

## Association between socioeconomic factors, behavioral, general health and oral mucosa status in elderly

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**Abstract** *This study aimed to investigate the association between socioeconomic and behavioral factors, general health, oral health, and plaque accumulation and oral mucosa condition outcomes in the elderly. This is a cross-sectional study conducted from 2004 to 2005 with 785 elderly dwellers of the city of Carlos Barbosa (RS), Brazil. We used questionnaires to collect socioeconomic, behavior and health status data. The physical examination of the oral structures comprised the Mucosal-Plaque Index proposed by Henriksen (MPS). A higher prevalence of moderate/severe plaque accumulation was observed in the elderly group, in less educated male elderly. The use of full upper dentures and income under one minimum wage were protective factors for moderate/severe plaque accumulation. Only the variables of the first block of the conceptual structure, male gender (OR = 2.13; 95% CI 1.26-3.61) and lower education (OR = 1.37; 95% CI 1.06-1.78) remained associated with an unacceptable MPS score. The findings suggest that, as per MPS, less educated male elderly are more likely to have poor oral health.*

**Key words** *Aging, Oral health, Oral mucosa, Socioeconomic factors*

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## Introduction

Aging is a physiological and heterogeneous process that can predispose individuals to pathologies such as oral lesions and infections, which often result from the interaction of several factors such as the use of dentures, microorganisms, nutrition, hormonal changes and reduced salivary flow<sup>1-3</sup>. Socioeconomic variables such as education, income, gender<sup>4</sup>, the social support network and depression<sup>5-7</sup> also appear to be associated with the oral health status of the elderly. Also, some chronic and neurodegenerative diseases may compromise oral hygiene practices and hinder access to dental services, increasing the impact on oral health problems<sup>8-11</sup>.

The most frequent oral problems in the elderly are dental caries, periodontal disease, tooth loss and edentulism, associated with systemic diseases, medications and the use of dentures<sup>12,13</sup>. The oral health survey conducted in Brazil in 2010 revealed that the elderly population had the worst oral health indicators, with a high prevalence of edentulism, when compared to the other age groups evaluated<sup>14</sup>. Studies in different countries also suggest that oral mucosa lesions are common in the elderly and are associated with behavioral factors and the use of medicines<sup>15-18</sup>.

The Social Determinants of Health (SDH) express the relationship between living conditions, work, social, economic, cultural, ethnic, psychological and behavioral factors of people or groups of the population and their health status<sup>19</sup>. This fact underscores the importance of studying these factors and their potential influence on the quality of life of people. However, in Brazil, studies investigating the association between SDHs and oral mucosal changes in the elderly are still scarce.

Based on the foregoing, a greater understanding of the influence of social determinants on the oral health conditions of the elderly population is required to identify associated factors and a more contextualized and resolute planning of oral health actions for this group, aiming at improving their quality of life. We suppose that the worst oral health condition in the elderly is related to worse socioeconomic, behavioral, general health and psychological factors. Thus, this study aimed to investigate the association between these factors and the presence of mucosal changes and bacterial plaque accumulation in the oral cavity of community-dwelling elderly.

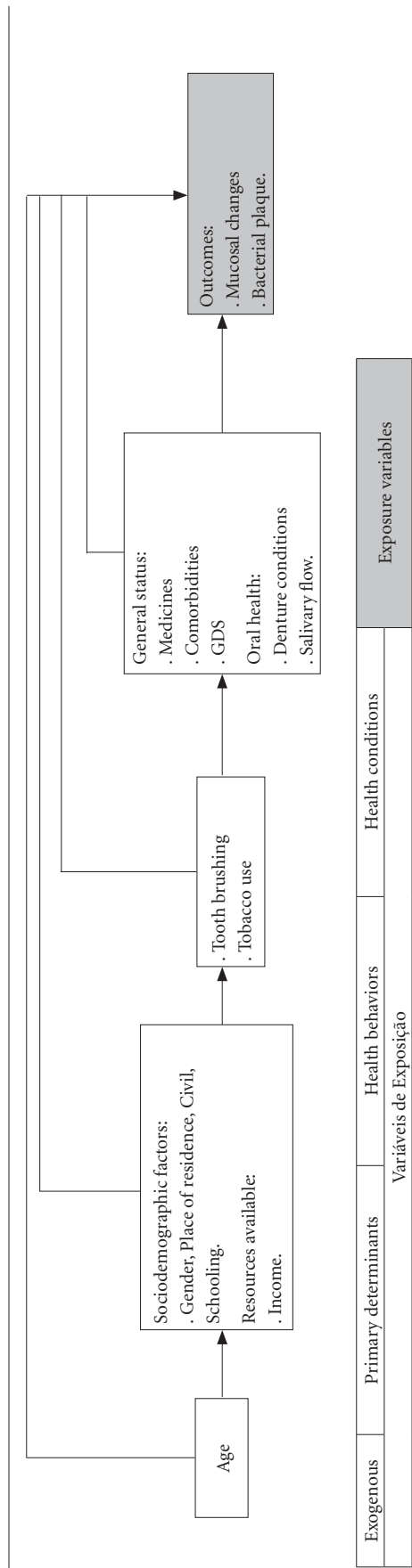
## Methods

This cross-sectional analytical study was carried out with a sample of independent elderly individuals aged 60 years and older from 2004 to 2005, in the city of Carlos Barbosa, Rio Grande do Sul, Brazil. Of the municipal registry of 2,167 elderly, 22 were deemed ineligible since they resided in a nursing home. The simple random sampling calculation was performed considering the percentage of the variable of interest of 50%, sampling error of 3% and confidence level of 99% and a loss rate of 11.5%, resulting in a sample of 1,106 individuals. The initial screening showed that nine older adults had died, one had moved to another city, and 113 were not found. Of the 983 contacted, 13 were bedridden, one person was hospitalized and 97 refused to participate in the study. Thus, 872 people participated in the initial study, and 785 completed the protocol analyzed in this research (Figure 1).

The interviews of the participants occurred before the oral examinations performed in dental offices of the Municipal Primary Healthcare Facilities. This study was only started with the approval of the Research Ethics Committee of the Federal University of Rio Grande do Sul. All participants were informed about the objectives and procedures of the study and signed the informed consent form.

Socioeconomic and demographic variables were: age (in years, for analysis purposes categorized in quartiles), gender, place of residence (urban or rural area), marital status (married, widowed, others), monthly individual income (in minimum wages, categorized as  $\leq 1$  minimum wage or  $> 1$  minimum wage), schooling (categorized as  $< 4$  years, 4 years or  $> 4$  years of formal education completed). Information on health conditions and health behavior included the amount of prescribed medications used (not used, used only 1, used 2 or more), comorbidities (had up to 1 disease or  $\geq 2$  diseases, according to medical diagnosis report), tobacco use at the time of data collection (yes or no), depressive symptoms according to the Geriatric Depression Scale (no symptoms or with depressive symptoms), information on upper and lower denture condition (without denture, removable partial denture, fixed denture, fixed and removable partial denture or full denture), salivary flow at rest (in ml/min), daily tooth brushing (more than twice, twice, less than twice).

Two experienced and previously trained examiners performed the clinical exams. The intra-



**Figure 1.** Theoretical conceptual model used in the study.

and interexaminer Kappa coefficients of 0.98 and 0.97, respectively, were found for the MPS Index before the study, indicating optimal concordance and reproducibility. Clinical examinations were performed with individuals sitting in a dental chair using artificial light. The intraoral inspection was performed with a buccal mirror. Dentures were removed from the mouth, to facilitate the inspection of every oral cavity.

The presence and type of denture were registered for maxilla and mandible. Henriksen's Mucosal-Plaque Score Index (MPS) was used, which provides a quick general assessment of the individual's oral health, noting the level of inflammation of the mucosa and the amount of bacterial plaque around the teeth and dentures<sup>20</sup>. The mucosa was rated according to the clinical aspect using the following numbering: 1- Normal appearance of the mucosa of the gingiva and palate; 2- Mild inflammation, with slightly red areas or hypertrophy/hyperplasia of the gingiva or slightly red areas on the mucosa of the palate; 3- Moderate inflammation with markedly red areas and gingival hypertrophy/hyperplasia, bleeding easily when pressure is applied, or markedly red areas of the palate (1/3 or more), markedly red and inflamed areas of the oral mucosa and other areas regions outside the palate, ulceration caused by the denture, red and inflamed fibrous hyperplasia caused by denture; 4- Severe inflammation, with severe redness and hypertrophy/hyperplasia of the gingiva, spontaneous gingival bleeding, marked granulations on the palate, areas that are easily ruptured, inflamed and bleed under pressure of denture when inserted into the oral cavity. The plaque index was based on clinical aspects of biofilm accumulation in the oral cavity (on dentures and teeth) using the following criteria: 1- No visible plaque; 2- Small amounts of visible plaque; 3- Moderate amounts of visible plaque; 4- Abundant amounts of confluent plaque. The MPS score is the sum of the score of the mucosal and plaque scores, ranging from 2 to 8. MPS is classified as good or acceptable when scoring between 2 and 4, as unacceptable when between 5 and 6, and as very poor when between 7 and 8. In this study, a score of 5 or higher was used to define unacceptable/poor condition. An illustrated manual containing 25 color photographs produced at the Gerontology Sector of the Faculty of Dentistry of the University of Oslo, Norway was used<sup>20</sup> for the calibration of this study.

The collection of unstimulated saliva followed the criteria proposed by Navazesh<sup>21</sup>, which was started by instructing the participant to swallow

the saliva, and then, requesting the participant to let the volume of saliva accumulate in the mouth without stimulation by orofacial movements. After 5 minutes, participants would cough up into a graduated collection tube. The resting salivary flow was expressed in ml/min and values < 0.1 ml/min were considered hyposalivation<sup>22</sup>.

A theoretical model was elaborated from the conceptual framework proposed by Andersen and Davidson<sup>23</sup> to analyze data. The model used in this study consisted of four blocks. The first block is more distal vis-à-vis the outcome and consists of the exogenous age variable ( $\geq 60$  years). The second block concerns the primary determinants, containing the variables of predisposing personal characteristics (gender, place of residence, marital status, schooling) and available resources (income). The third block, which is intermediate vis-à-vis the outcome, concerns oral health behavior, with the following variables: tooth brushing and smoking. The fourth block is the most proximal to the outcome and concerns oral health conditions, represented by variables: general health status (number of medications, comorbidities, GDS), and oral health (denture conditions, salivary flow). The evaluated outcomes were characterized by the presence of mucosal and bacterial plaque changes in the oral cavity, through the MPS index.

The MS, PS, and MPS outcomes were analyzed separately, and MS and PS were categorized as absent or mild (scores 1 and 2) and moderate or severe (scores 3 and 4), and the MPS score was categorized as MPS 1-4 (acceptable) or MPS 5-8 (unacceptable/poor). Concerning bivariate analysis, the Chi-square test and Odds Ratio (OR) with 95% confidence interval (95% CI) were used to verify the association between the exposure variables, which were classified into three main groups (socioeconomic, health behavior and oral health), and outcomes (MS, PS, MPS). The multivariate hierarchical logistic regression analysis procedure was performed to reduce confounding bias, in which variables with a  $p < 0.10$  in the bivariate analysis were included in the model, obtaining the adjusted OR. The tests were performed using SPSS Software (version 18.0). The level of significance was set at 5% ( $p < 0.05$ ).

## Results

The mean age of the elderly was  $68.3 \pm 6.6$  years; most were female (62.5%), married (71.3%), non-smokers (74.1%), resided in the rural area

(52.0%), completed four years of study (40.4%) and had income  $\leq$  one minimum wage (61.9%).

Table 1 expresses the percentage distribution of the variables referring to the primary determinants among the categories of the MS, PS or MPS indices. We found that the age groups evaluated had statistically significant differences only for the PS index ( $p = 0.01$ ), and most of the elderly with no PS or mild PS score had an age  $\leq 67$  years, while 54.6% of the elderly classified as moderate or severe had an age  $\geq 68$  years. Statistically significant differences were found in the distribution of the gender variable for the PS index ( $p = 0.001$ ), men accounted for 48.3% of the moderate or severe PS score, and only 25.6% of the no score or mild score. Income  $\leq$  one minimum wage showed a statistically higher frequency in the moderate or severe score ( $p = 0.01$ ). There was also a higher percentage of elderly with schooling lower than the 4<sup>th</sup> grade in the moderate or severe PS group (47.8%;  $p = 0.002$ ). For the MPS index, we found a statistically higher percentage ( $p < 0.05$ ) of men (44.5%) and of elderly with less than 4<sup>th</sup>-grade schooling (47.6%) in the group classified as unacceptable. There were no statistically significant differences in the distribution of the primary determinants for the MS score groups.

The analysis of the frequency of variables related to general and oral health among the categories of MS, PS or MPS scores is summarized in Table 2. There were no statistically significant differences between the health conditions evaluated and the MS index. However, there were differences in the PS score categories and the variables tooth brushing ( $p = 0.01$ ), tobacco use ( $p = 0.01$ ), and upper ( $p = 0.03$ ) and lower ( $p = 0.001$ ) dentures. The moderate or severe PS group had a higher percentage of elderly who reported that they were performing daily tooth brushing (33.2%), were current smokers (33.3%), were not using an upper denture (10.4%) and did not use a lower denture (41.8%), compared to the absent or mild PS group. The MPS index had statistically significant differences in the distribution of the daily tooth brushing ( $p = 0.03$ ) and lower denture ( $p =$  lower), as a higher percentage of elderly who reported daily tooth brushing (33.1%) and absence of lower denture (39.6%) in the unacceptable MPS group. The variables salivary flow, medications, comorbidities and geriatric depression scale did not show statistically significant differences between MS, PS and MPS scores.

The crude and adjusted association between the primary determinants and the outcomes are

Table 1. Distribution of variables related to age and primary determinants among the categories of MS, PS or MPS scores.

Variables	n <sup>1</sup>	MS Score			PS Score			MPS Score			p <sup>2</sup>
		Absence or mild		Moderate or severe	Absence or mild		Moderate or severe	Acceptable		Unacceptable	
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)		
Age (years)	779										0.38
60-62		138 (24.6%)	54 (24.9%)	129 (27.9%)	62 (19.7%)	122 (26.5%)	69 (21.7%)				
63-67		158 (28.0%)	51 (23.5%)	128 (27.6%)	81 (25.7%)	125 (27.2%)	84 (26.4%)				
68-72		129 (23.0%)	61 (28.1%)	108 (23.3%)	82 (26.0%)	107 (23.3%)	83 (26.1%)				
> 73		137 (24.4%)	51 (23.5%)	98 (21.2%)	98 (28.6%)	106 (23.0%)	82 (25.8%)				
Gender	783										0.001*
Female		378 (66.9%)	133 (61.0%)	346 (74.4%)	164 (51.7%)	333 (71.9%)	177 (55.5%)				
Male		187 (33.1%)	85 (39.0%)	119 (25.6%)	153 (48.3%)	130 (28.1%)	142 (44.5%)				
Place of residence	783										0.81
Urban		279 (44.4%)	97 (44.5%)	221 (47.5%)	155 (48.9%)	221 (47.7%)	155 (48.6%)				
Rural		286 (50.6%)	121 (55.5%)	224 (52.5%)	162 (51.1%)	242 (52.3%)	164 (51.4%)				
Marital status	783										0.48
Married		399 (70.6%)	159 (72.9%)	325 (69.9%)	232 (73.2%)	325 (70.2%)	232 (72.7%)				
Widowed		140 (24.8%)	53 (24.3%)	119 (25.6%)	74 (23.3%)	116 (25.1%)	77 (24.1%)				
Other		26 (4.6%)	6 (2.8%)	21 (4.5%)	11 (3.5%)	22 (4.8%)	10 (3.1%)				
Income	782										0.10
≤ Minimum wage		317 (56.2%)	135 (61.9%)	249 (53.5%)	203 (64.2%)	257 (55.5%)	195 (61.3%)				
> Minimum wage		247 (43.8%)	83 (38.1%)	216 (46.5%)	113 (35.8%)	206 (44.5%)	123 (38.7%)				
Schooling	780										0.002*
> 4 <sup>th</sup> grade		158 (28.1%)	50 (23.0%)	139 (30.0%)	69 (21.8%)	140 (30.3%)	68 (21.5%)				
4 <sup>th</sup> grade		182 (32.3%)	75 (34.6%)	160 (34.6%)	96 (30.4%)	158 (34.2%)	98 (30.9%)				
< 4 <sup>th</sup> grade		223 (39.6%)	92 (42.4%)	164 (35.4%)	151 (47.8%)	164 (35.5%)	151 (47.6%)				

<sup>1</sup>Number of individuals who answered. <sup>2</sup> Chi-square test. \*Statistically significant difference.

Table 2. Distribution of variables related to general and oral health among MS, PS or MPS score categories.

Variables	n <sup>1</sup>	MS Score			PS Score			MPS Score			p <sup>2</sup>
		Absence or mild		Moderate or severe	Absence or mild		Moderate or severe	Acceptable		Unacceptable	
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)		
Daily tooth brushing	780										
3 times or more		211 (37.5%)	81 (37.3%)	189 (40.8%)	102 (32.3%)	184 (39.8%)	107 (33.8%)			0.01*	0.03*
twice		205 (36.4%)	64 (29.5%)	160 (34.6%)	109 (34.5%)	164 (35.5%)	105 (33.1%)				
None or once		147 (26.1%)	72 (33.2%)	114 (24.6%)	105 (33.2%)	114 (24.7%)	105 (33.1%)				
Smoker	176										
Yes		27 (22.9%)	19 (32.8)	10 (14.7%)	36 (33.3%)	17 (21.8%)	29 (29.6%)			0.01*	0.24
No		91 (77.1%)	39 (67.2%)	58 (85.3%)	72 (66.7%)	61 (78.2%)	69 (70.4%)				
Upper denture	783										
No denture		45 (8.0%)	13 (6.0%)	25 (5.4%)	33 (10.4%)	30 (6.5%)	28 (8.8%)			0.03*	0.46
RPD, FD, FD and RPD, FuD on implant		70 (12.4%)	25 (11.5%)	59 (12.7%)	36 (11.4%)	58 (12.5%)	37 (11.6%)				
Full denture		450 (79.6%)	180 (82.6%)	381 (81.9%)	248 (78.2%)	375 (81.0%)	254 (79.6%)				
Lower denture	782										
No denture		194 (34.4%)	73 (33.5%)	135 (29.0%)	132 (41.8%)	141 (30.5%)	126 (39.6%)			0.001*	0.001*
RPD, FD, FD and RPD, FuD on implant		117 (20.7%)	57 (26.1%)	94 (20.2%)	79 (25.0%)	89 (19.2%)	84 (26.4%)				
Full denture		253 (44.9%)	88 (40.4%)	236 (50.8%)	105 (33.2%)	233 (50.3%)	108 (34.0%)				
Salivary flow	587										
Up to 0.7 mL/min		357 (84.8%)	147 (88.6%)	313 (87.7%)	190 (83.0%)	303 (86.6%)	200 (84.7%)			0.11	0.53
From 0.8 to 1.0 mL/min		64 (15.2%)	19 (11.4%)	44 (12.3%)	39 (17.0%)	47 (13.4%)	36 (15.3%)				
Medicines	736										
Does not use		148 (28.0%)	53 (25.6%)	109 (24.5%)	92 (31.6%)	118 (26.8%)	83 (28.1%)			0.10	0.92
Uses only 1		112 (21.2%)	45 (21.7%)	97 (21.8%)	60 (20.6%)	95 (21.6%)	62 (21.0%)				
Uses 2 or more		269 (50.9%)	109 (52.7%)	238 (56.6%)	139 (47.8%)	227 (51.6%)	150 (50.8%)				
Comorbidities	782										
Up to 1 disease		259 (45.9%)	102 (46.8%)	202 (43.4%)	159 (50.3%)	208 (44.9%)	153 (48.1%)			0.05	0.38
2 or more diseases		305 (54.1%)	116 (53.2%)	263 (56.6%)	157 (49.7%)	255 (55.1%)	165 (51.9%)				
GDS	762										
No symptoms		473 (86.5%)	190 (88.4%)	389 (83.3%)	274 (88.4%)	388 (86.4%)	275 (88.1%)			0.38	0.48
With symptoms		74 (13.5%)	25 (11.6%)	62 (13.7%)	36 (11.6%)	61 (13.6%)	37 (11.9%)				

<sup>1</sup>Number of individuals who answered. <sup>2</sup> Chi-square test. \* (p < 0.05). RPD = removable partial denture. FD = fixed denture. FuD = full denture. GDS = geriatric depression scale.

shown in Table 3. After adjusting for potential confounders, it was observed that the odds of showing moderate to severe PS index were 2.51 times more likely in male elderly, 1.48 times more likely among the elderly with less schooling, and the lower income had a protective effect (adjusted OR = 0.52; 95% CI = 0.33-0.82). For the MPS index, the adjusted measures showed that the elderly males had a higher risk of unacceptable MPS (adjusted OR = 2.13; 95% CI = 1.26-3.61) and elderly with lower levels of education also had a higher risk of unacceptable MPS (adjusted OR = 1.37; 95% CI = 1.06-1.78).

Also, measures of association between the variables concerning health conditions and outcomes were also estimated (Table 4). Only the upper full denture (FuD) category and PS score remained associated after logistic regression, suggesting a protective effect of the presence of the upper FuD for the occurrence of moderate or severe PS index (adjusted OR = 0.73; 95% CI = 0.55-0.97).

## Discussion

The main findings of this study suggest that the severity of changes in the oral mucosa, measured through the MS index, was not associated with the variables included in this investigation. On the other hand, we found that less educated male elderly showed a higher prevalence of moderate/severe plaques. The use of an upper full denture and income of up to one minimum wage were protective factors for moderate/severe plaque. Only the variables of the first block of the conceptual structure, male gender and lower level of schooling remained associated with the presence of an unacceptable MPS score.

Studies addressing the association between social determinants and oral health are relevant to indicate more efficient and population-based actions. In this study, the presence of bacterial plaque in the oral cavity of the elderly measured by PS and MPS index was related to demographic and socioeconomic factors, such as gender, income and schooling. However, no significant association was found between the variables age, gender, place of residence, marital status, and income with a mucosal score (MS). A possible explanation for these results may be the hypothesis that the variables alone do not have the power to develop mucosal changes, and the interaction of several local factors, such as microorganisms, hormonal factor, hyposalivation, sleeping habits with the prosthesis<sup>16,19,24</sup> is required.

The adjusted findings did not show an association between the presence of plaque and frequency of daily tooth brushing in the elderly. However, a more frequent acceptable MPS and absent or mild PS in elderly patients who performed 3 or more tooth brushings per day were observed. Although the practice of oral hygiene appears to be less common in older adults, the risk of older people developing diseases is more associated with the cumulative effect of the extensive exposure to risk factors than due to age itself<sup>25</sup>. It should be emphasized that although there was no association, the presence of the bacterial plaque in the oral cavity results from the neglect of personal hygiene, regardless of age. Previous studies have shown an association between oral hygiene, bacterial plaque level and socioeconomic conditions<sup>26-28</sup>.

In this study, the elderly who had upper full dentures and lower income had protective factors for the presence of plaque (PS). A study with elderly conducted in Norway<sup>20</sup> found that elderly denture users evidenced better MPS indicators than those who had natural teeth. Based on these data, we may suggest that it may be easier to remove the dentures and sanitize them efficiently than to keep the natural teeth clean. According to some studies, edentulism is strongly associated with gender<sup>29</sup>, low income<sup>30</sup> and low schooling<sup>31</sup>.

This study showed that elderly males with low educational level were associated with moderate/severe PS and unacceptable MPS. Similar results were obtained by Heriksen<sup>20</sup>, who observed that women had lower MPS scores, suggesting a reflection of different behaviors among genders in self-care. Besides the gender factor, previous studies have shown that the factors that evidenced the highest association with neglected oral hygiene in the elderly are socioeconomic conditions, schooling, poor health education and gender<sup>27,28</sup>.

Of the socioeconomic factors, schooling is considered the most basic, because it shapes the individual's work and income potential. Furthermore, it influences access to information, health promotion and disease prevention<sup>32</sup>. Education is an essential category in the construction of society, providing citizens with protection against social problems such as low income, unemployment, poor housing conditions, illiteracy and health problems, including oral health<sup>33</sup>. In Brazil, men tend to enter the labor market earlier than women, compromising their schooling process, and, thus, women show a higher educational level<sup>34</sup>. Schooling is, therefore, an essential component in determining health habits and care.

**Table 3.** Bivariate and multivariate analysis of the association between the variables related to primary determinants and outcomes.

Variáveis	MS Score (moderate or severe)		PS Score (moderate or severe)		MPS Score (acceptable or unacceptable)	
	OR <sub>crude</sub> (IC95%)	OR <sub>adjusted</sub> (IC95%)	OR <sub>crude</sub> (IC95%)	OR <sub>adjusted</sub> (IC95%)	OR <sub>crude</sub> (IC95%)	OR <sub>adjusted</sub> (IC95%)
Age (years)						
60-62	1.00	-	1.00	1.00	1.00	1.00
63-67	0.82 (0.52-1.28)	-	1.31 (0.87-1.98)	1.15 (0.59-2.25)	1.18 (0.79-1.78)	-
68-72	1.20 (0.77-1.87)	-	1.57 (1.04-2.39)*	1.03 (0.73-1.45)	1.37 (0.90-2.06)	-
> 73	0.95 (0.60-1.49)	-	1.91 (1.25-2.89)*	1.14 (0.91-1.43)	1.36 (0.90-2.06)	-
Gender						
Female	1.00	-	1.00	1.00	1.00	1.00
Male	1.29 (0.93-1.78)	-	2.71 (2.00-3.67)*	2.51 (1.44-4.35)*	2.05 (1.52-2.77)*	2.13 (1.26-3.61)*
Place of residence						
Urban	1.00	-	1.00	-	1.00	-
Rural	1.21(0.88-1.66)	-	0.94 (0.71-1.25)	-	0.96 (0.72-1.28)	-
Marital status						
Married	0.65 (0.31-1.37)	-	0.82 (0.50-1.34)	-	0.75 (0.44-1.26)	-
Widowed	0.96 (0.74-1.25)	-	0.92 (0.75-1.12)	-	0.95 (0.78-1.16)	-
Other	1.00	-	1.00	-	1.00	-
Income						
≤ Minimum wage	0.73 (0.46-1.15)	-	0.49 (0.32-0.76)*	0.52 (0.33-0.82)*	0.68 (0.45-1.03)	-
> Minimum wage	1.00	-	1.00	1.00	1.00	-
Schooling						
> 4 <sup>th</sup> grade	1.00	-	1.00	1.00	1.00	1.00
4 <sup>th</sup> grade	1.30 (0.85-1.97)	-	1.20 (0.82-1.77)	1.53 (0.84-2.79)	1.27 (0.86-1.87)	1.15 (0.64-2.07)
<4 <sup>th</sup> grade	1.30 (0.87-1.94)	-	1.85 (1.28-2.66)*	1.48 (1.13-1.94)*	1.89 (1.31-2.72)*	1.37 (1.06-1.78)*

<sup>1</sup>Number of individuals who answered. \*Statistically significant. CI95% = 95% confidence interval. OR = Odds Ratio.



**Table 4.** Bivariate and multivariate analysis of the association between general and oral health variables with outcomes.

Variables	Score MS (moderate or severe)		Score PS (moderate or severe)		Score MPS (acceptable or unacceptable)	
	OR <sub>crude</sub> (IC95%)	OR <sub>adjusted</sub> (IC95%)	OR <sub>crude</sub> (IC95%)	OR <sub>adjusted</sub> (IC95%)	OR <sub>crude</sub> (IC95%)	OR <sub>adjusted</sub> (IC95%)
Daily tooth brushing						
3 times or more	1.00	-	1.00	1.00	1.00	1.00
twice	0.81 (0.55-1.18)	-	1.26 (0.89-1.77)	1.34 (0.82-2.18)	1.10 (0.78-1.54)	1.24 (0.78-1.99)
None or once	1.27 (0.87-1.86)	-	1.70 (1.19-2.44)*	1.16 (0.87-1.54)	1.58 (1.10-2.26)*	1.14 (0.87-1.50)
Smoker						
Yes	1.00	-	1.00	1.00	1.00	-
No	0.60 (0.30-1.22)	-	0.34 (0.15-0.75)*	0.88 (0.17-4.54)	0.66 (0.33-1.32)	-
Upper denture						
No denture	1.00	-	1.00	1.00	1.00	-
RPD, FD, FuD and RPD, FuD on implant	1.23 (0.57-2.66)	-	0.46 (0.23-0.89)*	0.73 (0.29-1.84)	0.68 (0.35-1.32)	-
Full denture	1.38 (0.72-2.62)	-	0.49 (0.28-0.84)*	0.73 (0.55-0.97)*	0.72 (0.42-1.24)	-
Lower denture						
No denture	1.00	-	1.00	1.00	1.00	1.00
RPD, FD, FuD and RPD, FuD on implant	1.29 (0.85-1.96)	-	0.85 (0.58-1.26)	5.00 (0.10-240.8)	1.05 (0.72-1.54)	0.95 (0.38-1.39)
Full denture	0.92 (0.64-1.32)	-	0.45 (0.32-0.63)*	1.85 (0.74-4.62)	0.51 (0.37-0.72)*	0.93 (0.71-1.21)
Salivary flow						
Up to 0.7 mL/min	1.00	-	1.00	-	1.00	-
From 0.8 to 1.0 mL/min	0.72 (0.41-1.29)	-	1.46 (0.91-2.32)	-	1.16 (0.72-1.85)	-
Medicines						
Does not use	1.00	-	1.00	1.00	1.00	-
Uses only 1	1.12 (0.70-1.78)	-	0.73 (0.47-1.12)	1.09 (0.68-1.76)	0.92 (0.60-1.42)	-
Uses 2 or more	1.13 (0.77-1.66)	-	0.69 (0.48-0.97)*	0.87 (0.73-1.04)	0.93 (0.66-1.33)	-
Comorbidities						
Up to 1 disease	1.00	-	1.00	-	1.00	-
2 or more diseases	0.96 (0.70-1.32)	-	0.75 (0.56-1.01)	-	0.87 (0.66-1.17)	-
GDS						
No symptoms	1.00	-	1.00	-	1.00	-
With symptoms	0.84 (0.51-1.36)	-	0.82 (0.53-1.27)	-	0.85 (0.55-1.32)	-

\*Statistically significant. CI95% = 95% confidence interval. OR = Odds Ratio. RPD = removable partial denture. FD = fixed denture. FuD = full denture. GDS = geriatric depression scale.

There are several methods used to verify the presence of bacterial plaque in teeth and dentures, as well as periodontal health parameters in individuals and populations. The MPS index is a simple method that quickly and comprehensively verifies inflammation and the presence of plaque and is very effective in studies of populations such as the elderly, dispensing with the use of other indices in the measurement of these diseases. The more global character of assessment MPS index, as well as its practicality, were decisive factors for choosing the methodology of this study. Thus, the use of this index is an essential approach for screening or classifying oral problems in groups or populations such as the elderly and association with several factors. However, despite its proven efficacy in international studies<sup>20,35,36</sup>, it is still poorly used in epidemiological studies in elderly populations<sup>34</sup>.

This study has some strengths, such as the use of the MPS index and the good representativeness of the sample of the city of Carlos Barbosa during the period of data collection, besides high statis-

tical power with narrow confidence intervals. The representativeness of the participants was verified from the social and demographic data of the elderly population of Carlos Barbosa. There was no significant difference regarding age, gender, marital status and geographical location of residence between the study participants and Carlos Barbosa's population aged 60 years or older<sup>37</sup>.

The findings of this study suggest the association of poor oral health with socioeconomic factors among community-dwelling elderly. Less educated male elderly were more likely to evidence bacterial plaque. On the other hand, those who had lower income and used full dentures were protected for the most severe category of plaque in the oral cavity. The differences between the individuals regarding the oral health conditions are due to the social position linked to the educational level. Oral health is an essential component for elderly health care. Thus, public policies contextualized with local reality are required to ensure a better quality of life for this population.

## Collaborations

MB Oliveira worked on the concept, design of the study, data review and final drafting. VP Rodrigues worked on data statistical analysis, review and final drafting. FF Lopes worked on study design, data review and final drafting. CMC Alves worked on the concept, data review and final review. FN Hugo worked on the concept of the study, the methodological outline, data review and final drafting.

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