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Use of dental services by the Brazilian elderly: latent class analysis

Utilização dos serviços odontológicos por idosos brasileiros: análise de classes latentes

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ABSTRACT: ***Objective*:** To analyze the different profiles of dental service use by the Brazilian elderly and their possible association with sociodemographic factors, comorbidities, functionality and self-perception of oral health. ***Methods*:** Cross-sectional population-based study, using secondary data from the National Health Survey (PNS) of 2013. The sample size was 2,969 elderly individuals. Latent Class Analysis was used to construct the dependent variable "profile of dental service use" from questions related to this profile. The independent variables formed 3 blocks: sociodemographic; comorbidities; functionalities and self-perception of oral health. The Rao-Scott Test and Standardized Residue Analysis tested the association. To measure the effect of covariates, Odds Ratio was estimated using a multiple hierarchical model of multinomial logistic regression. Significance level was 5%. ***Results*:** Three latent classes were identified: Direct Disbursement Profile, Health Plan Profile and the Unified Health System (SUS) Profile. White elderly people were associated with the Direct Disbursement and Health Plans profile. The Health Plan profile was more associated with the married marital status or living with a spouse. In the multiple model, low schooling was associated with the profile of SUS users and elderly people diagnosed with cancer with the Health Plan profile. Self-perceiving oral health as bad or very bad increased the chances of belonging to the SUS profile. ***Conclusion*:** Latent Class Analysis proved to be a powerful strategy for a subtle and detailed understanding of the profile of dental service use and its relationship with associated factors.

Keywords: Comprehensive health care. Dental health services. Dental care for aged. Aged. Latent class analysis.

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RESUMO: ***Objetivo:*** Analisar os diferentes perfis de utilização de serviços odontológicos por idosos brasileiros e sua possível associação com fatores sociodemográficos, de comorbidades, de funcionalidade e autopercepção em saúde bucal. ***Métodos:*** Estudo transversal de base populacional, utilizando dados secundários da Pesquisa Nacional de Saúde de 2013. A amostra foi composta de 2.969 idosos. A Análise de Classes Latentes foi utilizada para a construção da variável dependente "perfil de utilização dos serviços odontológicos". As variáveis independentes formaram três blocos: sociodemográfico; comorbidades; e funcionalidades e autopercepção em saúde bucal. O Teste de *Rao-Scott* e a Análise de Resíduos Padronizados testaram a associação. Para mensurar o efeito das covariáveis, foram estimadas as odds ratios por meio de modelo múltiplo hierarquizado de regressão logística multinomial. O nível de significância foi de 5%. ***Resultados:*** Três classes latentes foram identificadas: perfil de desembolso direto, perfil de plano de saúde e perfil do Sistema Único de Saúde (SUS). Idosos da cor branca apresentaram associação aos perfis desembolso direto e planos de saúde. O perfil plano de saúde esteve mais associado ao estado civil casado ou que moram com cônjuge. No modelo múltiplo, a baixa escolaridade apresentou associação ao perfil de usuários do SUS, e idosos com diagnóstico de câncer, ao perfil plano de saúde. Autoperceber a saúde bucal como ruim ou muito ruim aumentou a chance de pertencer ao perfil SUS. ***Conclusão:*** A Análise de Classes Latentes mostrou-se potente estratégia para compreensão sutil e detalhada do perfil da utilização de serviços odontológicos e sua relação com fatores associados.

Palavras-chave: Assistência integral à saúde. Serviços de saúde bucal. Assistência odontológica para idosos. Idoso. Análise de classes latentes.

INTRODUCTION

The increasing elderly population resulting from the higher life expectancy and the reduction in natality rates have represented major changes in the age structure of countries all over the world[1,2]. The high number of people aged 60 years or more represents a new profile of needs[3], leading to a growing demand for health care, including dental services and proper oral health care[4]. This reality requires a continuous and multidisciplinary care organization that ensures the well-being of this population[2].

The problems related to the oral health of the elderly population — such as dental loss, non-functional removable dental prosthesis, lesions in the oral mucosa, periodontitis and radicular cavities — can interfere in the selection of foods by the affected people, in the ability to speak and chew and in social relations[5]. In the Brazilian context, it is important to highlight the prevalence of edentulism[6], which remains as a public health issue despite the evidence that the control or prevention of oral diseases enables the maintenance of the dental arch[7]. Among other factors, the regular use of dental services contributed with the maintenance of oral health with fewer complex and preventive treatments, early detection of diseases and improved quality of life among the eldery[8].

The characterization of the profile of health service use indicates if citizens who search for care actually obtain access to these services. Therefore, it allows to identify the existing differences both regarding the organization of the services and the social, economic

and demographic aspects of the users. It also establishes parameters of reference and goals related to regularly going to the dentist, in order to improve the initiatives and investment of public policies in oral health, considering that the equitable use of health care services is still a challenge[9-12].

Even though public dental services have been reorganized and improved with the implementation of the National Oral Health policy after 2004[13], it is still necessary to redesign the care addressed to the elderly to minimize the impacts of social and oral vulnerabilities that come with age[8], in order to prevent the overload of the Brazilian health system[14].

It is known that the higher the schooling of the elderly individual, the higher the use of dental services[11]. And that factors such as lower schooling or never having attended school, non-white skin color, lower income and going to the dentist with pain or to extract teeth are related to the use of public dental services by the elderly[8]. However, there are only a few studies about the use of dental services by the elderly in the Unified Health System (SUS), in comparison to private services[4].

Considering the several realities and health needs of the elderly about the factors associated with the use of dental services by this age group, the objective was to analyze the different profile of use of these services by the Brazilian elderly and its possible association with sociodemographic factors, comorbidities, functionality and self-perception in oral health.

METHODS

In this study, we analyzed the data from the National Health Survey (PNS), 2013[15]. PNS was a cross-sectional, population-based survey, with a household approach, carried out with the Brazilian Institute of Geography and Statistics (IBGE) and by the Ministry of Health (MS). Based on a complex sample, we investigated the aspects related to several health fields and socioeconomic and demographic aspects in different age groups. Methodological details of the sample are in Freitas (2014) [16].

PNS investigated 205,546 individuals, being 23,815 elderly (people aged 60 years or older). The weighted percentage of elderly individuals in the sample corresponded to 13.2% of the Brazilian population, including participants whose answers were obtained from a resident of the household where the elderly individual lives, aged more than 18 years. The sample of elderly individuals used in this study corresponds only to residents aged 60 years or more who answered the questions of the oral health module, accounting for 2,969 people.

The dependent variable was the profile of oral health services' use by the interviewed elderly individuals. Considering the questionnaire block constituted of seven questions related to the use of oral health services – if the location where dental care was offered was the city of residence; appointment covered by health insurance plan; payment of the appointment; appointment at SUS; main reason of the last visit to the dental surgeon; place of the last appointment; how the appointment was scheduled –, the methodological option was to understand this profile through the Latent Class Analysis (LCA). This is a statistical

method that identifies different groups (latent classes) based on the answer patterns observed in categorical variables. It is based on a probability model to identify characteristics that indicate the groups, to estimate the prevalence of each group and to classify each individual in the groups[17]. This type of analysis classifies different individuals as similar, and attributes the same weight for the different questions of the instrument.

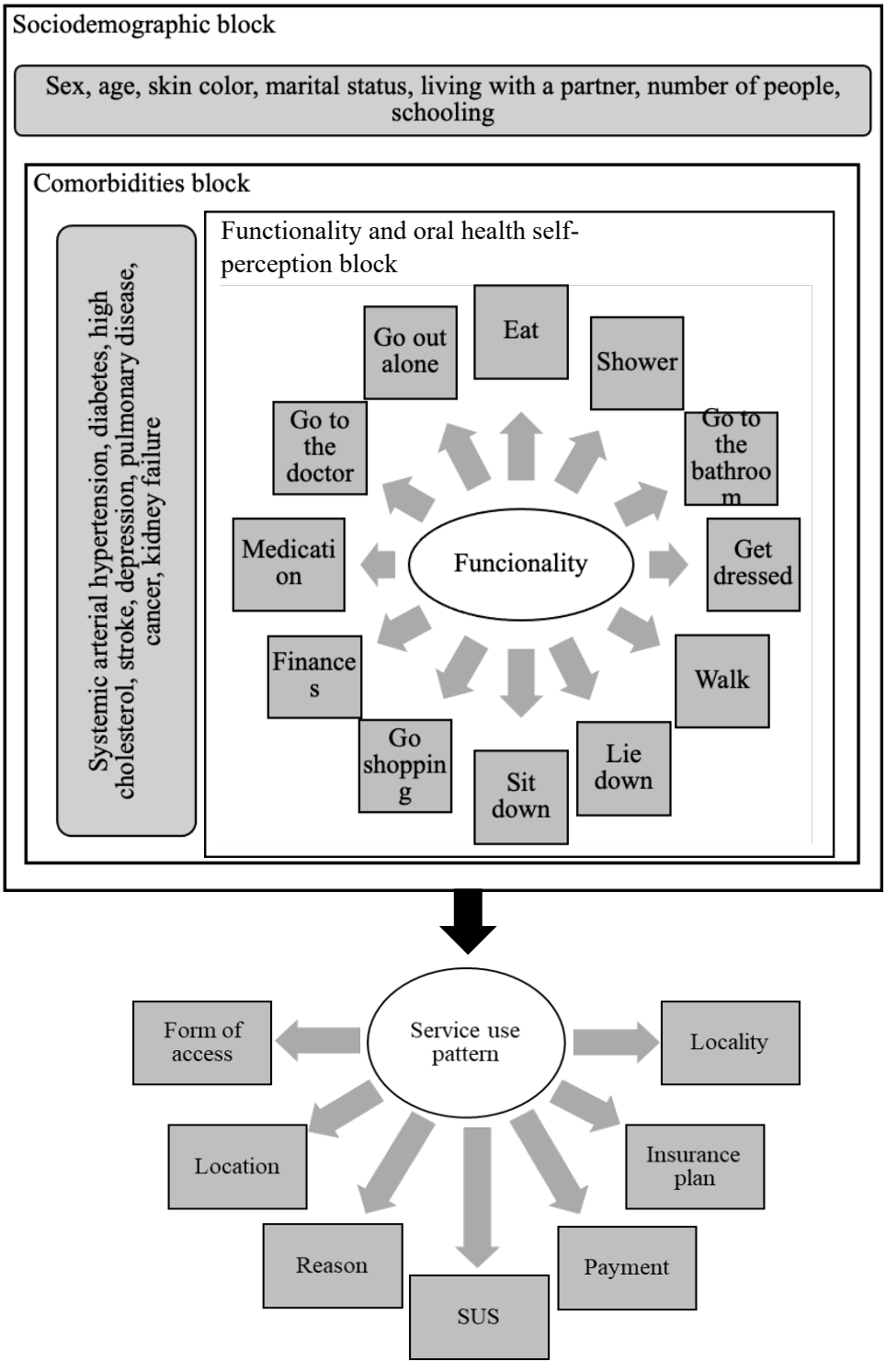
The latent variable "profile of oral health services' use" was created using the Growth Mixture Model (GMM), in the Mplus 6.12© software, creating and testing models from two to six classes. The six criteria that guided the selection of the best model of analysis were: The AIC test (Akaike Information Criterion); the BIC test (Bayesian Information Criterion); the adjusted BIC test (with the lowest values showing better adjustment to the model); entropy, when the value closest to 1 characterizes a model with a more adequate number of classes; and two likelihood ratio tests (*Vuong*, *Lo*, *Mendell*, *Rubin likelihood ratio test* — VLMR-LRT and *Likelihood ratio test* — LMR-LRT), which assess the statistical significance to indicate that the number of classes in the model would not need to be reduced to one less class[18,19].

The independent variables are in three hierarchized analysis blocks: sociodemographic, comorbidities and oral health functionality and self-perception. Figure 1 shows the hierarchized theoretical model. The sociodemographic block approaches the aspects regarding sex, age, skin color, marital status, living with a spouse or partner, number of people in the household and schooling. The block of comorbidities investigates the presence of diagnosis of systemic arterial hypertension, diabetes, high cholesterol, stroke, depression, pulmonary diseases, cancer or chronic kidney failure. For the functionality block, the answers to the 11 questions were also analyzed by the LCA to generate a single variable that represented this phenomenon as an optimal or moderate functionality, thus verifying the autonomy of the elderly individual to eat, shower, go to the bathroom, dress, walk, lie down, sit down, go shopping, administer finances, take medicines, go to the doctor and go out alone using transportation such as bus, subway, taxi, car etc. For self-perception in oral health, three categories of evaluation were considered for the elderly population: very good/good, regular, or bad/very bad.

The association between the independent variables and the dependent variable (categorized through the LCA) was analyzed using the Rao-Scott test[20]. Significance level was 5%.

The Standardized Residual Analysis was used for the association between the pairs of categories of the dependent variable and the independent variables, enabling the comparison of the patterns in each category. Significance was recognized when excess deviation was higher than 1.96, with significance level of 2.5% (one-tailed test).

The measures of effect of the analyzed factors about the dependent variable were calculated by multiple models of multinomial logistic regression, according to the hierarchized theoretical model presented in Figure 1, based on the hierarchized approach by Victora et al.[21]. At first, there was a bivariate analysis in the blocks of independent variables. In each block, the variables with $p < 0.25$[22] were tested in multiple models. At the end, the variables showing $p < 0.05$ remained in the final model of each block and were considered as adjustment factors for the subsequent blocks.



SUS: Unified Health System.

Figure 1. Hierarchized theoretical model to model the profile of oral health services' use. Brazil, 2020.

The data were analyzed using the software IBM SPSS Statistics, version 20, considering the weight and sampling strata from the PNS database. PNS was approved by the National Research Ethics Commission, of the National Health Council (n. 10853812.7.0000.0008/2013), and the microdata are available at IBGE's website.

RESULTS

The study sample was composed of 2,969 elderly individuals, mostly female (53.8%), aged 60 to 66 years (50.3%), white (65.8%), married (60.2%), living with a spouse or partner (62.9%), with 1 or 2 people living in the household (53.6%), and with complete elementary school (46.0%). About the presence of comorbidities, most were diagnosed with arterial hypertension (51.9%), but with no history of diseases such as: diabetes (81.6%), high cholesterol (72.6%), stroke (96.5%), arthritis/rheumatism (82.3%), depression (87.8%), pulmonary disease (96.8%), cancer (93.4%) or chronic kidney failure (97.0%). Functionality is optimal for most individuals (89.8%), and self-perception of oral health, very good or good (68.8%). The table with the descriptive analysis of the data is in the Supplementary Material of this article.

The LCA showed that the model with three classes was the most adequate one. Table 1 presents the distribution of the relative frequency of responses to the seven questions about the use of oral health services according to the three classes in the model. With the pattern of answers, it was possible to identify the following profiles: direct disbursement, health insurance profile and SUS profile.

The first profile was the most frequent one [59.6% (95% confidence interval —95%CI 56.5 – 62.6)], with prevalence of paid dental appointments, in private offices, with previous scheduling; the main reason for the appointment was to do a teeth cleaning, follow-up or prevention. The health insurance profile represented 18.7% (95%CI 16.4 – 21.3) of the sample and was characterized by approximately half of the users having their appointments covered by the plans; 76.6% did not pay for the appointment and the main reason of the visit was cleaning, follow-up or prevention. Most appointments in this profile also took place in a private office after previous scheduling. The SUS profile corresponded to approximately one fifth of the sample [21.7% (95%CI 19.1 – 24.4)]. Almost all of them were assisted in the same city where they lived in and did not pay for the appointment — made by SUS in 98.6% of the cases, and in Basic Health Units (UBS) in 78.2% of the cases. Even though 53.7% had scheduled the appointment, about one third (32.7%) went straight to the health service without previous scheduling. Approximately one fifth (19.0%) of the elderly individuals in this profile used the services for tooth extraction.

In all profiles, most interviewees attended the appointment in the same city where they lived in, for reasons of cleaning, follow-up or prevention, with previous scheduling. However, LCA allowed to visualize major differences that defined the profile of each latent class, besides other more subtle distinctions, which provided information that allowed a better characterization of the generated latent classes.

Table 1. Distribution of questions about the use of oral health services according to the probability of classification in the three categories of latent classes. Brazil, 2020.

Questions	Categories	Class 1	Class 2	Class 3
		Health Insurance (%)	Direct Disbursement (%)	SUS (%)
Location of dental care	In the city of residence	87.5	89.8	95.6
	In another city	12.5	10.2	4.4
Dental appointment covered by health insurance plan	Yes	49.9	2.1	4.1
	No	50.1	97.9	95.9
Paid dental appointment	Yes	23.4	100.0	0.1
	No	76.6	0.0	99.9
Dental appointment at SUS	Sim	0.2	0.6	98.6
	Não	99.8	99.4	1.4
Main reason for the last visit to the dentist	Cleaning, follow-up or prevention	59.9	43.2	48.3
	Pain	2.7	1.6	4.0
	Extraction	4.0	10.2	19.0
	Treatment	15.8	20.7	14.7
	Implant	4.0	5.9	0.2
	Prosthetic maintenance	9.5	15.6	11.2
	Others	4.1	2.8	2.6
Place of last dental appointment	UBS	1.4	0.2	78.2
	CEO	1.0	1.4	6.0
	UPA	0.5	0.3	5.0
	Public hospital	2.0	0.3	5.3
	Private office or hospital	90.3	97.8	4.4
	Others	4.8	0.1	1.2
Form of access to the dental appointment	In the health service, without scheduling	15.6	16.2	32.7
	Scheduled appointment	81.8	82.9	53.7
	Referred or assisted by a Family health group	0.0	0.4	11.4
	Others	2.6	0.6	2.2

SUS: Unified Health System; UBS: Basic Health Units; CEO: Dental Specialties Center; UPA: Emergency Care Units.

In the bivariate analysis with the profiles, we observed associated factors, and it was possible to identify statistically significant excesses of white elderly individuals associated with the direct disbursement and health insurance profiles, whereas the black or brown skin color was associated with the SUS profile. The health insurance profile was more associated with married individuals or those who live with a spouse; single people were more related to the SUS profile. Individuals who live in a household with up to two people were more related to the direct disbursement profile. Regarding schooling, it was observed that those who never attended school or studied only until elementary school were associated with the SUS profile.

In the comorbidity block, elderly individuals with arterial hypertension and diabetes were associated with the SUS profile. Differently from that profile, elderly individuals who presented some pulmonary disease were associated with the direct disbursement profile, and those diagnosed with cancer were mostly associated with the health insurance profile.

In the functionality and oral health self-perception block, elderly individuals who had regular, bad or very bad self-perception were associated with the SUS profile. In the functionality variable, it was observed that elderly individuals presented good independence in the two latent classes generated by the LCA. In the "moderate functionality" classification, there was a higher proportion of elderly individuals who presented difficulties to go out, go to the doctor, administer finances and go shopping alone, besides the association with the SUS profile.

Table 2 presents the results of the hierarchized multiple model of multinomial logistic regression. The reference category of the dependent variable was the direct disbursement profile. Therefore, all of the odds ratio measures compare with this profile. In the sociodemographic block, the variables that remained in the model were marital status, number of people in the household and schooling. Being single and living with more than two people respectively presented chances 75 and 45% higher of classification in the SUS profile. Elderly individuals who never attended school or were only literate respectively presented chances 31 and 48 times higher of belonging to the SUS profile.

Elderly individuals diagnosed with cancer had approximately twice as many chances of being in the health insurance profile, whereas presenting a pulmonary disease remained as a factor inversely associated with the profile. In the last block, controlled by the effect of the previous blocks, considering one's own oral health as bad or very bad doubled the chances of belonging to the SUS profile.

DISCUSSION

The Brazilian health system is constituted of a public-private mixture that includes three subsystems: public (represented by SUS and its universal character), private (with direct disbursement to pay for the provided service), and supplementary health (provided by health insurance plans)[22,23]. Such subsystems are different, but interconnected. It is possible to use services from all of them simultaneously, depending on access and the purchasing power of the individual[22].

Table 2. Estimations of the hierarchized multiple model of multinomial logistic regression. Brazil, 2020.

Block 1Sociodemographic	Health insurance profile		SUS Profile		P-value
	OR	95%CI	OR	95%CI	
Marital status					
Married	1.00		1.00		0.024
Separated or divorced	0.92	0.55 – 1.53	1.40	0.88 – 2.23	
Widow	0.77	0.50 – 1.18	0.89	0.62 – 1.27	
Single	0.57	0.34 – 0.93	1.75	1.06 – 2.90	
Number of people in the household					
≤ Median (1 – 2)	1.00		1.00		0.023
> Median (3 – 12)	1.44	1.02 – 2.04	1.45	1.07 – 1.95	
Schooling					
Never attended school	0.75	0.35 – 1.58	30.95	15.89 – 60.30	< 0.001
Literate	0.34	0.11 – 1.07	47.83	17.86 – 128.11	
Elementary school	0.63	0.39 – 1.01	15.85	9.04 – 27.78	
High School	1.31	0.82 – 2.09	5.72	2.91 – 11.24	
Post-gratuation	1.22	0.48 – 3.09	0.62	0.11 – 3.42	
Higher Education	1.00		1.00		
Block 2 Comorbidities	OR	95%CI	OR	95%CI	P value
Cancer diagnosis					
Yes	2.18	1.32 – 3.62	0.65	0.35 – 1.20	0.001
No	1.00		1.00		
Diagnosis of pulmonary disease					
Yes	0.16	0.06 – 0.42	0.61	0.32 – 1.15	0.001
No	1.00		1.00		
Block 3 Functionality and oral health self-perception	OR	95%CI	OR	95%CI	P value
Oral health self-perception					
Very good or good	1.00		1.00		0.043
Regular	0.83	0.56 – 1.25	1.25	0.87 – 1.79	
Ba dor very bad	0.93	0.39 – 2.24	2.12	1.03 – 4.37	

SUS: Unified Health System; OR: *odds ratio*; 95%CI: 95% confidence interval.

It is known that the prevalence of elderly individuals paying for an appointment with the dentist or using a health insurance plan to use the dental service corroborates the findings in the literature[4,8,11,13,24-26] — funding pattern similar to that of doctors' appointments[27,28]. The compared data analysis of the National Household Sample Survey (PNAD), conducted in 1993, 2003 and 2008, and PNS 2013, also shows increasing use of medical and dental appointments throughout these years[29].

On the other hand, the higher prevalence of use of dental appointments motivated by cleaning, follow-up, maintenance or prevention diverges from results in other studies, which point to the low use of this service for routine/maintenance procedures[11,12,24,30]. This can be considered as a positive result; however, it does not show the successful control of oral diseases in this age group, because other reasons that are often mentioned by elderly individuals to use dental services are dental prosthesis, tooth extraction, restoration procedures[12], cavity, bleeding, relationships affected by oral problems[24], conventional treatments, urgency[13] and toothache[,24].

Elderly individuals with better financial conditions are favored considering the use of services for prevention procedures and several treatments[25]. An important fact is that most elderly individuals who use private dental services in Brazil already wears prosthesis or present lower self-reported need to wear or change the dental prosthesis when compared to elderly individuals who attend the public service[31]. Even with the funding from regional dental prosthesis laboratories in SUS, the number of offered dental prosthesis is much lower than the real necessity of the population[30]. The prosthetic treatment is still mainly offered by private dental services[30].

Studies with data from the national oral health analyses — SB Brasil 2003 and SB Brasil 2010 — already revealed inequalities of race/color in the use of dental services by elderly individuals, with prevalence of use among the white people[32,33]. A black elderly person, for instance, had 62% less chances of having used dental services at least once in life than a white elderly individual[32]. Besides, white elderly individuals have been the majority among the ones who used these services more recently[32,33]. The results of this study show the permanence of these inequalities to the detriment of black elderly individuals.

It was possible to observe the higher use of dental services by married elderly individuals, corroborating the findings in the literature that recorded higher prevalence of this outcome by elderly people who live with a spouse or partner[11], suggesting that they also take better care of their teeth, possibly due to the importance of oral health in marital relations[7]. However, some local studies did not show such an association[24,30].

In Brazil, despite the tendency of increasing use of dental services throughout the years by the elderly individuals in all schooling levels, the schooling differences of this use are still expressed by the highest prevalence among those with higher schooling[29], with association between the shortest time spent since the last dental appointment and the elderly's higher schooling[11,12,26,30,33,34]. It is important to highlight the convergence found with other studies[4,24] as to the higher use of dental services from SUS by elderly individuals with lower schooling. Even though economic variables have not been inserted in this study, schooling

can be considered as a proxy for income[29], and the more frequent use of dental services in SUS has also been associated with lower family income[4,24], which can show the equity in the use of these services[4].

The SUS profile identified in this study was mostly composed of elderly individuals with low schooling, black and brown skin color, who reported few options of prosthetic treatment and dental implant. However, it is not correct to understand SUS as a poor system addressed to the more vulnerable population, since it is based on the principles of universality, integrality and equity, and includes social participation[35].

The association identified among the hypertensive and diabetic elderly individuals with the SUS profile probably occurred because they shared the same social determinants that interfere in the pattern of health services' use. Francisco et al.[36] revealed that in the capitals of the South/Southeast/Center-West regions of Brazil there were higher prevalence rates of arterial hypertension and diabetes among the black and brown elderly population, those with ≤ 8 schooling years, both non-smokers and smokers, and those with excess weight.

Elderly individuals who presented with pulmonary disease were associated with the direct disbursement profile, whereas those diagnosed with cancer were mostly associated with the health insurance profile. The difficulties to access public health services in both situations[37,38] may justify these findings.

Knowing the perception about oral health provides subjective and quantitative data[39] that are important to be considered in studies about the use of dental services[40]. There was a prevalence of regular and bad or very bad self-perception among the elderly in the SUS profile. This result is in accordance with the literature, which points to the association of negative oral health self-perception and elderly individuals, both black and brown[41], with lower schooling[41,42], unfavorable socioeconomic status[42] and higher use of dental services from SUS[24].

Among the limitations of this study, it is important to consider this is a cross-sectional analysis, so it is not possible to measure temporal variations or to make causal inferences. Despite adding the chances of reverse causality and memory bias, the several possibilities of research about the health of the population are reinforced, since these can be created based on the use of data from surveys.

The use of LCA showed to be superior to the use of traditional cluster methods, which only characterize the profile of service use based on the analysis of each question separately. In the case of direct disbursement, there was prevalence of this type of payment method, without, however, excluding from this group a percentage of elderly individuals whose main reason to see the dentist was tooth extraction. However, this was the profile who mostly used services for reasons of maintenance of dental prosthesis. This fact shows that the social response of the State regarding the dental mutilation that It causes is still submissive to the purchasing power of this type of treatment.

The SUS profile was the one that mostly assisted elderly individuals in the same city where they lived, showing the UBS as the main place of use. This result shows primary care as a gateway that organizes access to the care networks, with capacity to work with previous scheduling and direct care, with no need for scheduling. In this sense, it increases the possibilities

of access, considering that only a few reported pain as a reason for use. However, this profile had the highest proportion of elderly individuals whose reason for the last appointment was pain, allied to a very low proportion of dental implants as a reason for this appointment, which reinforces the still persisting gap in dental rehabilitation among SUS users.

The analysis of different profiles of dental services' use allowed to identify that single Brazilian elderly individuals, living in households with more than two people, who never attended school or are only literate, and wo consider their own oral health as bad or very bad, presented higher chances of belonging to the SUS profile. This characterization emphasizes the importance of SUS for this population group, especially considering the perspective of equity, in the sense that it is able to reach the population that needs it the most. Thus, it restates its needs for expansion, strengthening, and qualification of the provided services.

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