the quality assessment of the studies are shown in the Appendix 2.

Data Synthesis and Data Analysis

All evidence extracted was described qualitatively and summarized. Studies were considered for quantitative data analysis according sample size adequacy. The estimated sample size was calculated using the following formula: $Z^2 = P(1-P)/D^2$, where Z is the value of Z-statistic for the confidence level (95%), P is the expected prevalence, estimated at 17.4% (11), and D is the acceptable error (0.5%). The expected prevalence was based on an earlier systematic review involving low and middle-income countries (11), which included many epidemiological studies from Brazil. Based on that, studies with ≥ 221 participants were included in the meta-analysis.

To estimate the prevalence of each outcome from studies

PREVALENCE OF FRAILITY IN BRAZILIAN OLDER ADULTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

with ≥ 221 participants, random models were used using the Restricted Maximum Likelihood Method (REML) in R software package 3.6.2. Cochran's Q statistics was used to identify heterogeneity among studies, and the I^2 statistic was used to quantify the degree of heterogeneity. I^2 values below 25% were considered to be low, 25–50% moderate and over 50% high. To compare sexes, assessment methods and settings, random models were adjusted for each subgroup and fixed model were used to combine the subgroups. The heterogeneity within each subgroup was assumed to be the same and the Wald test was used to compare the subgroups. To verify the presence of outliers, the externally studied residues were used. Outlier studies are not necessarily influential, that is, they significantly modify the estimation of the parameters, when the studies were detected as outliers and influential, none of the studies presented as influential. To detect influential studies, the leave-one-out technique was used. Confidence interval was set at 95% (95%CI), and the level of significance was set at 5% for all analysis.

Results

Study Selection

The search and the study selection process are presented in Figure 1. A total of 328 potentially relevant studies were identified in the literature search. Of those, 200 were duplicated, 71 were excluded after title and abstract analysis. 57 full-text articles were assessed for eligibility, and then 29 were excluded for different reasons (same cohort of a large study, absence of frailty tool and absence of prevalence data). The methodological quality of the remaining 28 studies was assessed, and all studies were included in the qualitative synthesis. Among them, 18 studies were eligible for the meta-analysis according to the estimated sample size calculation applied in the present review.

Figure 1

Flow chart of the study selection process

Methodological Quality Assessment

The methodological quality assessment yielded a median score of 78% (range 44% – 100%) for all 28 studies according to the JBI Critical Appraisal Checklist for studies reporting prevalence, whilst the 18 studies included in meta-analysis scored 67% or more (median score was 89%) (Appendix 2). Among these, the majority was considered to have appropriated sample size, study design and data analysis, however some studies did not include enough details about the sample size calculation, subjects, setting, training of the interviewers and non-responders.

Overall Study characteristics

The summary data on the characteristics of the included studies are shown in Table 1. The majority of the studies (61%) included older adults from the Brazilian Southeast region and was designed as a cross-sectional survey (96%). Only 18% of the studies evaluated the frailty prevalence of older adults from the South and Northeast of Brazil. One study involving a population-based sample, which included at least one state from each region of Brazil, however, no study involved older adults exclusively from the Northern and Midwestern regions.

Participants were recruited from community (67.9%) (23–41), primary care services (21.4%) (42–47), outpatient clinics (7.1%) (48, 49) and Universities of the Third Age (3.6%) (50). The number of participants ranged between 53 to 5,532 (total N = 17,604 older adults) and the mean age ranged from 65.6 to 85.5 years old. The prevalence of women in the included studies ranged from 52.7 to 93%, and one studied included only older women (27). In relation to participant's characteristics, 75 and 64.3% of the studies reported information about the level of education and self-reported chronic disease, respectively. The operational definition of frailty most frequently used among the studies was based on frailty phenotype (57.1%) (24–26, 29, 31, 32, 36, 38–41, 43–46, 48), followed by the Edmonton Frail Scale (32.1%) (23, 27, 30, 33–35, 37, 42, 50). Three studies used other available tools, such as Kihon (28), Tilburg Frailty Indicator (47) and FRAIL (49). In 28.6% of the studies (25, 32, 40, 41, 44, 47, 48, 50), low performance in cognitive screening tests (e.g., Mini-mental State Examination) was considered an exclusion criterion. Proxy informants were allowed to answer the survey and/or frailty scale in 21% of the studies (30, 31, 33–35, 46).

Meta-analysis Findings

After the sample size adequacy cutoff (i.e., sample size ≥ 221 participants), 18 studies were selected for meta-analysis (23–26, 29–32, 34, 35, 39–41, 44, 46, 47, 49), with a total of 16,239 subjects and sample size ranging from 240 to 5,532. The pooled prevalence of frailty was 24% (95%CI = 21% to 26%, $I^2 = 98\%$, $p < 0.01$) and varied between 8% to 47% (Figure 2 A). When data were pooled according to the assessment methods, the prevalence of frailty was lower ($p < 0.01$) for physical frailty (16%, 95%CI = 13% to 19%, $I^2 = 93\%$, $p < 0.01$) than

Table 1
Characteristics of the studies included

Author	State	Region	Type	Setting	n	Age mean (SD) (%)	Female n (%)	Schooling	Chronic diseases	Cognitive status (exclusion)	Frailty n (%)	Respondent	Tool of assessment	Quality Score (%)
Phon et al., 2012 (23)*	SP	SE	Cross-sectional	Community	240	73.5 (8.4)	151 (62.9)	Yes	No	No	94 (39.1)	Participant	Edmonton Frail Scale	89
Tribess et al., 2012 (24)*	MG	SE	Cross-sectional	Community	622	71.1 (7.8)	406 (65.0)	Yes	Yes	No	124 (19.9)	Participant	Frailty Phenotype	100
Amaral et al., 2013 (25)*	RN	NE	Cross-sectional	Community	300	74.3 (6.9)	202 (67.3)	Yes	Yes	Yes	55 (18.5)	Participant	Frailty Phenotype	100
Andrade et al., 2013 (26)*	SP	SE	Cross-sectional	Community	1,374	-	820 (59.7)	Yes	Yes	No	116 (8.5)	Participant	Frailty Phenotype	100
Duarte et al., 2013 (27)	PB	NE	Cross-sectional	Community	166	73.2 (8.9)	166 (100)	Yes	No	No	65 (39.2)	Participant	Edmonton Frail Scale	67
Fernandes et al., 2013 (42)	SP	SE	Cross-sectional	Primary Care	128	68.9 (7.8)	86 (67.2)	Yes	No	No	36 (30.1)	Participant	Edmonton Frail Scale	44
Viana et al., 2013 (48)	MG	SE	Cross-sectional	Outpatient clinic	53	76.7 (5.9)	40 (75.5)	No	Yes	Yes	8 (15.1)	Participant	Frailty Phenotype	67
Sampaio et al., 2014 (28)	RS	S	Cross-sectional	Community	173	69.9 (7.4)	127 (73.4)	Yes	No	No	55 (23.7)	Participant	Kihon List	44
Corona et al., 2015 (29)*	SP	SE	Cross-sectional	Community	1,256	70.0 (-)	765 (60.9)	No	Yes	No	132 (8.0)	Participant	Frailty Phenotype	78
Greden et al., 2015 (50)	PR	S	Cross-sectional	U3A	100	65.6 (-)	93 (93.0)	Yes	Yes	Yes	3 (3.0)	Participant	Edmonton Frail Scale	44
Santos et al., 2015 (43)	BA	NE	Cross-sectional	Primary Care	139	72.3 (8.4)	105 (75.5)	Yes	Yes	No	25 (16.9)	Participant	Frailty Phenotype	67
Carneiro et al., 2016 (30)*	MG	SE	Cross-sectional	Community	683	70.9 (8.1)	443 (64.9)	Yes	No	No	243 (35.6)	Participant or Proxy	Edmonton Frail Scale	89
Santos et al., 2016 (31)*	BA	NE	Cross-sectional	Community	286	74.8 (9.8)	155 (54.2)	No	No	No	68 (23.8)	Participant or Proxy	Frailty Phenotype	89
Silva et al., 2016 (32)*	SP, MG, RS, PA, CE, PE, RN, MT	SE, S, N, NE, MW	Cross-sectional	Community	5,532	73.1 (6.2)	3,629 (65.6)	No	Yes	Yes	617 (34.1)	Participant	Frailty Phenotype	78
Teixeira-Gasparini et al., 2016 (33)	SP	SE	Cross-sectional	Community	114	85.5 (4.3)	79 (69.3)	Yes	No	No	51 (44.7)	Participant or Proxy	Edmonton Frail Scale	44
Aprahamian et al., 2017 (49)*	SP	SE	Cross-sectional	Outpatient clinic	811	81.6 (7.3)	591 (72.9)	No	Yes	No	306 (37.7)	Participant	FRAIL Scale	67
Augusti et al., 2017 (44)*	SP	SE	Cross-sectional	Primary Care	306	72.6 (5.7)	185 (60.3)	No	Yes	Yes	66 (21.5)	Participant	Frailty Phenotype	67
Carneiro et al., 2017 (35)*	MG	SE	Cross-sectional	Community	360	75.0 (7.6)	281 (78.0)	Yes	Yes	No	170 (47.2)	Participant or Proxy	Edmonton Frail Scale	67
Cruz et al., 2017 (34)*	MG	SE	Cross-sectional	Community	339	74.3 (8.2)	207 (61.1)	Yes	Yes	No	117 (35.7)	Participant or Proxy	Edmonton Frail Scale	89
Liberaleto et al., 2017 (36)	RS	S	Cross-sectional	Community	69	85.0 (5.6)	43 (62.3)	Yes	Yes	No	40 (58.0)	Participant	Frailty Phenotype	56
Mello et al., 2017 (37)	RJ	SE	Cross-sectional	Community	137	70.2 (7.4)	93 (67.9)	Yes	No	No	17 (12.4)	Participant	Edmonton Frail Scale	89
Tavares et al., 2017 (38)*	MG	SE	Cross-sectional	Community	1,609	-	1,036 (64.4)	Yes	Yes	No	219 (13.6)	Participant	Frailty Phenotype	100
Zazzetta et al., 2017 (39)*	SP	SE	Cross-sectional	Community	304	70.1 (7.6)	173 (56.9)	No	Yes	No	83 (27.3)	Participant	Frailty Phenotype	67
Bandeira et al., 2018 (45)	RS	S	Cross-sectional	Primary Care	201	71.8 (7.6)	133 (66.2)	Yes	Yes	No	126 (62.7)	Participant	Frailty Phenotype	78
Belisário et al., 2018 (40)	MG	SE	Cross-sectional	Community	705	-	471 (66.8)	Yes	Yes	Yes	112 (15.9)	Participant	Frailty Phenotype	89
do Santos Gomes et al., 2018 (41)*	RN	NE	Cross-sectional	Community	402	69.2 (-)	212 (52.7)	Yes	Yes	Yes	47 (11.6)	Participant	Frailty Phenotype	89
Gross et al., 2018 (46)*	RS	S	Cross-sectional	Primary Care	555	71.1 (8.3)	338 (60.9)	Yes	No	No	98 (17.7)	Participant or Proxy	Frailty Phenotype	78
Santiago et al., 2018 (47)*	RG	SE	Longitudinal	Primary Care	640	70.5 (8.2)	414 (64.7)	Yes	No	Yes	284 (44.2)	Participant	Tilburg Frailty Indicator	89

*studies included in the meta-analysis. N= north, S= South, SE=southeast, NE=northeast, MW=midwest, U3A= University of Third Age

PREVALENCE OF FRAILTY IN BRAZILIAN OLDER ADULTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

Figure 2

Random-effects pooled prevalence of frailty (A) and robust/non-frailty (B) according to assessment methods

Table 2

Overall and subgroup analyses for non-frail, pre-frail and frail states

Subgroups	Non-frailty				Pre-frailty				Frailty			
	Prevalence	95% CI	I ²	P values	Prevalence	95% CI	I ²	P values	Prevalence	95% CI	I ²	P values
Overall	37%	30-44	99%	<0.01	53%	49-57	93%	<0.01	24%	21-26	98%	<0.01
Assessment Method												
Frailty Phenotype	29%	21-38	99%	<0.01	54%	49-58	93%	<0.01	16%	13-19	98%	<0.01
Other scales	52%	40-64	99%	<0.01	49%	34-64	NA	NA	40%	35-44	98%	<0.01
Sex												
Female	34%	25-43	99%	<0.01	55%	50-60	85%	<0.01	28%	20-35	98%	<0.01
Male	37%	28-46	96%	<0.01	54%	49-59	84%	<0.01	25%	18-33	98%	<0.01
Setting												
Community	39%	32-47	98%	<0.01	53%	48-58	90%	<0.01	22%	19-25	98%	<0.01
Health care services	28%	13-43	99%	<0.01	55%	49-57	93%	<0.01	30%	25-36	98%	<0.01

for more broad definitions (i.e., Edmonton Frail Scale, FRAIL Scale and Tilburg Frailty Indicator) (40%, 95%CI = 35% to 44%, $I^2 = 79\%$, $p < 0.01$) (Figure 2A). Robust/non-frailty state also varied among the studies, with overall pooled prevalence of 37% (95%CI = 30% to 40%, $I^2 = 99\%$, $p < 0.01$), ranging between 7% to 65%. Similarly, robust/no-frailty state was lower ($p < 0.01$) in studies that used the physical frailty approach (29%, 95%CI = 21% to 38%, $I^2 = 99\%$, $p < 0.01$) than other assessment methods (52%, 95%CI = 40% to 64%, $I^2 = 99\%$, $p < 0.01$) (Figure 2B). Pre-frailty data were available for 13 studies (total of 13,977 subjects) and its pooled prevalence was 53% (95%CI = 49% to 57%, $I^2 = 93\%$, $p < 0.01$) (Table 2).

Sex prevalence data for frailty and robust/non-frailty states were presented in 16 studies (total of 14,155 subjects). Irrespective of the assessment method used, no difference was found for the pooled prevalence of frailty ($p = 0.67$) (Figure 3A) and robust/non-frailty ($p = 0.66$) (Table 2) states between men (frailty = 25%, 95%CI = 18% to 33%, $I^2 = 97\%$, $p < 0.01$; robust/non-frailty = 35%, 95%CI = 28% to 46%, $I^2 = 98\%$, $p < 0.01$) and women (frailty = 28%, 95%CI = 28% to 35%, $I^2 = 98\%$, $p < 0.01$; robust/non-frailty = 34%, 95%CI = 25% to 43%, $I^2 = 99\%$, $p < 0.01$). Eleven studies also reported pre-frailty data according to the sex of the participants (total of 11,898 subjects). The pooled prevalence for the pre-frailty state was

55% (95%CI 51% to 58%, $I^2 = 84\%$, $p < 0.01$), independently of the frailty assessment used. No difference ($p = 0.83$) was observed between men (54%, 95%CI = 49% to 59%, $I^2 = 84\%$, $p < 0.01$) and women (55%, 95%CI = 50% to 60%, $I^2 = 85\%$, $p < 0.01$) for pre-frailty state (Table 2).

Figure 3

Random-effects pooled prevalence of frailty according to sex (A) and setting (B)

The frailty prevalence in non-institutionalized older adults differed ($p < 0.01$) according to the settings of recruitment. Among older adults from the community (14 studies with a total of 13,166 participants), frailty prevalence was lower (22%, 95%CI = 19% to 25%, $I^2 = 98\%$, $p < 0.01$) than among those recruited from health services (4 studies and a total of 3,073 participants) (30%, 95%CI = 25% to 36%, $I^2 = 97\%$, $p < 0.01$) (Figure 3B). However, no difference ($p = 0.19$) was found between community-dwelling older adults (39%, 95%CI = 32% to 47%, $I^2 = 98\%$, $p < 0.01$) and those from health services (28%, 95%CI = 13% to 43%, $I^2 = 99\%$, $p < 0.01$) for the prevalence of robust/non-frailty state (Table 2). Regarding the pre-frailty state, the pooled prevalence for non-institutionalized older adults from community (10 studies with a total of 12,305 subjects) and health services (3 studies with a total of 1,672 subjects) were 53% (95%CI 48% to 58%, $I^2 = 90\%$, $p < 0.01$) and 55% (97%CI 46% to 64%, $I^2 = 93\%$, $p < 0.01$) (Table 2), respectively.

Table 3

Physical phenotype components analyses

Components	Prevalence	95% CI	I ²	P values
Fatigue	32%	18-46	99%	<0.01
Low muscle strength	26%	18-34	98%	<0.01
Low physical activity	27%	22-33	96%	<0.01
Slow gait	32%	17-48	99%	<0.01
Weight loss	17%	13-20	97%	<0.01

Among the 12 studies that used the physical frailty approach, the frequency rate of the frailty phenotype components (i.e., fatigue, low muscle strength, low physical activity, slow gait and weight loss) were obtained from nine studies (total of 11,206 subjects). The most prevalent frailty phenotype components were low gait speed (32%, 95%CI = 17% to 48%, $I^2 = 99\%$, $p < 0.01$) and fatigue (32%, 95%CI = 18% to 46%, $I^2 = 99\%$, $p < 0.01$), followed by low physical activity (27%, 95%CI = 22% to 33%, $I^2 = 96\%$, $p < 0.01$), low muscle strength (26%, 95%CI = 18% to 34%, $I^2 = 98\%$, $p < 0.01$) and weight loss (17%, 97%CI 13% to 20%, $I^2 = 99\%$, $p < 0.01$) (Table 3). In general, it was observed heterogeneity in the evaluation of the frailty phenotype's components among studies.

Discussion

The pooled prevalence of frailty among non-institutionalized Brazilian older adults is estimated at 24% (18 studies, total of 16,239 individuals), which is higher compared to other meta-analysis involving low and middle-income (11, 51), and in high-income countries (9, 52). Da Mata and colleagues (51) found that the prevalence of frailty in community-dwelling older adults from Latin American countries and the Caribbean is 19.6%, with a range of 7.7% to 42.6%. In subgroup analyses,

PREVALENCE OF FRAILTY IN BRAZILIAN OLDER ADULTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

the authors also showed a prevalence of frailty of 17.9% among Brazilian older adults (12 studies, total of 12,485 individuals). Furthermore, Siriwardhana and colleagues (11) observed an overall prevalence of frailty of 17.4% (47 studies, total of 75,133 individuals) in community-dwelling older adults from low and middle-income countries around the world. The proportion of studies using a broader frailty approach was higher (33.3%) in the present study and, thus, this fact could partially explain the higher overall prevalence of frailty in our results, as explained below.

Previous meta-analyses have reported that frailty prevalence varies according to the assessment method, that is, physical phenotype versus other strategies (9, 11, 51, 52). In community-dwelling older adults from low and middle-income countries, studies reported a prevalence of physical frailty of 10.6 (51) and 12.7% (11), whilst broader frailty approaches suggested prevalence values three times higher (i.e., near 36%) (11, 51). Corroborating with this studies, among non-institutionalized Brazilian older adults, the prevalence of frailty was also different regarding the assessment method, being lower for the physical approach (i.e., 16%, ranging from 8 to 27%) in comparison with other assessment methods (i.e., 40%, ranging from 35 to 47%). Despite these similarities, the presently reported prevalence rates, for both assessment methods analyzed, are still higher in our study, in part justified by the inclusion of older adults from health care services (primary care and outpatient clinics).

The prevalence of frailty also seems to differ according to the settings where older adults were recruited from. In a meta-analysis conducted by O’Caoimh and colleagues (52), frailty prevalence in community and non-community (primary care, outpatient geriatrics clinics, hospital and care home) based studies (62 studies, total of 13,932) from different European countries were 12% and 45%, respectively. As expected, the authors also pointed that the highest prevalence rates were found among older adults from care homes (over 60%) and hospitals (around 50%), whilst a prevalence around 30% was observed for primary care and outpatient settings. Similar results were found in the present meta-analysis, as frailty prevalence was lower among Brazilian older adults from the community (22%), compared with those recruited from health care services (30%). It is important to note that, among the studies conducted in health care services, three evaluated older adults from primary care (44, 46, 47), reinforcing the importance of advancing the knowledge regarding the cost-effectiveness of screening older people for frailty and the strategies for preventing/postponing its progression (53–55), mainly in low and middle-income countries.

While there is evidence from high-income countries that supported the influence of sex on frailty rates (9), differences between men and women are not consensus in low and middle income countries (11, 15, 51). The meta-analysis of Siriwardhana and colleagues (11) showed that the pooled prevalence of frailty among women was higher (15.2%)

compared with men (11.1%). Differences regarding sex were also observed for the pre-frail state, with its prevalence estimated at 56.3 and 53.8% in women and men, respectively. On the other hand, no significant differences between sexes were found by other researchers (51), in spite of prevalence rates of 23.4% for women and 15.0% for men.

In the present meta-analysis, no differences were found for frailty (28% vs. 25%) and pre-frailty (55% vs. 54%) states between older women and men, contradicting the influence of sex on frailty. It is possible that both the design of the studies and some socio-environmental factors have contributed to this result. First of all, the mean age of the participants was below 75 years old in the majority of the studies included in the meta-analysis, except for one study (49). Considering that women live longer and, consequently, have more chronic conditions at an older age (56), it is plausible that sex differences regarding frailty prevalence rates become more evident in the older age ranges. In regions where life expectancy is not very high (e.g., life expectancy in Brazil is below 80 years old), sexes differences in frailty prevalence might be underestimated, once those with frailty may die earlier and only the more robust ones probably reach advanced ages, especially men.

A recent large cohort study from Brazil (15), in which data from 8,556 participants over 49 years old from different regions were analyzed, also showed no differences between sexes. The prevalence of frailty, based on Cardiovascular Health Study (CHS) criteria (21), for those 65 years and over was 16%, which is aligned to our findings. The authors also found that frailty was associated with age, low education levels, negative income sufficiency perception, poor self-rated health, multimorbidity, and difficulty to perform one or more basic activities of daily living, however, sex and smoking status were not statistically associated with frailty. Findings from the SABE (Health Well-being, and Ageing Study) (57), a population-based prospective study carried out in the city of São Paulo, showed that in their sample women were older and had lower schooling, a greater number of diseases, obesity, lower grip strength, and slower gait speed at baseline. In contrast, smoking history/habits, alcoholism, body mass and stroke were higher among men. As data about other socio-environmental (e.g., education levels and income) and health (e.g., number of chronic disease and presence of disability) factors were not analyzed in the present meta-analysis, mainly because of absence of data collection standardization among studies, the influence of other confounders in our findings cannot be ruled out.

The analysis of the frailty phenotype components showed a higher prevalence of low gait speed (32%) and fatigue (32%) among non-institutionalized older adults living in Brazil. Furthermore, other modifiable components, such as low physical activity (27%) and low muscle strength (26%), were also frequently present in our study. These findings reinforce the need for interventions that could prevent/postpone frailty progression. Besides the fact that the effectiveness of some

potential interventions for frailty is yet to be scientifically confirmed, a recent meta-analysis showed that physical exercise, physical exercise plus nutritional supplementation, and medication management seem to be effective to reduce frailty, however, these results must be analysed with caution as the quality of the evidence was low (58).

Not surprisingly, weight loss was the least prevalent (17%) component in our study, which is aligned to age-related changes on body composition, characterized by the increase and redistribution of fat mass and the reduction of fat-free mass (i.e., muscle), resulting in weight gain over the years (59). Data from prospective studies, for example, support the increase of body weight until the seventies (60, 61) but, after this, older adults are more susceptible to weight loss (61). As mentioned above, the mean age of the participants of the studies included in our meta-analysis was below 75 years, leading us to believe that obesity can be also present in the studied samples. Among the studies included in the frailty components analysis, only Corona and colleagues (29) reported the prevalence of obesity (i.e., body mass index ≥ 30 Kg/m²) in the participants (37.8% for frails and 32.3% for robusts). Thus, it is possible that obesity, mainly when associated with sarcopenia (i.e., sarcopenic obesity) (62), can be more relevant for frailty onset and progression in young-old than oldest-old adults, constituting an interesting topic for further studies.

Potential limitations should be addressed. Firstly, as we observed in this systematic review and meta-analysis, several papers did not reach enough power to be included for meta-analysis. Secondly, as Brazil is a continental country with heterogeneous socioeconomic development, it should be important to observe frailty characteristics in more poor regions of the country (North and Northeast). Thirdly, most of the studies did not publish sociodemographic and clinical characteristics that could potentially untangle the higher prevalence of frailty in low to middle income countries.

Conclusion

The results of the present meta-analysis demonstrated that frailty is very common in Brazil, reinforcing the need for a national task force to standardize procedures to measure and manage this syndrome in non-institutionalized older adults. In addition, a harmonized research protocol to be implemented in the whole country would be essential to foster the understanding of the influence of associated factors, health (e.g., number of chronic diseases, polypharmacy, presence of disability, cognitive impairment) or socio-environmental (e.g., education level, income, access to health services) factors. The need for screening frailty in the poorest regions of Brazil is clear, as the majority of the studies published so far have been conducted in the richest area (Southeast). Due to the huge socio-economic disparities, managing frailty in Brazil is probably beyond the health care services walls and should involve public policies to improve different socio-economic

parameters nationally. Despite all challenges, it is time for frailty screening, diagnosis, and management to be on the priority agenda of our public health system.

Acknowledgment: Mônica Sanches Yassuda and Ivan Aprahamian received a national grant from the National Council for Scientific and Technological Development (Ministry of Science, Technology, Innovation and Communications, Brazil). This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001. We are grateful to the authors of the original articles who kindly share additional data.

Conflict of Interest: The authors declare no conflict of interest.

Ethical Standards: This study did not include any animal or human experiments.

References

1. Morley JE, Vellas B, van Kan GA, et al. Frailty consensus: a call to action. *J Am Med Dir Assoc* 2013;14:392–397.
2. Hoogendijk EO, Afilalo J, Ensrud KE, Kowal P, Onder G, Fried LP. Frailty: implications for clinical practice and public health. *Lancet* 2019;394:1365–1375.
3. Vermeiren S, Vella-Azzopardi R, Beckwée D, Habbig A-K, Scafoglieri A, Jansen B, Bautmans I, Gerontopole Brussels Study group. Frailty and the Prediction of Negative Health Outcomes: A Meta-Analysis. *J Am Med Dir Assoc* 2016;17:1163.e1–1163.e17.
4. Kojima G. Frailty as a predictor of disabilities among community-dwelling older people: a systematic review and meta-analysis. *Disabil Rehabil* 2017;39:1897–1908.
5. Cheng M-H, Chang S-F. Frailty as a Risk Factor for Falls Among Community Dwelling People: Evidence From a Meta-Analysis. *J Nurs Scholarsh* 2017;49:529–536.
6. Kojima G. Frailty as a Predictor of Nursing Home Placement Among Community-Dwelling Older Adults: A Systematic Review and Meta-analysis. *J Geriatr Phys Ther* 2018;41:42–48.
7. Kojima G, Iliffe S, Walters K. Frailty index as a predictor of mortality: a systematic review and meta-analysis. *Age Ageing* 2018;47:193–200.
8. Kojima G. Increased healthcare costs associated with frailty among community-dwelling older people: A systematic review and meta-analysis. *Arch Gerontol Geriatr* 2019;84:103898.
9. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. *J Am Geriatr Soc* 2012;60:1487–1492.
10. Harttgen K, Kowal P, Strulik H, Chatterji S, Vollmer S. Patterns of frailty in older adults: comparing results from higher and lower income countries using the Survey of Health, Ageing and Retirement in Europe (SHARE) and the Study on Global AGEing and Adult Health (SAGE). *PLoS One* 2013;8:e75847.
11. Siriwardhana DD, Hardoon S, Rait G, Weerasinghe MC, Walters KR. Prevalence of frailty and prefrailty among community-dwelling older adults in low-income and middle-income countries: a systematic review and meta-analysis. *BMJ Open* 2018;8:e018195.
12. Brazil Population. (2019-06-09). Retrieved 2019-12-19, from World Population Review. Available at: <http://worldpopulationreview.com/countries/brazil/>. Accessed December 2019;19, 2019.
13. Alves LC, Andrade FCD, Corona LP, Santos JLF, Duarte YADO. Inequalities in Life Expectancy With Frailty Among Brazilian Older Adults: A Multistate Approach. *Innov Aging* 2019;3:igz032.
14. Projeções e estimativas da população do Brasil e das Unidades da Federação Instituto Brasileiro de Geografia e Estatística (IBGE). Available at: <https://www.ibge.gov.br/apps/populacao/projecao/>. Accessed December 19, 2019.
15. Andrade JM, Duarte YA de O, Alves LC, Andrade FCD, Souza Junior PRB de, Lima-Costa MF, Andrade FB de. Frailty profile in Brazilian older adults: ELSI-Brazil. *Rev Saude Publica* 2018;52(Suppl 2):17s.
16. Neumann LTV, Albert SM. Aging in Brazil. *Gerontologist* 2018;58:611–617.
17. Braga L de S, Lima-Costa MF, César CC, Macinko J. Social Inequalities on Selected Determinants of Active Aging and Health Status Indicators in a Large Brazilian City (2003-2010). *J Aging Health* 2016;28:180–196.
18. Lourenço RA, Moreira VG, Mello RGB, Santos IS, Lin SM, Pinto ALF, et al. Brazilian consensus on frailty in older people: concepts, epidemiology and evaluation instruments. *Geriatr, Gerontol Aging* 2018;12:121–135.
19. Puts MTE, Toubasi S, Andrew MK, Ashe MC, Ploeg J, Atkinson E, Ayala AP, Roy A, Rodríguez Monforte M, Bergman H, McGilton K. Interventions to prevent or reduce the level of frailty in community-dwelling older adults: a scoping review of the literature and international policies. *Age Ageing* 2017;46:383–392.

PREVALENCE OF FRAILTY IN BRAZILIAN OLDER ADULTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

20. Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 2009;6:e1000097.
21. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, McBurnie MA, Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001;56:M146–56.
22. Munn Z, Moola S, Lisy K, Riitano D, Tufanaru C. Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and cumulative incidence data. *Int J Evid Based Healthc* 2015;13:147–153.
23. Phon JRS, Diniz MA, Leonardo KC, Kusumoto L, Haas VJ, Rodrigues RAP. Frailty syndrome related to disability in the elderly. *Acta Paul Enferm* 2012;25:589–594.
24. Tribess S, Virtuoso Júnior JS, Oliveira RJ de. Physical activity as a predictor of absence of frailty in the elderly. *Rev Assoc Med Bras* 2012;58:341–347.
25. Amaral FLJDS, Guerra RO, Nascimento AFF, Maciel ACC. [Social support and the frailty syndrome among elderly residents in the community]. *Cien Saude Colet* 2013;18:1835–1846.
26. Andrade FB de, Lebrão ML, Santos JLF, Duarte YA de O. Relationship between oral health and frailty in community-dwelling elderly individuals in Brazil. *J Am Geriatr Soc* 2013;61:809–814.
27. Duarte MCS, Fernandes M das GM, Rodrigues RAP, Nóbrega MML da. [Prevalence and sociodemographic factors associated with frailty in elderly women]. *Rev Bras Enferm* 2013;66:901–906.
28. Sampaio PYS, Sampaio RAC, Yamada M, Ogita M, Arai H. Validation and translation of the Kihon Checklist (frailty index) into Brazilian Portuguese. *Geriatr Gerontol Int* 2014;14:561–569.
29. Corona LP, Andrade FCD, Duarte YA de O, Lebrão ML. The Relationship between Anemia, Hemoglobin Concentration and Frailty in Brazilian Older Adults. *J Nutr Health Aging* 2015;19:935–940.
30. Carneiro JA, Ramo2015s GCF, Barbosa ATF, Vieira ÉDS, Silva JSR, Caldeira AP. Falls among the non-institutionalized elderly in northern Minas Gerais, Brazil: prevalence and associated factors. *Rev Bras Geriatr Gerontol* 2016;19:613–625.
31. Santos KT, Fernandes MH, Carneiro JA, Coqueiro R da Silva. Motor performance tests as screening instruments for frailty in the older adults. *Appl Nurs Res* 2016;32:80–84.
32. Silva SLA da, Neri AL, Ferrioli E, Lourenço RA, Dias RC. [Phenotype of frailty: the influence of each item in determining frailty in community-dwelling elderly - The Fibra Study]. *Cien Saude Colet* 2016;21:3483–3492.
33. Teixeira-Gasparini E, Partezani-Rodrigues R, Fabricio-Wehbe S, Silva-Phon J, Aleixo-Diniz M, Kusumoto L. [Assisting technologies and frailty in aged 80 years and older]. *Enferm Univers* 2016;13:151–158.
34. Cruz DT da, Vieira M de T, Bastos RR, Leite ICG. Factors associated with frailty in a community-dwelling population of older adults. *Rev Saude Publica* 2017;51:106.
35. Carneiro JA, Cardoso RR, Durães MS, Guedes MCA, Santos FL, Costa FM da, Caldeira AP. Frailty in the elderly: prevalence and associated factors. *Rev Bras Enferm* 2017;70:747–752.
36. Liberalesso TEM, Dallazen F, Bandeira VAC, Berlezi EM. [Prevalence of frailty in a long-lived population in the Southern region of Brazil]. *Saúde debate* 2017;41:553–562.
37. Mello A de C, Carvalho MS, Alves LC, Gomes VP, Engstrom EM. [Food consumption and anthropometry related to the frailty syndrome in low-income community-living elderly in a large city]. *Cad Saude Publica* 2017;33:e00188815.
38. Tavares DMS, Corrêa TAF, Dias FA, Ferreira PCS, Pegorari MS. Frailty syndrome and socioeconomic and health characteristics among older adults. *Colomb Med* 2017;48:126–131.
39. Zazzetta MS, Gomes GAO, Orlandi FS, Gratão ACM, Vasilceac FA, Gramani-Say K, Ponti MA, Castro PC, Pavarini SCI, Menezes ALC, Nascimento CMC, Cominetti MR. Identifying Frailty Levels and Associated Factors in a Population Living in the Context of Poverty and Social Vulnerability. *J Frailty Aging* 2017;6:29–32.
40. Belisário MS, Dias FA, Pegorari MS, Paiva MM de, Ferreira PCDS, Corradini FA, Tavares DMS. Cross-sectional study on the association between frailty and violence against community-dwelling elderly people in Brazil. *Sao Paulo Med J* 2018;136:10–19.
41. Dos Santos Gomes C, Pirkle CM, Zunzunegui MV, Guedes DT, Barbosa JFS, Hwang P, Guerra RO. Frailty and life course violence: The international mobility in aging study. *Arch Gerontol Geriatr* 2018;76:26–33.
42. Fernandes H da CL, Gaspar JC, Yamashita CH, Amendola F, Alvarenga MRM, Oliveira MA de C. Frailty assessment in the elderly assisted at a Family Health Unit. *Text Context Nursing* 2013;22:423–431.
43. Santos PHS, Fernandes MH, Casotti CA, Coqueiro R da S, Carneiro JAO. [The profile of fragility and associated factors among the elderly registered in a Family Health Unit]. *Cien Saude Colet* 2015;20:1917–1924.
44. Augusti ACV, Falsarella GR, Coimbra AMV. [Analysis of frailty syndrome in primary care - Cross sectional study]. *Rev Bras Med Fam Comunidade* 2017;12:1–9.
45. Bandeira VAC, Berlezi EM, Gross CB, Colet C de F. Antidepressant use and the components of the frailty syndrome. *Rev Bras Geriatr Gerontol* 2018;21:7–15.
46. Gross CB, Kolankiewicz ACB, Schmidt CR, Berlezi EM. Frailty levels of elderly people and their association with sociodemographic characteristics. *Acta Paul Enferm* 2018;31:209–216.
47. Santiago LM, Gobbens RJJ, van Assen MALM, Carmo CN, Ferreira DB, Mattos IE. Predictive validity of the Brazilian version of the Tilburg Frailty Indicator for adverse health outcomes in older adults. *Arch Gerontol Geriatr* 2018;76:114–119.
48. Viana JU, Silva SLA, Torres JL, Dias JMD, Pereira LSM, Dias RC. Influence of sarcopenia and functionality indicators on the frailty profile of community-dwelling elderly subjects: a cross-sectional study. *Braz J Phys Ther* 2013;17:373–381.
49. Aprahamian I, Lin SM, Suemoto CK, Apolinario D, Oiring de Castro Cezar N, Elmajian SM, Filho WJ, Yassuda MS. Feasibility and Factor Structure of the FRAIL Scale in Older Adults. *J Am Med Dir Assoc* 2017;18:367.e11–367.e18.
50. Giden CRB, Barreto MFC, Sousa JAV de, Chuertniek JA, Reche PM, Borges PK de O. Association between physical frailty and cognitive scores in older adults. *Rev Rene* 2015;16. doi:10.15253/2175-6783.2015000300012.
51. Da Mata FAF, Pereira PP da S, Andrade KRC de, Figueiredo ACMG, Silva MT, Pereira MG. Prevalence of Frailty in Latin America and the Caribbean: A Systematic Review and Meta-Analysis. *PLoS One* 2016;11:e0160019.
52. O’Caoimh R, Galluzzo L, Rodríguez-Laso Á, Van der Heyden J, Ranhoff AH, Lamprini-Koula M, Ciutan M, López-Samaniego L, Carcaillon-Bentata L, Kennelly S, Liew A, Work Package 5 of the Joint Action ADVANTAGE. Prevalence of frailty at population level in European ADVANTAGE Joint Action Member States: a systematic review and meta-analysis. *Ann Ist Super Sanita* 2018;54:226–238.
53. Ambagtsheer RC, Beilby JJ, Visvanathan R, Dent E, Yu S, Braunack-Mayer AJ. Should we screen for frailty in primary care settings? A fresh perspective on the frailty evidence base: A narrative review. *Prev Med* 2019;119:63–69.
54. Cesari M, Prince M, Thiagarajan JA, De Carvalho IA, Bernabei R, Chan P, Gutierrez-Robledo LM, Michel J-P, Morley JE, Ong P, Rodriguez Manas L, Sinclair A, Won CW, Beard J, Vellas B. Frailty: An Emerging Public Health Priority. *J Am Med Dir Assoc* 2016;17:188–192.
55. Dent E, Martin FC, Bergman H, Woo J, Romero-Ortuno R, Walston JD. Management of frailty: opportunities, challenges, and future directions. *Lancet* 2019;394:1376–1386.
56. Hubbard RE, Rockwood K. Frailty in older women. *Maturitas* 2011;69:203–207.
57. Alexandre T da S, Corona LP, Brito TRP, Santos JLF, Duarte YAO, Lebrão ML. Gender Differences in the Incidence and Determinants of Components of the Frailty Phenotype Among Older Adults: Findings From the SABE Study. *J Aging Health* 2018;30:190–212.
58. Negm AM, Kennedy CC, Thabane L, et al. Management of Frailty: A Systematic Review and Network Meta-analysis of Randomized Controlled Trials. *J Am Med Dir Assoc* 2019;20:1190–1198.
59. Seidell JC, Visscher TL. Body weight and weight change and their health implications for the elderly. *Eur J Clin Nutr* 2000;54 Suppl 3:S33–9.
60. Batsis JA, Petersen CL, Crow RS, Cook SB, Stevens CJ, Seo LM, Brooks E, Mackenzie TA. Weight change and risk of the foundation of National Institute of Health Sarcopenia-defined low lean mass: Data from the National Health and Nutrition examination surveys 1999-2004. *Clin Nutr*, 2019. doi:10.1016/j.clnu.2019.10.032.
61. Drøystad WB, Nilsen TIL, Krüger O, Holmen TL, Krokstad S, Midthjell K, Holmen J. Change in height, weight and body mass index: Longitudinal data from the HUNT Study in Norway. *Int J Obes* 2006;30:935–939.
62. Batsis JA, Villareal DT. Sarcopenic obesity in older adults: aetiology, epidemiology and treatment strategies. *Nat Rev Endocrinol* 2018;14:513–537.