



# Edentulism and frailty in domiciled older adults: a cross-sectional study

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## Abstract

**Objective:** To investigate the association between frailty and edentulism in community-dwelling older adults and determine the individual, sociodemographic, and clinical factors associated. **Method:** A total of 333 older adults aged 65 years or more participated in this study; they responded to the Edmonton Frail Scale instrument (EFS). Data on socioeconomic factors, oral health, and use of and need for dentures were also collected. Those with cognitive difficulties were excluded. Hierarchical multivariable logistic regression models were performed using the *stepwise* and backward procedure, which tested the relationship of edentulism and covariates with EFS results. Variables with  $p < 0,20$  in the unadjusted analyzes were included in the adjusted logistic regression. **Results:** The prevalence of moderate to severe frailty was 12.3%. Edentulism was related to frailty (OR 3,45; IC 95%: 1,45 – 8,25;  $p=0,01$ ), age (OR 2,19; IC 95%: 1,07 – 4,46;  $p=0,03$ ), female sex (OR 2,75; IC 95%: 1,23 – 6,15;  $p=0,01$ ), the need of lower dental prosthesis (OR 3,19; IC 95%: 1,27 – 8,05;  $p=0,01$ ) and toothache perception (OR 2,74; IC 95%: 1,15 – 6,15;  $p=0,02$ ). **Conclusions:** Frailty was associated with edentulism, age, female sex, the need for lower dental prosthesis and toothache perception. These oral conditions are highly prevalent among older adults and can be prevented by multiprofessional actions supported by public policies. Oral examinations should be considered in pre-frail and frail patients' assessments as oral health indicators were associated of older adults' frailty.

**Keywords:** Frail Elderly. Oral Health. Frailty. Health Of The Elderly.

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Funding: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq). Process number: 478620/2013-6.

The authors declare that there is no conflict in the conception of this work.

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Received: June 28, 2023  
Approved: August 22, 2023

## INTRODUCTION

Frailty is a multifactorial geriatric syndrome, characterized by a multidimensional state of vulnerability resulting from a complex interaction of biological, cognitive, and social factors<sup>1</sup>. Brazil is aging very fast. In 2010, 39 Brazilians were 65 years or older for each 100 young ones, and this proportion of older adults will jump to 153 for the same number of younger ones, in 2040<sup>2</sup>. The prevalence of edentulism over the world from 50 years older adults was near 10% between 1990 and 2015<sup>3</sup> and 54% among Brazilians 64-75 years old persons, in 2010<sup>4</sup>. This is a huge public problem because edentulism affects not only the quality of life<sup>5</sup>, but it has been associated to all cause of mortality among older adults<sup>6</sup>. The number of individuals classified as frail is expected to increase with the aging of the world population; hence, the aging population requires increased attention regarding healthcare, given the high risk of mortality in this group<sup>7</sup>.

The oral health of older adults is influenced by sociodemographic characteristics<sup>5</sup>. Age is the first factor to be considerate because important oral health conditions such as the dental caries and the periodontal diseases tend to be more severe over the years leading to the toothache perception, tooth loss and edentulism, use and need of dental prosthesis. Other important concern regards upon impoverishment of the oral condition perception of the aging older adults which might increase the frailty risk in this group<sup>5</sup>. The adult females are more sensitive over the years to oral conditions tending to be over treated compared to men later in life<sup>5</sup>. Other individual social characteristics, such as the family income and education attainment also influence the oral health. The association of lower family income with in older adults<sup>5</sup>. Despite this group to be less formally educated, the fewer school years frequented is also associated with the fewer natural teeth<sup>8</sup>. These characteristics must be considered in a frailty study regarding oral health status because of its potential to be confounders over the analyses.

Frailty represents a challenge for the oral health demands of older adults, since they postpone appointments due to poor perception of oral health

needs<sup>9</sup>. Compromised oral health status contributes to frailty, owing to difficulties with oral hygiene and chewing problems<sup>5</sup>. Many people still consider the edentulism as a natural condition for older adults and this belief underpins the historical lack of public policies on oral health for the adult population<sup>10</sup>. Nevertheless, tooth loss has been related to frailty as the remaining of natural teeth has been associated to robust older adults<sup>11</sup>. Naturally, if there is tooth loss or even edentulism the use of dental prosthesis is present or in need, but the oral rehabilitation in its several possibilities still lacks evidence regarding the frail syndrome over older adults. The complex relationship between oral health and frailty needs to be better understood.

Considering that poor oral health is a predictor of frailty and that frailty is associated with the quality of life and oral health in older adults<sup>9</sup>, and that both the prevalence of frailty and oral health problems are high in low- and middle-income countries<sup>12</sup>, such as Brazil, the present study aimed to investigate the association between frailty and edentulism in community-dwelling older adults and determine the individual, sociodemographic, and clinical factors associated.

## METHOD

A cross-sectional home-based study was conducted in 2015 in the city of Bauru, State of São Paulo, Brazil, with a total estimated population of 31,376 older adults aged  $\geq 65$  years, according to the Brazilian Institute of Geography and Statistics<sup>13</sup>. The two examiners discussed the dental indexes with pictures first, then they examined five dentate and five edentulous older adults twice times each. The last round was considered approved because Kappa statistics achieved. ( $>0.80$ )<sup>5</sup>. A pilot study was carried out with 35 older adults aged 65 years or more who were living at the Vila Dutra Public Health Clinic area, to evaluate the data collection methods and estimate the sample size. The pilot study was successful, and its data was incorporated to the main research<sup>14</sup> with the Edmonton Frail Scale (EFS)<sup>15</sup> assessment completed twice within a 14-day interval, the frequency of moderate-to-severe frailty was found to be 16.2%. The sample size was

333 older adults, with a confidence interval of 95%, a margin of error of 5%, and design effect of 1.1.

The city was divided for this research in 5 regions (north, east, west, south and central) to participate with 3 Primary Attention Public Clinic. The Family Health Strategy is only used as a model for Primary Health Attention in Bauru at North and West areas. The group started searching for older adults walking from and around the blocks of each Public Clinic as in a spiral until completed the adscripted blocks ended<sup>5</sup>. The dental exams were realized with the older adult seated in a chair at their homes in a place with natural light sheltered by sun. Before the exams started the examiner kindly asked to remove dental prosthesis, and then the questionnaires were completed by interview. All the older adults were invited to participate in and the ones without minimal understanding of the research parameters, questions and nature of the oral exams were excluded for cognitive reasons.

The EFS validated for the Brazilian population was used to assess the frailty of the participants<sup>16</sup>. This instrument consists of 11 items grouped into the following nine domains: a) Cognition – placing the numbers in the correct position in a pre-drawn circle to represent a clock, and then placing the hands to indicate the time “ten and eleven” (0 = no errors, 1 = small spacing errors, 2 = other errors); b) general health status, number of hospitalizations in the last year (0, 1–2 and  $\geq 2$ ), and self-rated general health (0 = excellent/very good/good, 1 = fair, 2 = poor); c) functional independence – number of daily activities the respondent needs assistance with, including meal preparation, shopping, transportation, telephone, cleaning, laundry, money management, and medication use (0 = 0–1, 1 = 2–4, 2 = 5–8); d) social support – person they can count on when they need help to meet their needs (0 = always, 1 = sometimes, 2 = never); e) use of medication – five or more different prescriptions on a regular basis (0 = no, 1 = yes) and forgetting to use medication (0 = no, 1 = yes); f) nutrition – weight loss that caused the clothing to become loose (0 = no, 1 = yes); g) mood – often feeling sad or depressed (0=no, 1=yes); h) continence – loss of urine control (0 = no, 1 = yes); i) functional performance – time taken to sit on a chair (knee joint angle usually  $> 90^\circ$  of flexion) with back

and arms at rest, stand, walking about 3 m, return to chair, and sit (0 = 0–10 s, 1 = 11–20 s, 2 =  $>20$  s). Two categories were used in this study: “0” - no frailty/apparently vulnerable/mild (0–8 points) and “1” - moderate to severe frailty ( $\geq 9$ ).

The following sociodemographic characteristics were included as covariates: age (0 = 65 to 74 years old, 1 = 75 years old and over), sex (0 = male, 1 = female), monthly family income (0 =  $\leq 2$  minimum wages [MW], 1 =  $> 2$  MW; MW in Brazil in 2015 was R\$ 788.00 [US\$ 203.61]), and educational level (0 = up to 3 years of schooling, 1 = 4 or more years of schooling). To assess the oral condition, the Caries Assessment Spectrum and Treatment (CAST) instrument was used<sup>17</sup> the use of and need for dentures was assessed<sup>18</sup>. Edentulism was recorded using the CAST instrument; code 8, referring to edentulism, was used to categorize the sample into the group with total loss of teeth, i.e., edentulous, and presence of natural teeth, i.e., non-edentulous. Self-perceived pain was categorized as follows: 0 = absent and 1 = present.

The clinical status of the oral condition was assessed according to the use of and need for upper and lower dentures<sup>18</sup>. The types of dentures used were coded as follows: 0 = no denture, 1 = bridge, 2 = more than one bridge, 3 = partial denture, 4 = both bridges and partial dentures, and 5 = full removable denture. Use of dentures was categorized as follows: 0 = does not use dentures and 1 = uses one or more dentures. The need for a dental prosthesis was coded as follows: 0 = no need for a dental prosthesis, 1 = needs a single dental prosthesis (replacement of one tooth), 2 = needs a multi-unit dental prosthesis (more than one tooth replacement), 3 = needs a combination of single and/or multi-unit dentures, and 4 = needs complete denture (replacement of all teeth). The need for a dental prosthesis was categorized as follows: 0 = no need for a dental prosthesis and 1 = needs one or more dental prostheses.

Those who could not understand the questions in the questionnaires owing to cognitive difficulties were excluded. Data were collected at the participants' homes through individual interviews and oral examinations, performed by trained researchers. The frequencies of edentulism, sociodemographic

characteristics, dental/clinical measures, and self-perceived dental pain were presented in absolute and relative frequencies. The data of edentulism, covariates, and EFS results were subjected to crude logistic regression. Hierarchical multivariable logistic regression models with stepwise backward elimination were used to test the relationship of edentulism with the covariates and EFS results. The variables with a  $p$ -value  $<0.20$  in the unadjusted analyzes were included in the adjusted logistic regression.

Cronbach's alpha coefficient was calculated to determine the internal consistency of the EFS questionnaire<sup>9</sup>. The quality of the logistic regression models was evaluated by testing the multicollinearity of the independent variables according to the variance inflation factor (VIF) using the linear regression procedure and by the Hosmer and Lemeshow test concomitantly with the logistic regression to evaluate the observed and predicted frequencies ( $p>0.05$ ).

This study was approved by the Research Ethics Committee of the Faculty of Dentistry of Bauru, University of São Paulo (CAAE 37043414.2.0000.5417; Approved Report 1.604.600) and complied with the principles and guidelines indicated in Resolution No. 466 of 2012 of the National Health Council and with the Declaration of Helsinki of 1975.

## RESULTS

Initially, 335 community-dwelling older adults agreed to participate; the sample represented the

following areas: central (69, 20.60%), south (41, 12.24%), west (105, 31.34%), east (18, 5.37%), and north (102, 30.45%). The interviews of two participants were excluded due to incomplete information; hence, the final sample consisted of 333 older adults. Among them, 58.6% were 65–74 years old and 41.4% were 75 years or above. Women represented 56.5% (188) of the sample, and most participants (54.05%) had up to 3 years of educational attainment. Most participants needed lower dentures (64.9%). The characterization of the sample according to sociodemographic variables is presented in Table 1.

The prevalence of moderate-to-severe frailty was 12.3%. Participants with moderate-to-severe frailty were mostly adults aged 75 years or older (58.5%), women (78.0%), and from low-income families (95.1%). The prevalence rates of the need for upper and lower dentures among those with moderate-to-severe frailty were 75.6% and 85.4%, respectively. Of the participants with moderate-to-severe frailty, 80.5% were edentulous and 26.8% reported the presence of dental pain.

Table 2 presents the unadjusted bivariate analysis of the relationship between frailty, edentulism, age, sex, family income, need for upper and lower dentures, and self-perceived toothache, noting that moderate-to-severe frailty was statistically and significantly associated with all studied variables. Nevertheless, the adjusted logistic regression remained without the need for upper denture variable only, as all the others were still in the final model (Table 3).

**Table 1.** Sample characterization according to clinical and sociodemographic variables (N=292). Bauru, SP, 2015.

	EFS	
	0 (%)	1 (%)
<b>Edentulism</b>		
Not edentulous n (%)	135 (94.41)	8 (5.59)
Edentulous n (%)	157 (82.63)	33 (17.37)
<b>Age</b>		
65-74 n (%)	178 (91.28)	17 (8.72)
75 or older n (%)	114 (82.61)	24 (17.39)
<b>Sex</b>		
Male n (%)	136 (93.79)	9 (6.21)
Female n (%)	156 (82.98)	32 (17.02)
<b>Family income (MW)</b>		
≤ 2 n (%)	239 (85.97)	39 (14.03)
> 2 n (%)	53 (96.36)	2 (3.64)
<b>Education attainment (in years)</b>		
≤ 3 n (%)	151 (83.89)	29 (16.11)
> 3 n (%)	141 (92.21)	12 (7.79)
<b>Upper denture use</b>		
No n (%)	104 (88.03)	14 (11.97)
Yes n (%)	188 (87.38)	27 (12.62)
<b>Lower denture use</b>		
No n (%)	196 (87.84)	27 (12.16)
Yes n (%)	96 (87.16)	14 (12.84)
<b>Need for upper denture</b>		
No n (%)	131 (92.91)	10 (7.09)
Yes n (%)	161 (83.85)	31 (16.15)
<b>Need for lower denture</b>		
No n (%)	111 (94.87)	6 (5.13)
Yes n (%)	181 (83.8)	35 (16.2)
<b>Toothache</b>		
No n (%)	246 (89.13)	30 (10.87)
Yes n (%)	46 (80.70)	11 (19.30)

“0” - no frailty/apparently vulnerable/mild (0-8 scores) and “1” - moderate to severe frailty (≥ 9).

**Table 2.** Crude logistic regression analysis between frailty and clinical and sociodemographic variables (N=292). Bauru, SP, 2015.

	Moderate/severe frailty OR (95% CI; p)
Edentulism	
Not edentulous	-
Edentulous	3.54 (1.58; 7.94; 0.01)
Age	
65-74	-
75 or older	2.20 (1.13; 4.28; 0.02)
Sex	
Male	-
Female	3.10 (1.43; 6.72; 0.01)
Family income (MW)	
≤ 2	-
> 2	0.23 (0.05; 0.99; 0.04)
Education attainment (in years)	
≤ 3	-
> 3	0.23 (0.05; 0.99; 0.04)
Upper denture use	
No	-
Yes	1.06 (0.53; 2.11; 0.86)
Lower denture use	
No	-
Yes	1.06 (0.53; 2.12; 0.86)
Need for upper denture	
No	-
Yes	2.52 (1.19; 5.34; 0.02)
Need for lower denture	
No	-
Yes	3.58 (1.46; 8.78; 0.01)
Toothache	
No	-
Yes	1.96 (0.92; 4.19; 0.08)

**Table 3.** Logistic regression adjusted analysis between frailty and clinical and sociodemographic variables (N=292). Bauru, SP, 2015.

	Moderate/severe frailty OR adjusted (95% CI; p)
Edentulism	
Not edentulous	
Edentulous	3.45 (1.45: 8.25; 0.01)
Age	
65-74	
75 or older	2.19 (1.07: 4.46; 0.03)
Sex	
Male	
Female	2.75 (1.23: 6.15; 0.01)
Need for lower denture	
No	
Yes	3.19 (1.27: 8.05; 0.01)
Toothache	
No	
Yes	2.73 (1.15: 6.51; 0.02)
Constant	0.01 (-: -; 0.01)

No differences were observed between the observed and predicted frequencies by the Hosmer–Lemeshow test in the adjusted logistic regressions ( $p > 0.05$ ). Furthermore, VIF values lower than 10 suggested the absence of multicollinearity.

## DISCUSSION

The association between edentulism and moderate to severe frailty was confirmed for older adults in our study. The demographic characteristics was also associated corroborating previous studies which associated frailty with aging and females<sup>19</sup>. The need for lower dentures was already observed<sup>19</sup>, nevertheless the reason for this association regarding frail older adults is still not plainly discussed, and the toothache associated to frail older adults highlight the need for a special primary health attention for older adults and the frail ones.

The prevalence of moderate-to-severe frailty in our study was 12.3%, among participants aged  $\geq 75$  years and women, in line with the results of previous studies<sup>19</sup>. A systematic review showed that

the prevalence of frailty ranged from 4.0% to 59.1% in older adults, and the overall weighted prevalence was 10.7%. The severity of frailty increased with age<sup>20</sup> and was more common in females<sup>21</sup>. Despite frailty might be observed in younger older adults ages, its prevalence is often observed in the aging older adults<sup>20,21</sup>. Statistically significant associations were observed between women and frailty. Women tend to have a greater level of exposure to health treatments over the course of their lives, furthermore, women are more affected by chronic diseases that can impact quality of life<sup>22</sup>. The connections between these associations can be attributed to the natural decline in muscle mass that occurs with aging and the increased susceptibility of women to sarcopenia, which is an inherent risk factor for developing frailty<sup>23</sup>.

Most of the older adults with moderate-to-severe frailty were completely edentulous, however, in a previous study it was found that the loss of masticatory function in edentulous older adults without masticatory difficulties did not pose a high risk of frailty<sup>24</sup>. The tooth loss *per se* might not be the reason for an increase of frailty risk in older adults, especially if the rehabilitation is rapidly present,

but the continuous loss of teeth might lead to bad changes in diet, such as the reduction of fiber and protein consumption in favor of soft foods with fat and carbohydrates more easily swallowed, especially in edentulous older adults without oral rehabilitation.

The need for lower dentures was significantly associated with moderate-to-severe frailty. This may be attributed to factors such as the physical effort and coordination required for denture wearing, as well as complaints related to masticatory capacity, retention, and comfort<sup>24</sup>. Dissatisfaction with these factors is a primary reason why individuals do not use their lower dentures, which can lead to malnutrition, weight loss, and other complications that contribute to frailty in the elderly<sup>25</sup>. The anatomy of superior maxilla remains retentive even after the alveolar bone loss in several cases favoring the superior denture retention. Nonetheless, the use of lower denture is harder because of the stability difficulties regarding the natural alveolar bone loss after many years of extracted inferior teeth. Plus, the inferior denture is not as aesthetic as the superior one. Aging older adults and the frail ones are less worried to aesthetics, their focus regards the maintenance of function without any pain, thus the common effort to use the lower denture with any difficulty is not the priority of a frail older adult. In any case regardless of the number of the remaining teeth, the use of functional dentures poses a low risk of frailty<sup>24</sup>.

The toothache was associated with moderate to severe frailty in older adults. Pain impacts the quality of life in physical and emotional dimensions<sup>26</sup>. Toothache interferes in several daily activities<sup>27</sup>, sleeping<sup>28</sup>, socialization<sup>29</sup>, and the work productivity diminishes<sup>28</sup>, plus this is the reason number one for dental appointments<sup>30</sup>. Older adults are severely impacted by tooth loss and the remaining teeth are commonly found with clinical needs which causes pain and discomfort<sup>5</sup>, and despite the general quality of life perception perishes with aging<sup>5</sup> the toothache still maintain impact which contributes to the extraction of the remaining teeth, due to the fast solution of the pain reinforcing the oral rehabilitation needs. This logic applies for the frail older adults with one aspect to be highlighted, this behavior happens earlier in life when a person starts to show the first signs of frailty.

Frailty must be faced as an important dental public health problem. The demographic parameters are changing very fast in Brazil and worldwide towards the grow of the aged group<sup>31</sup>, but the public policies are not answering for this call in the same intensity. Three main aspects must be the focus of policymakers: the first one regards on the adult population which is not reaching the primary health attention as other age groups, mainly because of the labor ours conflicting with the open ours of public clinics, but also because of the necessary oral health education perhaps not attained earlier in life<sup>32</sup>; secondly, because there is a huge need for secondary oral health attention in Brazil. The Brazilian Unified Health System (SUS) is truly under construction permanently and the primary oral health attention is spread over the municipalities, nevertheless the secondary oral health attention has not reached the similar population covered as in the primary health attention causing important wait lines for dental treatment<sup>33</sup>. Recently, a new dental public policy<sup>34</sup> was introduced to enlarge the access for the 3770 Brazilian municipalities until 20,000 inhabitants (68%), an important step towards universality due to the federal financing support for the oral health specialties attendance towards the integrality of SUS. Third, there is a loss of interest in the dental selfcare and its treatments by frail older adults<sup>9</sup>, therefore the geriatric theme must be included in the university curriculum with frailty included, also there is a lack of public health services toward the frail older adult because the current laws regarding the aged population rights<sup>35</sup> in Brazil does not reach entirely the frail ones which could be equally included in the rights of the 80 years or more persons, per example. Frailty syndrome must be known of every health professional in public and private sectors, in Dentistry and over the other professions, in Brazil and abroad, because this is a vulnerable condition reaching silently an important part of the aging population.

As a cross-sectional study, we were not able to establish the causality between exposure and outcome, and the findings might be extrapolated cautiously to institutionalized older adults. Plus, time might be considered a limitation since the survey occurred in 2015. However, this study has some strengths, namely the use of probabilistic sampling and validated questionnaires to assess frailty. Promotion of oral health and preventive dental care

through primary healthcare services can prevent oral diseases throughout life and improve the oral health of older adults, especially among those who are frail. It is necessary to develop longitudinal studies that can determine the factors associated with frailty in older adults.

## CONCLUSION

This study is relevant because edentulism, the need for dental prostheses, and self-perceived toothache was associated with moderate-to-severe frailty in community-dwelling older adults. Although these characteristics are highly prevalent among the elderly population, they can be preventable through multiprofessional actions at various levels of healthcare attention targeting adults and older adults, therefore these measures must be included in the public health policies locally and abroad. Furthermore, frailty assessments should include oral examinations as edentulism are associated to frailty.

## AUTHORSHIP

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responsible for all aspects of the work, ensuring that issues related to the accuracy or integrity of any part of the work are resolved.

- Liliane Cristina Barbosa - writing the article; approval of the version to be published, and responsible for all aspects of the work, ensuring that questions relating to the accuracy or integrity of any part of the work are addressed.
- Thais de Moraes Souza - writing the article; approval of the version to be published, and responsible for all aspects of the work, ensuring that questions relating to the accuracy or integrity of any part of the work are addressed.
- Roosevelt Silva Bastos - conception and design, critical review, approval of the version to be published, responsible for all aspects of the work, ensuring that issues related to the accuracy or integrity of any part of the work are resolved.

## ACKNOWLEDGMENT

Publication supported by the Coordination for the Improvement of Higher Education Personnel (CAPES), for which the authors are grateful.

Edited by: Yan Nogueira Leite de Freitas

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