

FACTORS ASSOCIATED WITH VISIBLE BIOFILM ACCUMULATION IN INSTITUTIONALIZED ELDERLY

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ABSTRACT: To evaluate the presence of visible biofilm accumulation and check associated factors in institutionalized elders. We conducted a cross-sectional study with elders ($n=193$) from long-term care facilities ($n=7$) in the metropolitan region of João Pessoa-PB. The presence of visible biofilm in teeth and/or dentures was considered as dependent variable. The independent variables of the study were: socio-demographic characteristics, physical state, hygiene habits, and presence of oral diseases. The influence of independent variables on dependent variables was analyzed according to logistic regression ($\alpha < 0.05$). The presence of visible dental biofilm (IPV) (63.3%) is associated with age over 80 years ($PR=1.53$), presence of dental calculus ($OR=4.91$) and brushing frequency up to once a day ($OR=1.96$). The increase in visible biofilm is associated with advancing age, presence of dental calculus and low frequency of hygiene.

KEY WORDS: Biofilms; Dependence; Fragile Elderly; Homes for the Aged; Oral Health.

FATORES ASSOCIADOS AO ACÚMULO DE BIOFILME VISÍVEL EM IDOSOS INSTITUCIONALIZADOS

RESUMO: O objetivo desse estudo foi avaliar o acúmulo de biofilme visível e verificar os fatores associados em idosos institucionalizados. Realizou-se um estudo transversal com idosos ($n = 193$) em instituições de longa permanência ($n = 7$) da região metropolitana de João Pessoa (PB). A presença de biofilme visível nos dentes e/ou nas próteses dentárias foi considerada como variável dependente. As variáveis independentes do estudo foram: características sociodemográficas, estado físico, hábitos de higiene e presença de agravos bucais. A influência das variáveis independentes sobre as variáveis dependentes foi analisada segundo regressão logística ($\alpha < 0,05$). Foi possível perceber que a presença de biofilme dental visível (63,3%) está associada com idade superior a 80 anos ($OR = 1,53$), presença de cálculo dental ($OR = 4,91$) e frequência de escovação até uma vez ao dia ($OR = 1,96$). Diante disso, o acúmulo de biofilme visível está associado com avanço da idade, presença de cálculo dental e baixa frequência de higiene.

PALAVRAS-CHAVE: Biofilmes; Dependência; Idoso Fragilizado; Instituição de Longa Permanência para Idosos; Saúde Bucal.

INTRODUCTION

The demographic transition observed on a global scale warns of the need to further study health conditions of elderly population¹.

As aging progresses globally, universal health coverage becomes a matter not only of public health, but also of human rights. Knowledge about the population aging process is important for the development of health systems that allow universal coverage and a continuous monitoring cycle in order to reach a healthy aging society².

Between 2015 and 2020, there was an increase of 20.6% of the population above 60 years in Brazil, with a total of 30.2% elders being estimated for 2020³. According to the World Health Organization (WHO), in 2025 there will be 1.2 billion people over the age of 60. The population of people aged 80 and over is the fastest growing⁴. The increase in functional dependence resulting from the aging process and the limited availability of families to provide care for their elders has led to a significant increase in the number of individuals using the services of long-term care facilities for the elderly (LTCF). Often, the elders are responsible for their voluntary institutionalization, as they believe they represent a burden on the family structure and do not feel comfortable in demanding care that changes the family routine⁵.

Institutionalized elders often have greater impairment of functional skills compared to community dwelling elders⁶. In addition, the institutionalized elderly in Brazil is characterized by low income, low education and a high prevalence of general health problems⁷. Functional dependence makes self-care impossible and, consequently, biofilm control and maintenance of oral health⁸. This directly reflects in the oral health of the Brazilians elders, that is characterized by the high prevalence of missing teeth and the need for dentures^{9,10}.

In addition to impacting the prevalence of oral conditions, the accumulation of biofilm may be responsible for colonization of the respiratory tract, which is related to the prevalence of systemic conditions, such as aspiration pneumonia. These aspects directly affect the quality of life of the elderly population^{11,12}.

Data on oral hygiene of institutionalized elderly and their associated factors are still scarce in the literature. Understanding the oral health condition of institutionalized elderly people and related physical and biological factors will improve the oral hygiene care and protocols. Thus, this study sought to assess the presence of visible biofilm accumulation and to verify the factors associated among institutionalized elders.

METHODOLOGY

ETHICAL ASPECTS

This study was approved by the Research Ethics Committee from the Centro de Ciências da Saúde of Universidade Federal da Paraíba (CAAE: 66122917.6.0000.5188), complying with the required ethical standards, as well as the Helsinki Declaration of 1964 and its subsequent amendments. All participants provided written informed consent when signing the free and informed consent form.

UNIVERSE, SAMPLE AND STUDY SITE

A cross-sectional study was carried out, using questionnaires and physical examinations with institutionalized elders. The metropolitan region of João Pessoa (Paraíba, Brazil) includes seven LTCF, which were visited by the study, with an estimated institutionalized elderly population of 398 individuals. The response rate was estimated at 40%, since many of the institutionalized individuals lacked the ability to understand the instruments (data informed by the LTCF management and through the Mini Mental State Examination questionnaire). A design effect of 1.4¹³ was calculated and the sample size of 191 individuals was defined as representative of elders without cognitive impairment. All the elderly with no cognitive impairment, with the ability to answer the interview, and able to participate in the oral exam were included (n=193).

DATA COLLECTION

The study was developed with institutionalized elders from seven long-term institutions in the metropolitan region of João Pessoa, from July 2018 to December 2018. A team of calibrated researchers composed of undergraduate and master students (Kappa 0.85) collected the data. The following explanatory variables were included in the present study: 1) sociodemographic characteristics (sex, age - collected through a questionnaire); 2) associated data with physical status (performance of activities of daily living, frailty, handgrip strength, motor coordination

- collected through a questionnaire and physical test); 3) variables related to oral health (caries experience, edentulism, presence of dental calculus, frequency of brushing and person responsible for hygiene - collected from oral examination). The outcome was the accumulation of biofilm, assessed using the O'Leary plaque index (PI). All data were collected through validated questionnaires.

Trained examiners assessed the accumulation of visible biofilm on dentures and reminiscent teeth, under natural light ($Kappa = 0.85$). Dental biofilm was evaluated on the four surfaces of all teeth (medial, distal, buccal and lingual) and prosthesis base, using the O'Leary Plaque Index (PI)¹⁴. Biofilm accumulation was confirmed when $PI > 20\%$.

Dental caries experience, edentulism and the presence of dental calculus were verified through clinical examination, with the aid of a dental probe, following the same criteria adopted by the World Health Organization¹⁵ and oral health surveys in Brazil¹⁶. The dental caries experience was translated by the DMFT index, which represents the sum of the number of decayed, missing and filled teeth. Edentulous individuals were considered to be those with all missing teeth. The frequency of brushing and the identification of the person responsible for hygiene were collected through a questionnaire prepared by the researchers themselves.

Socioeconomic data were collected through a questionnaire prepared by the authors themselves. The dependence of activities of daily living was assessed using a validated questionnaire based on the Katz scale, composed of six items that assess performance in activities of daily self-care, including the following domains: 1) feeding; 2) sphincter control; 3) transfer; 4) personal hygiene and use of the bathroom; 5) ability to dress; 6) take a shower¹⁷. Each dependency score is considered a point¹⁷. In this research, the data were dichotomized for statistical analysis considering the independent participants (dependent on up to one function) and dependent (dependent on two or more functions).

A modified Fried model was used to assess frailty, as previously described in the literature^{19,20}. The questionnaire uses five criteria: unintentional weight loss of 3 kg (not as a result of diet or exercise) (Criterion 1); self-perception of exhaustion (Criterion 2); measurement

of muscle strength (Criterion 3); decrease in walking speed (Criterion 4); and low level of physical activity (Criterion 5). The data were dichotomized for statistical analysis, classifying the elderly as fragile when they obtained three or more positive scores for frailty; and not fragile or potentially fragile when they obtained less than three scores.

Psychomotor coordination was assessed using the *Purdue Pegboard Test*, which consisted of assessing how many wooden pins the individual can insert into a perforated panel (two parallel rows of 25 holes), within 30 seconds. Initially, individuals were asked to choose their hand of preference (dominant). They started with the dominant hand, followed by the non-dominant hand and then using both hands. For the present study, individuals were categorized according to the level of psychomotor coordination, according to the median value obtained in each phase of the test. Thus, the elderly were classified as having good psychomotor coordination when inserting more than six pins and with poor motor coordination when inserting up to six pins²¹.

The handgrip strength of both hands was assessed using the *Camry*® dynamometer (model EH101). The elderly were instructed to apply maximum grip strength with each hand, during 5 seconds. The device recorded the maximum grip strength in kilograms (Kg). The median handgrip strength (12 kg) of the participants was determined and, based on the established value, the elderly were categorized into: normal strength - greater than or equal to 12 kg; and reduced strength - less than 12 kg.

DATA PROCESSING AND ANALYSIS

The data were tabulated and analyzed in IBM Statistical Package for the Social Sciences software (IBM SPSS, v. 20, Chicago, IL). The explanatory variables (dependence, frailty, psychomotor coordination and handgrip strength) were dichotomized for statistical analysis. Initially, data were subjected to bivariate analysis (chi-square test and Fisher's exact test) aiming to test variables potentially associated with the outcome. The criteria for entering variables in the logistic regression model was $p < 0.25$ and followed the order at three levels: sociodemographic variables (block 1); variables related to physical state (block 2); and oral health variables (block

3), until the final model is built. For the logistic regression model presentation, odds ratios (OR) and 95% confidence intervals (CI) were calculated, considering $\alpha < 0.05$.

RESULTS

The sample was mainly composed of female individuals (72%, $n = 139$), aged 80 years or over (59%, $n = 106$). Elders were mostly independent (70%, $n = 142$) and non-fragile or potentially fragile (54%, $n = 104$).

From the investigated elderly, 60.7% ($n = 117$) had low handgrip strength and 61.7% ($n = 119$) had low motor coordination for the non-dominant hand.

There was a high dental caries experience among institutionalized elderly (DMFT average = 29.3 ± 4.5). All the elders presented tooth loss, of which 38.3% ($n = 72$) were partially edentulous and 61.7% ($n = 116$) total edentulous. The accumulation of biofilm in dental prostheses or remaining teeth was observed in 64.9% ($n = 122$) (Table 1).

Table 1. Distribution of the sample according to the accumulation of biofilm on the surface of the teeth and prostheses of institutionalized elderly, João Pessoa, Paraíba, Brazil, 2018

(Continued)

Variable	n	No visible biofilm		With visible biofilm		p
		n	%	n	%	
Sex						
Male	54	18	9.3	36	18.7	0.535
Female	139	53	27.5	86	44.6	
Age Range						
60-79 years	85	35	18.3	50	26.2	0.245
80 years or more	106	35	18.3	71	37.2	
Dependency on daily activities						
Independent (up to 1 functions)	142	51	26.4	91	47.2	0.675
Dependent (≥ 2 functions)	51	20	10.4	31	16.1	
Fragility						
Not fragile or pre-fragile	104	43	22.3	61	31.6	0.156
Fragile	89	28	14.5	61	31.6	
Dominant hand strength						
≥ 12 kg	92	29	15	63	32.6	0.148
<12 kg	101	42	21.8	59	30.6	
Non-dominant hand strength						
≥ 12 kg	76	23	11.9	53	27.5	0.130
<12 kg	117	48	24.4	69	35.8	
Coordination of the dominant hand						
More than 6 pins	101	46	13.0	55	28.5	0.179
Up to 6 pins	92	25	23.8	67	34.7	
Coordination of non-dominant hand						
More than 6 pins	74	22	11.4	52	26.9	0.109
Up to 6 pins	119	49	25.4	70	36.3	
Coordination of both hands						

						(Conclusion)
> 8 pins	69	24	12.4	45	23.3	0.667
≤ 8 pins	124	47	24.4	77	39.9	
Edentulism						
Partial toothless	72	6	3.2	66	35.1	<0.001*
Total toothless	116	60	31.9	56	29.8	
Dental calculus						
No	128	69	35.8	59	30.6	<0.001*
Yes	65	2	1	63	32.6	
Brushing frequency						
Two or more times	145	54	28.0	91	47.2	0.820
Up to one time	48	17	8.8	31	16.1	
Responsible for oral hygiene						
Elderly	165	53	28.6	112	60.5	0.042*
Caregiver	20	11	5.9	9	4.9	

*Chi-square test and Fisher's exact test ($p < 0.05$)

For binary logistic regression, 178 individuals were considered. The reduction in the sample size was due to some elderly people did not allow oral examinations or did not perform the physical test, causing some sample units being missed. The presence of biofilm (63.3%) is associated with the age over 80 years ($p = 0.041$), presence

of dental calculus ($p < 0.001$) and brushing frequency up to once a day ($p = 0.013$). Non-dominant hand strength below 12 kg ($p = 0.041$) and oral hygiene performed by the caregiver ($p = 0.024$) were associated with the absence of biofilm (Table 2).

Table 2. Adjusted logistic regression analysis to verify the factors associated with the accumulation of visible biofilm in institutionalized elderly, João Pessoa, Paraíba, Brazil, 2018

Variable	B ^a	OR (CI 95%) ^b	p
Sex (Male)	-0.188	0.829 (0.502 – 1.369)	0.463
Age range (>80 years)	0.424	1.528 (1.018 – 2.294)	0.041
Fragility (Fragile)	0.181	1.199 (0.796 – 1.805)	0.386
Non-dominant hand strength (<12kg)	-0.475	0.622 (0.395 – 0.980)	0.041
Dental calculus	1.592	4.913 (2.127 – 11.348)	<0.001
DMFT	-0.109	0.897 (0.769 – 1.047)	0.167
Brushing (up to 1x)	0.672	1.958 (1.152 – 3.328)	0.013
Responsible for hygiene (Elderly)	0.736	2.088 (1.104 – 3.950)	0.024

^aRegression coefficient; ^bOdds ratio and Confidence Interval.

DISCUSSION

The present study exposed the predominance of women, aged over 80 years, which corroborated the literature regarding the institutionalized elderly in Brazil^{22,23}. There was also a predominance of independent elders, with regards the performance of daily living activities, and the majority of non-frail or pre-frail elders. LTCF residents can be characterized by a history of abandonment and systemic diseases that compromise general physical status and self-care^{24,25,26}. According to the literature, frailty and dependence are associated with advancing age, presence of chronic systemic diseases and less education^{8,27}.

The elders' handgrip strength was considered reduced, which can be justified by the physiological loss of muscle tone, as a result of the aging process²⁸. After institutionalization, elders become more vulnerable to the decline of their cognitive function²⁹. The lack of physical and cognitive stimulation is one of the main causes of the acceleration of this decline.²⁹

Elders who had reduced non-dominant hand strength and self performed their oral hygiene were associated with the accumulation of oral biofilm. This demonstrates the key role of caregivers in maintaining oral health, especially for those most physically weak. Interventions in hygiene of institutionalized elderly, through continuing education programs have a significant impact on the oral health of these individuals¹². Thus, it is suggested that practical oral hygiene measures carried out in dependent elderly people are as efficient as promotion and prevention actions among elders with regular cognitive and physical status.

In Brazil, the oral health conditions of the elderly in LTCF are characterized by high values of the DMFT index compared to that of other countries, such as Spain,¹⁰. Institutionalized elders have a high prevalence of edentulism and low frequency of denture use³⁰.

The presence of biofilm in teeth and dentures corresponded to more than half of the examined elderly, who reported a tooth brushing routine of two or more times a day. We observed that the elderly classified as independent, non-frail or pre-frail and those who performed their own oral hygiene had a higher prevalence of biofilm. This aspect may be related to the negligence of

caregivers in the supervision and guidance of oral hygiene, which negatively contributed to oral biofilm control³¹.

Institutionalized elderly caregivers have the responsibility to assist, supervise and guide all elders in activities of daily living. It is the professional's duty knowing the correct technique for brushing teeth and dentures, in a way they will be able to execute and instruct elders. This will stimulate self-care, the cognitive and physical function of institutionalized elders⁹.

Health education actions directed to caregivers and to institutionalized elders can improve care knowledge and care effectiveness. Activities such as direct practical training for educational approaches to oral health, with the participation of dentists, demonstrate better results in health care¹². Preventive and promotional practices can be decisive for good oral health and impact on the general health status and quality of life of elders. The development of professional courses aimed at training elders' caregivers is an alternative to improve the provision of care to institutionalized elderly with equity, promoting improvements in the quality of life of this population.

Among the limitations of this study, we can mention the challenge of participating in the LTCF routine so that data collection could be performed at the best time for each elderly person, without interfering in their daily activities. As well as obtaining the confidence of each volunteer to consent to respond attentively and sincerely answer to the questions of our extensive instrument for data collection and carrying out the intra-oral physical examination in non-clinical and appropriate conditions.

CONCLUSION

Visible biofilm accumulation in institutionalized elderly people was associated with advanced age, presence of dental calculus and low frequency of hygiene.

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