

# Weight Loss Severity and Functional Decline Among The Oldest Old in a Middle-Income Country: The Fibra Study Longitudinal Findings

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## Research Article

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# Abstract

**Background and objective:** Nutritional status is a key modifiable risk factor associated with disability, and further evidence suggests that weight change is also linked to this adverse outcome. Thus, the aim of this study is to evaluate weight loss severity and functional decline in instrumental activities of daily living (IADL) in a seven-year period among a sample of Brazilian oldest old adults.

**Methods:** This is a longitudinal prospective study using data from FIBRA study (Frailty in Older Brazilians), a population-based investigation carried out in 2008/2009, with follow up data collected in 2016/2017 from participants who were 80 years and older in the follow-up in Campinas, Brazil. Of the 167 participants who were interviewed with complete data in 2016-2017, 16 had improved their functional status and were excluded, so the final sample was restricted to 151 participants who maintained or declined functional status. We considered functional decline when a subject had a greater number of IADL dependencies at follow-up than at baseline. Logistic regression was performed to assess the effect of weight loss, according to severity (moderate weight loss: 5-10% of body weight; severe weight loss >10%) in increasing the number of disabilities, in relation to the group with stable weight, controlling for covariates (gender, age, education and morbidity). An alpha level <5% was adopted.

**Results:** During the follow-up period, 60.3% of the participants kept stable weight, 21.8% had moderate weight loss and 17.9% had severe weight loss. During the follow-up, only severe weight loss was associated to higher risk of functional decline (OR=2.74;p=0.032).

**Conclusions:** weight loss consisted in a risk factor to functional decline in this sample of oldest old, but severity of the loss must be considered as only severe loss was significant. Given that weight loss is expected for the oldest old, it is important to quantify this loss and measure its severity, and also to identify the magnitude of the loss that is associated with functional decline.

## Background

Functional disability affects a growing portion of many developed countries as populations age. In general, its prevalence increases rapidly with age, resulting in the oldest old being the most affected (1). This issue is especially important to low- and middle-income countries (LMIC) where access to health care is limited. Residents of such countries will comprise 57% of the individuals 80 years or older in the world by 2025.(2)

Nutritional status is a key modifiable risk factor associated with disability,(3) and there is evidence that weight loss is associated with it as well. Strandberg et al.(4) found that individuals with weight loss had higher levels of disability than participants of normal weight. Murphy et al.,(5) in a prospective study of older adults aged 70-79 years, showed that weight loss, but not weight gain, was associated with higher mobility disability. Son et al. (2020) found that in Korean older adults, regardless of the risk factors, both weight loss and weight gain increased the mortality rate compared with stable weight (6). The oldest old, here defined as those 80 years or older, are at increased risk for nutritional changes and fat redistribution,

(7) which can impact functional decline, wellbeing, and mortality risks. Little is known about associations between weight change and disability among people who live in LMIC, where nutritional transitions are still in course, and situations of obesity and undernutrition can be presented in the same family, and this process is very different from high income countries (8).

A Brazilian study restricted to female participants aged 75 and older found opposite results to Murphy et al.'s— weight gain was associated to higher levels of disability, but not weight loss.(9) However, women tend to start losing body mass later than men,(10) which, coupled with the younger cutoff, likely explains the unusual result.

Thus, questions about the oldest old in middle-income countries remain. This study aims to evaluate weight changes and functional decline in instrumental activities of daily living (IADLs) in a 7-year longitudinal study among the oldest old adults in Brazil, a middle-income country.

## Methods

### Design and participants

The Frailty in Older Brazilians Study (Fragilidade em Idosos Brasileiros, FIBRA Study) started as a multicentric cross-sectional study conducted in seven Brazilian cities between 2008 and 2009. Methodological procedures of the FIBRA study are documented elsewhere.(11) The present analyses focus on participants who were 80 years and older (FIBRA 80+) residents in the city of Campinas who were re-interviewed in 2016/2017. The study was approved by the local Ethics in Research Committee. Participation was voluntary and a signed informed consent was obtained.

In the first wave conducted in Campinas in 2008 and 2009, 900 individuals were enrolled, but 211 participants were excluded because they had low cognitive scores according to the cut-off point the Mini-Mental State Examination, adjusted by years of education. Among the FIBRA participants, 475 were born between January 1911 and June of 1936 and were eligible for the follow-up in 2016/2017. At the follow-up, 109 participants had died and 130 were lost. Among those located, 67 were not able to respond the questionnaire due to severe cognitive impairment and were excluded from our analysis. Among the remainder, 2 participants did not have a body weight measurement. Analysis focused on the 167 who remained. Figure 1 presents the study design and final sample.

### Instruments and procedures

IADL measures were based on the Lawton and Brody questionnaire designed for the purpose.(12) It addresses using transportation, shopping, administering one's own money, using a telephone, controlling one's own medications, preparing hot meals, and performing household chores. We defined functional decline to be present if a subject had a greater number of IADL difficulties at follow-up than at baseline. Among the 167 participants with complete data, 16 had improved functional status during follow-up,

unexplained by any variables here included, so we focus on the remaining 151, all of whom had maintained or declined their functional status (Figure 1).

Body weight was measured using a calibrated scale, with the individual wearing light clothing. Differences in weight were calculated between the baseline and follow-up and changes (gain or loss) of 5% or more were considered significant. Body Mass Index (BMI) was calculated dividing body weight (kg) per height (m).

Sociodemographic variables were gender, age in years, and schooling (in years). As a health proxy, we included the total number of self-reported chronic diseases (diabetes mellitus, hypertension, cardiovascular disease, stroke, arthritis or rheumatism, cancer, pulmonary disease, depression and osteoporosis). For all these sociodemographic variables, baseline values were included in the analyses.

## Data analysis

For descriptive analysis, categorical variables were compared using the chi-square test. Mann-Whitney and Kruskal-Wallis rank tests were used to compare quantitative variables with across groups.

The dependent variable was functional decline, considered dichotomously – no decline or any decline. The independent variable of interest was the weight change. Changes of less than 5% were considered stable weight (reference category) throughout the period. Given the very low proportion of older adults who gained weight in the period (n=14; 9.3%), individuals who gained weight were combined with those who had stable weight (n=77). Weight loss was categorized according to severity – moderate weight loss (5 to 10% of body weight); or severe weight loss (>10% of body weight).

Logistic regression analysis was performed to assess the effect of weight loss in functional decline, controlling for covariates. Analyses were performed using Stata® 14 with alpha level <5%.

## Results

At baseline, when compared to those who were lost in the follow-up or who had died, those who remained in the sample were younger (p=0.002), more educated (p=0.011), had fewer chronic conditions (p=0.021), and had a higher number of difficulties in IADLs (p<0.001). Mean body weight was higher among those who remained in the sample (68.3kg), but the difference was not statistically different from those who had died (65.9kg) or were lost to follow-up (66.9kg) (p=0.271).

Table 1 displays the baseline characteristics of the participants at the beginning of the study and according to functional status at follow-up. At follow-up, 44.4% of the study sample had functional decline. At baseline, most of the individuals were women (70.9%), mean age was 76.1 years-old, mean years of formal education was 4.9, and mean number of self-reported chronic conditions was 2.0. Only mean education was significantly lower in the group with functional decline (p=0.013). Body weight and BMI in the baseline were not different between groups. Functional decline was higher (59.3%) in those with severe weight loss (p=0.043).

Figure 2 displays the mean number of reported IADL difficulties at baseline and follow-up, according to weight change during the period. Even though not statistically significant, the functional ability of the stable weight group at baseline was slightly higher than the other two groups. At the follow-up, both groups that lost weight had a significantly higher increase in number of difficulties than the stable weight group. Those with moderate weight loss had higher mean number of difficulties at follow-up than the group with severe weight loss, but the difference was not significant.

Table 1

– Sample characteristics (%) at baseline and after a 7-year follow-up period, according to functional decline in Instrumental Activities of Daily Living (IADL). FIBRA 80+ Study, Campinas, Brazil: 2008-2016.

Characteristic	Baseline (n=151)	Follow-up		P- value
		Maintained IADL function (n=84)	Declined IADL function (n=67)	
Gender (%)				0.103
Male	29.1	65.9	34.1	
Female	70.9	51.4	48.6	
Age (mean)	76.1	75.8	76.4	0.166
Years of formal education (mean)	4.9	5.4	4.4	0.013
Number of chronic conditions (mean)	2.0	1.9	2.2	0.219
Body Weight, (mean, kg)	68.6	69.5	67.5	0.545
Body Mass Index (mean, Kg/m <sup>2</sup> )	27.6	27.5	27.6	0.721
Weight change categories				0.043
Stable weight	60.3	62.6	37.4	
Moderate weight loss	21.8	48.5	51.5	
Severe weight loss	17.9	40.7	59.3	

Table 2 displays results of the logistic regression analysis for functional decline. Moderate weight loss was not significantly associated to higher risk of decline, but the effect of severe weight loss is consistent – even when controlling for covariates, chances of functional decline was twice as high as stable weight participants (p=0.032).

Table 2

– Results of the logistic regression model for functional decline in a 7-year period among oldest old. FIBRA 80+ Study, Campinas, Brazil: 2008-2016.

Characteristic	Unadjusted OR	P value	Adjusted OR	P value
Weight change categories				
Stable weight	(ref)	-	(ref)	-
Moderate weight loss	1.78	0.159	1.99	0.108
Severe weight loss	2.44	0.046	2.74	0.032
Gender				
Male	(ref)	-	(ref)	-
Female	1.83	0.105	1.78	0.140
Age	1.05	0.298	1.04	0.413
Years of formal education	0.95	0.156	0.94	0.110
Number of chronic conditions	1.14	0.204	1.13	0.295
OR, odds ratio.				

## Discussion

Findings show that severe weight loss is associated with functional decline among the oldest old in Brazil, a middle-income country. Previous studies have found similar results in other countries. For example, Strandberg et al. (2013) followed 1,114 men (mean age 47 years at baseline) from the Helsinki Businessmen Study for 26 years and reported that weight loss was associated with disability in late life (4). Murphy et al. (5) had similar results in men (n=931) and women (n=1,044) aged 70 to 79 at baseline in the Health ABC study, in United States, and also showed that, compared to those with stable weight, those who had lost weight had increased mobility disability. Among women, those who experienced weight cycling (gain and loss of weight) also had increased risk of mobility disability.

Using activities of daily living (ADLs) instead of IADL as were used here, Vermeulen et al.(13) conducted a systematic review to examine which physical frailty indicators predicted functional disability in community-dwelling older adults. They reported that four studies (all conducted in USA) found that older adults who experienced (unintentional) weight loss had a significantly higher risk of ADL disability. We also distinguished intentional from unintentional weight loss, but only 27.7% of participants who lost weight reported that it was unintentional, and the results did not change (data not shown). As pointed out by Murphy et al (5), intentionality is difficult to be captured.

In our study, the proportion of older adults who gained weight in the period was very low, and incidence of functional decline was similar among this group and the stable weight group – 37.7% (CI: 27.5-49.1) and

35.7% (CI: 15.0-63.5), respectively (data not shown), and so we combined these groups in the reference category. We also created a sensitivity analysis excluding the weight gain group, but results did not change – moderate weight loss was still not associated with functional decline (OR: 1.94; p=0.131) and those with severe weight loss had twice the rate of functional decline as those with stable weight (OR: 2.66; p=0.040).

Our study advances because most studies use only one category of weight loss. But amongst the oldest old, losing weight may be the most visible consequence of sarcopenia, a process that is particularly common after 80 even in the absence of other disease.(10) This is why Woo et al.'s<sup>11</sup> study of adults aged 70 and older found that three times as many subjects lost 5kg in weight as gained 5kg, and only age could be identified as a contributing factor to weight loss, and also would explain why so few participants in our study gained weight.

Besides, we used changes in body weight rather than body mass index (BMI). BMI is the most frequently used method for assessing nutritional status in literature, but as pointed out by Kuzuya (2020), it is reported that between the ages of 30 and 80, the height of both men and women will be reduced by an average of 5 and 6.2 cm, respectively. So, BMI would naturally increase if there is no change in weight in the oldest old(14).

Interpretation of our results should consider some limitations. Disability was self-reported, but previous studies indicate that self-reported health information offer adequate validity.(15–17) Another limitation was the high proportion of losses throughout the study period. However, this is a common problem in studies with older adults, due to high mortality rates and cognitive impairment. As well, participants of FIBRA Study in Campinas showed low rates of disability at baseline. The eligibility criteria at baseline (no cognitive decline) and the fact that data collection took place at a senior center or church may have caused the selection of a robust group.(18) In addition, body composition data to evaluate the losses in different body compartments was unavailable.

This study has also several strengths. First, longitudinal studies in Latin America are rare, especially with the oldest old, even though the speed of the aging process is faster in LMIC than experienced in high-income countries. Given that changes in dietary consumption and energy expenditure still underway in Brazil, more studies should address the impact of weight change on later life outcomes. Recent studies show that underweight can coexist with overweight in the same household, and this co-occurrence may be more important in LMIC, that are increasing rapidly the prevalence of obesity – the paradox is that, in such places, food insecurity coupled with an energy imbalance, and so policies that focus on reducing the energy density of the diet may also be affect other members of the household (8, 19). Another strength is that the focus on a healthier cohort with low disability and morbidity rates can help explain the disability process in segments of the society in better health, which may indicate the outcomes if better health behaviors are adopted.

## Conclusions

We conclude that severe weight loss was associated to higher risk functional decline in Brazilian oldest old. But given that weight loss is expected for the oldest old, it is important to quantify this loss and measure its severity, and also to identify the magnitude of the loss that is associated with functional decline, and our study advanced in this point. These findings help illuminate the links between nutritional status and disability in older adults in middle-income countries, providing knowledge for preventive strategies on modifiable risk factors directed to persons aged 80 and older, which is the fastest growing segment of older adults.

## List Of Abreviations

ADL: activities of daily living; BMI: Body Mass Index; CI: Confidence Interval; FIBRA: Frailty in Older Brazilians Study (Fragilidade em Idosos Brasileiros); IADL: Instrumental Activities of Daily Living; LMICs: Lower and middle-income countries; OR: odds ratio;

## Declarations

### Ethics approval and consent to participate

The Research Ethics Committee at the University of Campinas approved both waves of the FIBRA Study. Participation was voluntary, and a signed informed consent form was obtained of all participants in each wave.

### Consent for publication

Not applicable.

### Availability of data and materials

The datasets on which the conclusions of this manuscript rely are not available publicly. The datasets used and/or analyzed during the current study are available from ALN (anitalbn@uol.com.br) an MSY (yassuda@usp.br), PIs of FIBRA Study, on reasonable request.

### Competing interests

The authors declare that they have no competing interests.

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### Authors' contributions

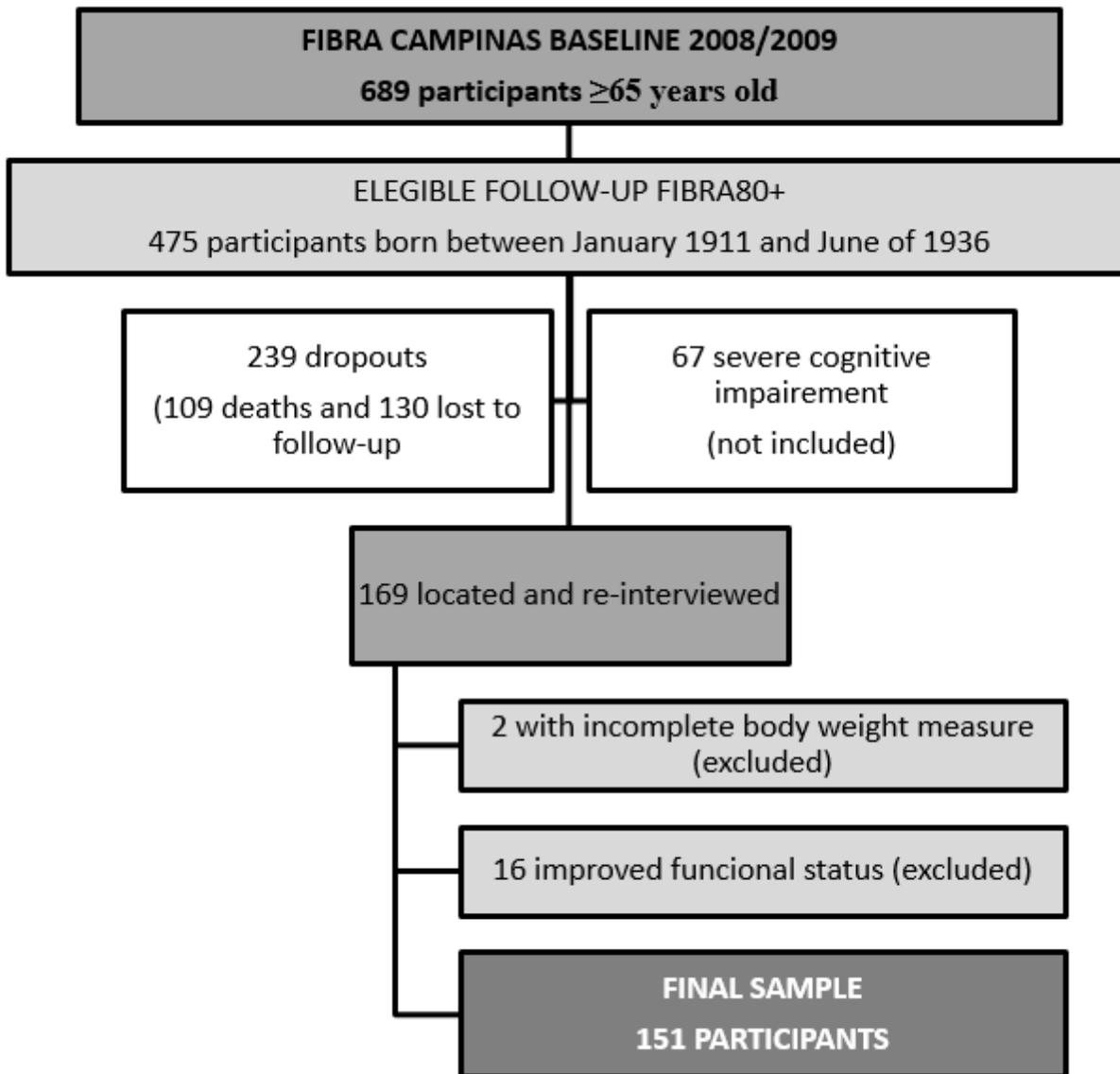
L.P.C and F.C.D.A formulated the research question and performed analysis. F.S.A.B. was responsible for data acquisition and collaborated in analysis. I.A., A.F. and M.C. collaborated in writing and drafting the paper. M.S.Y. and A.L.N. are the principal investigators of study and responsible for data acquisition. All authors participated in the drafting of the manuscript and approved its final version.

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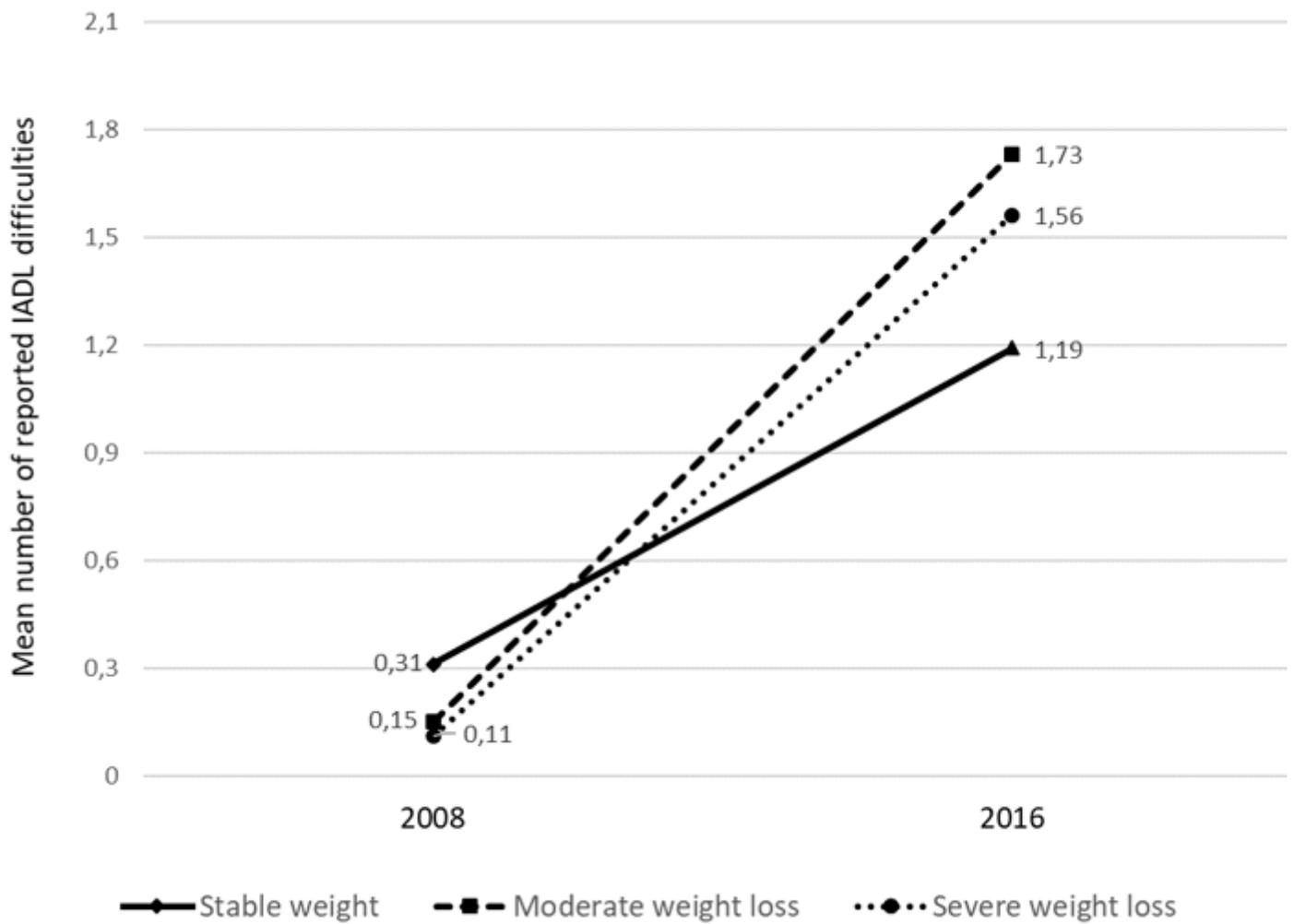
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## Figures



**Figure 1**

Study design and status of the sample, from 2008 baseline to the end of follow-up in 2016 (IADL, instrumental activities of daily living). FIBRA 80+ Study, Campinas, Brazil: 2008-2016.



**Figure 2**

Mean number of reported Instrumental Activities of Daily Living (IADL) difficulties in baseline and follow-up, according to weight change during the period. FIBRA 80+ Study, Campinas, Brazil: 2008-2016.