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Rural-urban differences in oral health among older people in Southern Brazil

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Abstract: This study aimed to assess the association between oral health and rurality in an older Brazilian population. Population-based samples of 1,451 urban and 411 rural elders were obtained from two databases. Several oral health and related measures, including the number of teeth lost, use of dental prostheses, dental visits, self-reported oral health, and perceived need for a dental prosthesis, were compared. Oral health-related information was obtained by a trained research team with interviews conducted in the individuals' homes. Regression models were used to verify the association between living in rural areas and oral health outcomes after adjusting for possible confounding factors. The elderly population mostly comprised of women in rural or urban areas, and the mean age was 70 years in both locations. Less-educated individuals (without or with complete elementary schooling) were more common in rural regions than in urban areas. After adjustment for socioeconomic characteristics, living in rural areas was associated with a lower perceived need for dental prostheses (PR 0.68, 95% CI 0.56–0.84), poor self-reported oral health (OR 1.24; 95% CI 1.05–1.46), and having fewer teeth (β -1.31; 95% CI -2.18 to -0.45). The place of residence had a significant impact on oral health indicators, with rurality negatively influencing oral health. These findings suggest that preventive and curative strategies for dental services may be needed for the Brazilian rural population.

Keywords: Oral Health; Rural Health; Urban Health; Tooth Loss; Dental Prosthesis; Self Concept.

Introduction

It is well known that social factors affect health. A higher burden of disease is found in populations with poor socioeconomic conditions.[1] Social inequalities not only affect general health but also oral health.[2,3] Better living conditions are generally associated with better general health, oral health, and quality of life. In the World Health Organization (WHO) conceptual model, the social determinants of health are characterized as structural and intermediary.[4] In this model, place of residence was included as an intermediate social determinant, influencing the unequal distribution of resources and health choices, thus contributing to oral health inequalities.4 Thus, living in rural or remote areas may influence health outcomes.

In general, rural populations have been decreasing in Brazil.[5] Younger individuals are migrating to urban centers to study or find better employment opportunities.[6] A greater mechanization of agriculture has also led to a reduction in the need for rural workers.[6] Furthermore, it is evident that the rural areas in Brazil are populated with older individuals. The aging index, calculated as the ratio of the older (≥ 65 years) to the young (< 18 years) population, increased from 9.7% to 21.4% in rural areas from 1991 to 2010.[5]

Residing in rural areas is associated with poor oral health.[7-13] Indeed, the rural population is becoming older and sicker.[12] Previous studies evaluating rural and urban oral health reported differences in oral health service utilization[7,10,11] and the oral health-related quality of life (OHRQoL).[12,13] Some authors have attributed urban-rural differences in oral health to barriers in access and utilization of dental services,[10,14] with lower access in rural areas. Socioeconomic differences between rural and urban populations have also been highlighted as contributing to poorer health in rural areas.[10] To respond to population necessities, the National Unified Public Health System (SUS) has increased the number of dental services available for the population over that time, but access is still less in rural areas,[15] and associated with more barriers, especially for the elderly.

Few population-based studies are evaluating the difference in oral health outcomes between rural or remote communities and urban populations, mainly in developing countries, including the elderly population. Therefore, this study aimed to investigate the influence of residential location on oral health among older individuals living in southern Brazil.

Methodology

Sample

This was a population-based cross-sectional study with a representative sample of urban and rural elderly populations from Pelotas, Brazil. Pelotas is a medium-sized city located in the southernmost state of Brazil, with approximately 340,000 inhabitants. Of those, 7% live in eight different districts that comprise the rural area. The study sample was limited to the older population (≥ 60 years), excluding those living in hospitals, nursing homes, prisons, homeless people, and those unable to answer the questionnaire due to cognitive disability or illiteracy. The sample represents a combined dataset from two similar surveys conducted by the Graduate Program in Epidemiology, Federal University of Pelotas, carried out in 2014 (urban) and 2016 (rural). Previous reports have described the methodology and sampling for each survey.[16,17]

The urban survey selected the participants using a multistage sampling method. The first cluster comprised the Census tract (according to the last National Census), and the second was inhabited private houses. From all 469 census tracts, 133 were randomly selected. Next, 4,123 houses were selected according to a probability proportional to the census tract size. Finally, all individuals aged 60 years or over and residing in houses were invited to participate.

The rural survey also used a multistage sampling process. Twenty-four census tracts were randomly selected from a total of 50 in all eight rural districts of the city, taking into account the population size of each. To identify the houses (the second cluster), each census tract was formed by a series of housing nuclei comprising at least five houses in a one-kilometer radius from each nucleus center. The largest nucleus in the census tract was chosen first to select houses with more than one housing nucleus, if necessary. Thirty inhabited houses were selected by the census tract to be included in the sample. Finally, all individuals above 17 years of age were invited to participate. For this study, we included only older adults (≥ 60-years-old).

Sample size

The minimum sample size necessary to evaluate the association between living in rural areas and different oral health measures was obtained, considering a significance level of 95%, power of 80%, an unexposed/exposed ratio of 3:1, and a prevalence ratio of 1.4. The minimum estimated sample size was 1,044 participants. Considering the design effect (DEFF = 1.4) and adding 10% for possible losses and refusal, the final sample size required to assess possible associations with the dependent variables was 1,608 participants.

The sample obtained from the urban older adult survey included 1,451 participants, while the rural study evaluated 411 individuals aged 60 years or more. In total, 1,862 older individuals were included in the final sample for the current study.

Data collection and instruments

Data were collected at the participants' homes through a structured questionnaire digitally administered by trained interviewers. The five targeted oral health measures were tooth loss, time since last dental visit, use of dental prosthesis, self-perceived oral health, and self-perception of prosthetic needs. Tooth loss information was obtained using two questions: "How many natural teeth do you have in the upper arch of your mouth?" "How many natural teeth do you have in the lower arch of your mouth?". The responses of the two questions were summed to obtain the total number of teeth (ranging from 0 to 32). The time since the last dental visit was considered as a proxy for regular use of dental services, and it was assessed by the following question: "When was the last time you visit the dentist?" The response options were as follows: *"in the last 12 months," "from 12 to 24 months ago,"* and *"more than 24 months ago."* Use of a dental prosthesis was assessed by the following questions: "Do you use any dental prosthesis in your mouth?" The responses were "*yes*" or "*no*;" Self-perception of oral health was assessed with the following question: "Compared to other persons, how you describe your oral health?" with 5 possible responses "*much better*" "*better*," " "*regular*," " "*fair*," and "*poorer*"); and "Do you think that you need any dental prosthesis?" with response options "*yes*" or "*no*."

The sociodemographic information collected included sex (male/female), skin color (white/non-white), marital status (married, or living with a partner/single, or divorced/widowed), and educational level (none, or elementary incomplete/elementary complete, or high school incomplete/high school complete, or undergraduate incomplete/undergraduate or graduate completed).

Statistical analysis

The prevalence rates of the dependent variables were computed. Non-adjusted and adjusted regression analyses were used to evaluate the association between rurality and oral health measures. To guide regression modeling, a directed acyclic graph (DAG) was used to consider putative causal relationships (Figure). Poisson regression models were employed for the dichotomous outcomes: use of dental prosthesis and self-perceived perception of prosthesis needs, presenting its respective prevalence ratios (PR) and

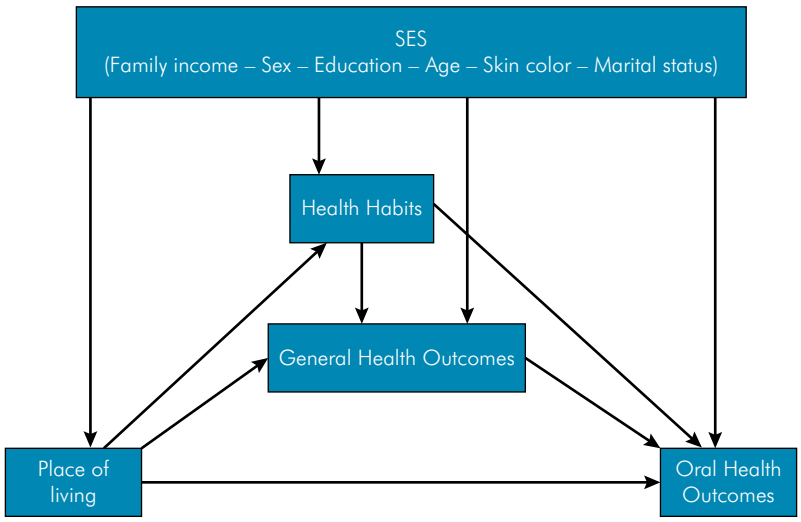

Figure. Conceptual model of the relation between place of living and oral health outcomes considering confounders and possible mediators to properly guide statistical regression analysis.

95% confidence interval (95%CI). For self-perceived oral health and the time since last dental visit (both ordinal variables), ordinal logistic regression models were used, with estimates presented as odds ratios (ORs). Linear regression was used with the mean number of teeth, and the outcome was presented as the adjusted linear coefficient value (β). The Wald test was used with a significance level of 5%. All analyses were conducted using the statistical package Stata 14.2 (StataCorp. College Station, TX, USA), using the command "survey (svy)" for complex samples.

Results

Sociodemographic, socioeconomic, and clinical characteristics of the total sample are presented in Table 1, by residential location. Irrespective of housing location, the sample comprised mostly White women and those married or living with a partner. However, in rural areas, there was a higher proportion of men, fewer black individuals, and more married persons. The mean age was 70 years in both rural and urban areas. There was a higher proportion of better-educated people in urban areas.

Table 2 presents the participants' oral health characteristics. Urban older individuals presented a higher number of remaining natural teeth than their rural counterparts. For both urban and rural individuals, the last visit to the dentist occurred predominantly more than 2 years previously. The majority of individuals living in urban and rural areas perceived their oral health to be good. The use of prostheses was noted in almost 85% of both populations. The perceived need for dental prosthesis was more evident among urban older individuals than those in the rural regions.

Table 1. Sociodemographic, socioeconomic and general health characteristics of the sample.

Variable	Urban		Rural	
	%	95%CI	%	95%CI
Sex				
Male	37.0	(35.0–39.1)	46.5	(43.1–50.0)
Female	63.0	(60.9–65.0)	53.5	(50.0–57.9)
Skin Color				
White	83.7	(80.7–86.3)	88.6	(82.9–92.5)
Black	11.6	(9.5–14.2)	3.2	(1.4–6.9)
Others	4.7	(3.5–6.2)	8.3	(5.2–13.0)
Marital Status				
Married/ with partner	52.7	(49.4–56.0)	60.8	(54.2–67.0)
Single/ without partner	6.3	(5.0–7.9)	7.5	(5.0–11.2)
Divorced	9.3	(7.9–10.8)	5.6	(3.3–9.4)
Widow	31.7	(29.2–34.4)	26.0	(21.6–31.0)
Education				
None/Elementary incomplete	37.1	(33.2–41.2)	63.8	(54.0–72.5)
Elementary complete/Middle school incomplete	31.0	(28.0–34.0)	25.4	(18.8–33.3)
Middle school complete/ High school incomplete	9.9	(8.4–11.7)	3.7	(2.3–5.9)
High school complete/college incomplete	11.1	(9.1–13.4)	4.2	(2.7–6.4)
College complete	10.9	(8.1–14.5)	3.0	(1.5–5.8)
	Mean	**SD**	**Mean**	**SD**
Age	70.7	8.2	70.1	7.3

CI: confidence interval. SD: standard deviation.

Table 2. Oral health characteristics of the sample.

Variable	Urban		Rural	
	%	CI95%	%	CI 95%
Last dental visit				
Less than a 12 months	38.3	(34.8–42.0)	25.4	(21.1–30.2)
12 to 24 months	9.4	(7.8–11.4)	11.8	(8.6–15.9)
More than 24 months	52.3	(48.6–55.8)	62.8	(57.7–67.6)
Self perception of oral health				
Much better	8.4	(6.9–10.0)	4.5	(2.9–6.8)
Better	57.7	(55.0–60.5)	56.2	(52.8–59.5)
Regular	25.0	(22.6–27.6)	28.4	(24.8–32.2)
Fair	6.9	(5.6–8.3)	9.7	(6.7–13.7)
Poorer	2.0	(1.4–2.9)	1.2	(0.6–2.7)
Dental prosthesis utilization				
No	15.2	(13.2–17.4)	15.1	(11.3–19.8)
Yes	84.8	(82.5–86.7)	84.9	(80.2–88.7)
Self perception of prosthesis necessity				
No	58.9	(56.1–61.6)	72.1	(65.4–78.0)
Yes	41.1	(38.4–43.9)	27.9	(22.0–34.6)
	Mean	**SD**	**Mean**	**SD**
Number of remaining teeth	8.7	9.8	5.5	7.4

SD: standard deviation.

Table 3. Effect of living in rural places in specific oral health outcomes according to specific regression analyses. Crude and adjusted analysis.

Outcomes	Effect of living rural place		
		Non-Adjusted	Adjusted
Self-perceived prosthesis need	PR (95%CI)	0.68 (0.54–0.85)**	0.68 (0.56–0.84)**
Dental prosthesis utilization	PR (95%CI)	1.00 (0.95–1.06)	-
Last dental visit	OR (95%CI)	1.63 (1.29–2.06)**	1.19 (0.91–1.56)
Poorest self-perceived oral health	OR (95%CI)	1.33 (1.18– - 1.57)**	1.24 (1.05–1.46)*
Total number of teeth	β (95% CI)	-3.22 (-4.38– - 2.11)**	-1.31 (-2.18– - 0.45)*

*$p < 0.05$; **$p < 0.001$. Model adjusted by education, sex, skin color, family income and marital status.

Table 3 presents crude and adjusted estimates for each outcome assessed. The adjusted analysis shows that living in rural areas was a risk indicator for self-perceived poor oral health (OR: 1.24; 95% CI: 1.05–1.46) and having fewer remaining teeth (β: -1.31; 95% CI: -2.18 to -0.45). Those living in the rural area had a lower perceived need for dental prostheses than their urban counterparts (PR: 0.68; 95%CI: 0.56–0.84).

Discussion

This study showed that older people living in rural regions generally have poorer oral health than those living in urban areas. These findings are in agreement with those of the previous studies,[7,9-14,18] where older adults living in rural areas had higher rates of tooth loss, poorer self-reported oral health, and a lower perceived need for dental prostheses.

A previous study conducted in Norway found that individuals living in rural areas had a higher rate of tooth loss than the urban population.[18] Remote access and barriers to health facilities in rural populations have been listed as the main reasons for tooth loss[10,15,19]. Indeed, lower dental service utilization among rural populations was found in different scenarios.[7,11,14]

The relationship between objective measures of oral health and dental service utilization is the most accepted explanation for worse oral health outcomes in remote populations. However, in the present study, we did not find an association between place of residence and the use of dental services. Similarly, a previous study found no difference in dentist-visiting patterns in one year between urban and rural individuals. However, there was a significant difference in the distance to the dental clinic and transportation,[12] which were recognized as barriers to access. It is important to highlight that, despite being underfunded, Brazil has the largest public oral health system worldwide. The system provides free of charge dental treatments (preventive and curative) for 75% of the Brazilian population, while the remaining 25% are covered by private insurance.[15]Specifically, in Pelotas, the city where the investigation was carried out, there is good coverage by public dental services in both rural and urban areas. Of these, 25% of the health units are located in rural areas (13 of 51 according to the municipality health program on the date of the data collection; available at: http://www.pelotas.com.br/storage/saude/arquivos/plano_municipal_saude.pdf). This high coverage by public health services may explain the lack of significant difference between dental service utilization in urban and rural areas observed in our study.

Besides the use of dental services, the lower number of teeth present in rural individuals could be explained by education, health behaviors, lifestyle, or social and cultural factors. First, the concept and valorization of oral health can differ between rural and urban individuals,[20] leading to different patterns of dental attendance[9]. Moreover, there is a higher social acceptance of edentulism and tooth loss in rural than in urban areas, with tooth loss being considered a natural process of ageing.[21] Thus, the belief that the use of dental services is unnecessary for edentulous individuals constitutes a barrier to service access.[21] Second, the rural population generally adopts worse health behaviors than the urban population. Alcohol consumption, unhealthy diet, irregular vaccination schedule, and lower tooth brushing frequency were some of the factors associated with living in rural area.[7,22] Finally, isolation and distance from the nearby neighborhood and places of social gathering could hinder social interaction and support, which may impair the adoption of healthier behaviors.[23]

It is noteworthy that elderly populations have a higher risk of tooth loss *per se*. The main causes of tooth loss are chronic conditions that increase with ageing.[24] Moreover, at older ages, the risk of tooth loss may be due to physiological alterations as part of the aging process, such as lower salivary flow rate, poor dental hygiene due to the lack of fine motor skills, low motivation, and comorbidities[25]. When considering the treatment for tooth loss, the lack of dental prostheses negatively impairs oral health-related quality of life. Azevedo et al.[26] reinforced the need to offer proper dental treatment for tooth loss in the elderly population to re-establish their masticatory function, esthetics, as well as psychological and social well-being.

Subjective oral health outcomes were also associated with the residential location. Urban elderly individuals perceived their oral health condition better than their rural counterparts, as previously found in other studies.[11-13,27] Self-perceived oral health is strongly related to oral health-related quality of life and healthy behavioral choices. A previous study comparing rural and urban areas detected that living in rural areas increased the odds of poor OHRQoL[12] by 60%. Similarly, objective oral measures are strongly associated with education and access to information.[28] Rural areas in Brazil have limited access to information resources, hindered by factors such as poor Internet connection and TV signals, which, together with few health professionals and scarce health facilities, contribute to worse self-perceived oral health.

The self-perceived need for prosthesis is influenced not only by education level and access to information but also by lesser concern for dental esthetics in rural than in urban areas, for which social acceptance

plays an important role[29]. In addition, older adults are usually more resilient and can usually accept a worse oral condition or tolerate an ill-fitting or less esthetic prosthesis. In rural elderly, such resilience could be even higher, especially considering the lower level of social contact. Subjective measures must be considered when planning health actions, as patient perceptions are critical in evidence-based dentistry.

Our study had some important limitations. Tooth loss (number of remaining natural teeth) and dental prostheses use were assessed by self-report. Oral health examination by a dentist is considered the gold standard method for determining oral health outcomes. However, self-reporting measurements have been used for different outcomes at different ages in epidemiological studies. Previous population-based studies have also used the same approach.[14,30]

Another limitation is that the two populations were evaluated at different periods (urban population in 2014 and rural population in 2016) and not at the same time. Nevertheless, considering the seven years between the last two National Oral Health Surveys (SB2003 and SB2010), few differences were observed when comparing the oral health of the elderly in both surveys. Further, when considering the subjective oral health outcomes measured, we must consider that the elderly had grounded perceptions created and shaped throughout their lives, and therefore a difference of 2 years may not lead to great modifications. For objective oral health outcomes, we evaluated chronic conditions (tooth loss), which were unlikely to vary significantly over two years, as demonstrated by the results from national evaluations.[31] Finally, the municipality health program in the specific years did not show any specific oral health actions for the rural population in the period.

Fluoride is another important consideration. We did not investigate the access to water fluoridation. It was shown that municipalities with smaller populations had higher DMFT values than larger ones due to differences in fluoridation. The same occurs in rural or remote populations. Rural areas had worse access to fluoride water,[32] which may result in poorer oral health, mainly in terms of tooth loss. Finally, the cross-sectional design does not allow us to infer causal relationships, notwithstanding that social mobility in rural areas is not a regular pattern, indicating that older adults living in rural areas are exposed to the same rural environment throughout their lives.

In general, people living in rural areas have worse oral outcomes. Rural populations are becoming older on average. Many living in the rural regions have been neglected in terms of health. There is a need to include them in the global agenda to tackle the poor health conditions and identify the underlying mechanisms.[8-32] When planning public health policy actions, the impact of residential location, especially rurality, on oral health should be considered. Considering the cultural and behavioral aspects of the rural elderly population is key to efficient programs aimed at reducing health inequalities and consequently improving oral health and quality of life in rural populations.

Conclusion

The findings of this study showed that rurality had an adverse effect on the oral health of older individuals. Those living in rural areas had a higher rate of tooth loss, poorer self-reported oral health, and a lower perceived need for dental prostheses.

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