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Dental visits and depression mediating the association of socioeconomic status with oral health behaviors

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Abstract: Determinants of oral diseases include behaviors, which in turn are influenced by a series of social determinants such as psychosocial aspects and dental care services. Therefore, the aim of this study was to investigate whether depressive symptoms and use of dental care services mediate the relationship between socioeconomic status (SES) and oral health behaviors. This was a cross-sectional study that analyzed data from participants in the 2019 National Health Survey (PNS) (n = 88,531). The eligibility criteria were individuals who were 18 years and older and exclusion criterion was living in households located in special or sparsely populated census tracts. Structural equation modeling (SEM) was used to test direct and indirect pathways from a latent variable for SES to oral health through depressive symptoms (assessed through the "Patient Health Questionnaire-9") and use of dental care services. The maximum likelihood estimator for complex samples with the robust standard error was used. The final model presented an adequate fit: RMESA of 0.008, CFI of 0.998, and SMRM of 0.005. The results showed that higher SES was directly associated with better oral health-related behaviors [standardized coefficient (SC): 0.428; $p < 0.01$] and indirectly through depressive symptoms [(SC): 0.002; $p < 0.01$] and dental care services [(SC): 0.089; $p < 0.01$]. The total effect of SES on oral health-related behaviors was equal to [(SC: 0.519 ($p < 0.01$)]. In conclusion, the findings suggest that high socioeconomic status, mediated by depressive symptoms and dental care services, has a positive effect on oral health.

Keywords: Social Determinants of Health; Oral Health; Health Behavior; Latent Class Analysis.

Introduction

Socioeconomic status can affect health at different points in the life course at the individual and community levels through a number of intermediary determinants that include behavioral, biological, material, and psychological factors.[1,2] Evidence demonstrates that the poorest and most socially disadvantaged members of society are most affected by oral diseases.[3] Health behaviors also show a social gradient, suggesting that they are influenced by socioeconomic patterns.[4] However, socioeconomic status (SES) only partially explains variations in behaviors that influence

oral health.[4] Determinants such as psychosocial factors and access to health services might play a role in the relationship between SES and oral health-related behaviors.[5,6]

Psychosocial factors can influence the mental health of individuals with far-reaching consequences for oral health-related behaviors and oral health-related quality of life.[7] Psychosocial factors can be related to psychological distress leading to low self-esteem, anxiety, and depression.[8] The latter is characterized by increased feelings of sadness and hopelessness and might affect daily behaviors.[8,9] Previous studies have suggested that depression may be associated with poorer oral hygiene and less frequent dental visits.[9,10] However, the role of depressive symptoms in explaining the socioeconomic gradient in oral health may vary according to the population and the social context studied.[11] Although psychosocial factors may be critical in explaining socioeconomic inequalities in oral health-related behaviors, the existing evidence suggests that this does not fully explain these inequalities.[5]

People from low SES are less likely to use dental care and have regular check-ups.[12] Access to dental care has a prominent role in explaining inequalities in oral health.[13] However, studies show that the provision of dental care, which is associated with oral health-related behaviors, can be modified according to the social context, perpetuating oral health inequalities.[13,14] In addition, while extensive research established the links between behaviors and oral diseases, few studies have addressed the mechanisms by which inequalities affect oral health-related behaviors, especially using large, nationally representative samples.[15]

Analysis of the possible pathways by which inequalities are linked to oral health-related behaviors can improve the understanding of oral health inequalities,[13] with implications for policy formulation and implementation to address persistent inequalities.[16] The hypothesis of this study is that the association between SES and oral health-related behaviors is mediated by depressive symptoms and dental service utilization. Therefore, the aim of this study was to examine the mediating role of depressive symptoms and use of dental services in inequalities associated with oral health-related behaviors.

Methodology

Design and setting

This was a cross-sectional study that used data from the 2019 National Health Survey (PNS). The data were collected between August 2019 and March 2020 through personal interviews. The PNS is a population-based survey with a sample representative of the Brazilian population residing in private households. The PNS allows for the estimation of outcomes for urban and rural population at the five Brazilian macro-regions, states, state capitals, and metropolitan areas.[17]

Ethical aspects

The PNS data are available for public access and use on the official website of the Brazilian Institute of Geography and Statistics (IBGE) (https://www.ibge.gov.br/estatisticas/sociais/saude.html). The PNS was approved by the National Research Ethics Commission (CONEP 3.529.376). An informed consent form was obtained from all participants at the time of the interview. To write this manuscript we followed the 'Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)' guideline.

Participants and sample selection

For the 2019 PNS, randomly selected 94,114 individuals aged 15 years and over were interviewed. The participants answered an individual questionnaire that was divided into three sections: a) household questionnaire; b) questionnaire for all household residents, answered by an individual aged 18 years or older; c) individual questionnaire, answered by an individual aged 15 years or older, selected by drawing lots.[17] The research sample excluded households located in special or sparsely populated census sectors, such as indigenous groups, barracks, military bases and accommodation, camps, boats, penitentiaries, penal colonies, prisons, jails, long-term care for older adults, networks of integrated care for children and adolescents, convents, hospitals, agricultural villages for settlement projects, and quilombola groups.[17] More details about the methods are available elsewhere.[17] This study included data on adults aged 18 years and older, therefore the final sample was 88,531.[17]

Data sources

The data collection was coordinated by the IBGE and carried out by field researchers, supervisors, and state coordinators. Data were collected face-to-face using electronic forms uploaded onto mobile devices. The interview was based on the identification of the resident who would provide information about the household and its residents, in addition to the selection of a resident aged 15 years or older to respond to the individual interview.

Variables

Outcome - Oral health behaviors

Participants were asked two questions about oral health behaviors (flossing and tooth-brushing frequency). The answer for flossing was categorized as 'yes' or 'no' and the answer for tooth-brushing frequency was categorized as "less than once a day", "once a day", "twice a day" or "thrice a day or more". Scores were assigned to response options so that higher values on the latent variable indicated better or improved oral health behaviors.

Socioeconomic status (SES)

Two indicators were used to derive the latent SES variable: education level of the respondent and per capita household income. Education level was categorized into 'no education', 'incomplete elementary school', 'complete elementary school', 'incomplete high school', 'complete high school', 'incomplete higher education', or 'complete higher education'. Monthly per capita household income (family income) was analyzed as an increasing continuous variable and collected in Brazilian reals (R$), (US$ 1.0 was equivalent to R$ 4.0 in August of 2019). Both indicators were organized so that higher values in the latent variable represented better SES.

Use of dental care services

The use of dental care services was evaluated by the following question: 'Did you seek dental care in the last 12 months?' [considering the year prior to the interview] with 'yes' or 'no' as possible answers. The reference category was 'yes'.

Depressive symptoms

The participants answered the "Patient Health Questionnaire-9 (PHQ-9)", a valid instrument for tracking depressive episodes in epidemiological studies. The PHQ-9 has nine questions that assess the presence of each of the symptoms that define episodes of major depression (depressed mood, anhedonia, sleep problems, tiredness or lack of energy, change in appetite or heaviness, feelings of guilt or worthlessness, problems with concentration, feelings of sluggishness or restlessness, and suicidal thoughts).[18,19] The frequency of each symptom in the last two weeks [prior the interview] is evaluated on an ordinal scale from 0 to 3 corresponding to the answers 'never', 'several days', 'more than half the days', and 'almost every day', respectively. Answers are summed up and a total score that ranges from 0 to 27 is obtained. The PHQ-9 was analyzed as a quantitative variable.[18,19]

Analysis plan

Descriptive data were analyzed using STATA 14.0 (Stata Corporation, College Station, TX, USA). A structural equation modeling (SEM) framework generated using the software Mplus version 6.12 was used to verify the possible pathways between SES [both directly or via depressive symptoms] and use of dental services, on oral health behaviors. All analyses were performed considering the sample weights provided by the IBGE due to the complex nature of the study sample.

First, the two latent variables (SES and oral health behaviors) were specified separately using confirmatory factor analytic models, where all standardized factor loadings were above the benchmark of 0.3. Afterward, we created the path analytic model, including the latent constructs, to jointly estimate the direct and indirect associations of SES with the outcome (Figure 1). The SEM analysis was composed of the structural model, which estimated the magnitude of the effects among the observed variables (pathways analyses).

The maximum likelihood estimator for complex samples with robust standard error was used. Standardized direct and indirect paths were estimated from SES to oral health-related behaviors. Modification indices (MI) and factorial loads were used for the

adjustment of the parsimonious model. The MI parameters used were: root mean square error of approximation (RMSEA) with its respective 90% confidence interval (CI) and values ≤0.05; comparative fit index (CFI) with values ≥0.9; Tucker-Lewis index (TLI) also with values ≥0.9; and standardized root mean square residual (SRMR) with values ≤0.08.[20,21] Path coefficients were estimated and presented as standardized coefficients (SC) to maintain the same scale from different equations, contributing to the interpretation of the direction and magnitude of the associations. Standardized coefficients between 0.10 and 0.30 indicate a small effect, between 0.30 and 0.50 indicate a moderate effect, and larger than 0.50 indicate a strong effect.[22] Results were adjusted for sex and age (18–59 years and 60 years or older).

Results

In this study, 88,531 individuals aged 18 years and older were analyzed. Table 1 shows the sample distribution for the adjustment variables (sex and age) and for variables of the model; SES (formal education and monthly family income), use of dental services, depressive symptoms, and oral health behaviors (flossing and toothbrush use). The sample was composed mostly of women (53.2%), people aged 18-59 years (78.4%), and with incomplete elementary school (28.7%). A large part of the sample reported brushing their teeth thrice a day or more (62.8%). However, 61.6% of the participants did not floss.

The path analytical model (Figure 1) had a good fit, with SRMR of 0.005. Direct path effects of SES included a positive path to dental service use and a negative path to depressive symptoms. In addition, the model showed that higher SES had a positive path to oral health-related behaviors.

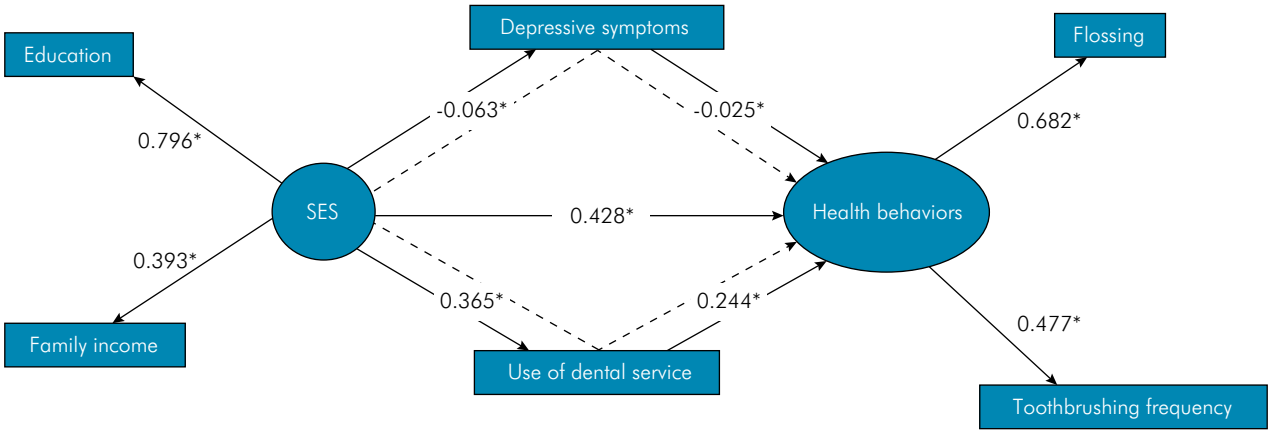
When estimating the direct effects on oral health behaviors from the structural model, SES [standardized coefficient (SC): 0.428; $p < 0.01$], depressive symptoms [(SC: -0.025; $p < 0.01$)], and dental service utilization [(SC: 0.244; $p < 0.01$] were associated with oral health-related behaviors (Table 2; Figure).

Mediation effects of depressive symptoms and dental service utilization between SES and oral health-related behaviors are presented in Table 2. In addition to the direct effect and larger magnitude, SES was associated with oral health-related behaviors via the use of dental services [(SC): 0.089; $p < 0.01$] and depressive symptoms [(SC): 0.002; $p < 0.01$]. However, the association between SES and oral health behaviors via depressive symptoms was week. The total effect of SES on oral health-related behaviors was equal to [(SC: 0.519 ($p < 0.01$)] (Table 2).

Table 1. Characteristics of the sample from the National Health Survey (PNS) (n = 88,531).

Sample characteristics	Weighted (%)*
Socioeconomic factors	
Sex	
Male	46.4
Female	53.6
Age (years)	
18–59	73.4
≥ 60	26.6
Formal education	
None	6.8
Incomplete elementary school	30.8
Complete elementary school	7.8
Incomplete high school	5.8
Complete high school	27.7
Incomplete higher education	4.5
Complete higher education	16.6
Individual income in R$[a] [mean (SE[b])]	1795.9 (32.7)
Psychosocial and behavioral factors	
Depressive symptoms [mean (SE[b])]	3.81 (0.57)
Dental visit in the 12 months prior the interview	
No	51.7
Yes	48.3
Flossing	
No	38.5
Yes	61.5
Toothbrush use	
Never	0.3
Once a day	5.1
Twice a day	32.5
Thrice a day	62.1

*Taking into account the sample weight. R$[a]: Brazilian real (US$1.0 is equivalent to R$4.0 approximately); SE[b]: standard error.



Goodness-of-fit statistics: CFI = 0.998, RMSEA = 0.008, SMRM = 0.005. Variables are coded so that positive values indicate high SES, last dental visit in less than one year, good oral hygiene habits. Adjusted for sex and age. *p<0.01= indirect effect.

Figure. Path diagram of the model for health behaviors with standardized parameters.

Table 2. Standardized parameters (95%CI) for direct, indirect, and total effects of socioeconomic status on oral health-related behavior.

Variable	Standardized coefficients*	Total effects*
Pathway		
Direct	0.428 (p < 0.01)	0.519 (p < 0.01)
Mediation via depressive symptoms	0.002 (p < 0.01)	-
Mediation via use of dental service	0.089 (p < 0.01)	-
General mediation	0.091(p < 0.01)	-
Model fit		
RMSEA (90%CI)	0.008 (0.006–0.011)	
CFI	0.998	
TLI	0.987	
SRMR	0.005	

*Taking into account the sample weight. RMSEA: root mean square error of approximation; CI: confidence interval; CFI: comparative fit index; TLI: Tucker-Lewis index; SRMR: standardized root mean square residual.

Discussion

This study analyzed a nationally representative sample and revealed that SES is related to oral health behaviors primarily through a direct pathway. This supports the hypothesis that economic conditions play a central role in how people care for their teeth/mouth. Depressive symptoms and the use of dental services played a minor role in explaining the effect of socioeconomic inequalities on oral health behaviors. Overall, the results of the analyses confirm the study's hypothesis that SES is associated with oral health behaviors both directly and through psychosocial factors and access to care.

Although recent studies have reported that oral diseases are related to behaviors, which in turn are related to SES,[13,23] data on whether psychosocial factors and access to care mediate the association between SES and oral health behaviors are scarce. The present study took an important step forward by testing SES as a latent variable in a model with multiple predictors within a conceptual framework.

Nationally representative data and an analytical SEM approach allowed quantification of the direct and indirect effects of SES on oral health, comparing

different mediation pathways.[24] SEM allows to test theoretical frameworks that incorporate networks of interactions between different exposures,[24,25] such as what has been done in this study. As far as we know, this is the first time that the mediating role of depressive symptoms was investigated using a valid questionnaire in a nationally representative sample and SEM analysis.

The direct path of SES was relatively stronger for oral health behaviors. The emphasis on individual lifestyle as the cause and solution to health problems is particularly common in dentistry.[26] The focus of most oral health policies is on changing individual behavior, which is often considered a consciously chosen personal behavior.[2,26] The predominant direct effect of SES on oral health behaviors indicates the potential relevance of the unequal wealth distribution and the broader social structures in inequalities in oral health behaviors. Behavioral approaches do not reduce health inequalities, but rather increase them by favoring those in society who have the resources and ability to change their behavior.[27] Strategies to mitigate the above problems should include policies that address the unequal distribution of power, money, and resources in modern society, as well as supportive community actions.[13,26]

This study showed that symptoms of depression are directly associated with oral health behaviors. Similar findings were found in studies suggesting that depression is related to less frequent toothbrushing.[9] Psychosocial pathways are important mediators of the effects of social determinants on health outcomes.[10,28] However, depressive symptoms played a minor role in mediating the association between SES and oral health behaviors. A possible explanation of the relationship between depression and oral health behaviors is the lack of interest of depressed individuals in most normal activities, such as personal self-care.[29] Because depression and oral diseases are common in the general population, the relationship between oral health and mental health must be elucidated to improve the public health management of these factors.[28,30] In particular, it is important to know the degree to which depressive symptoms affect oral health behaviors in order to manage the oral health of patients with depressive symptoms.[28,30]

The direct path from SES to dental care indicates that a higher SES is associated with more visits to the dentist. Possible reasons for this pattern include different financial barriers, geographic barriers, perceptions, and beliefs about oral health of groups with different SES.[12,27] It was also possible to observe the mediating but mild effect of use of dental services in explaining inequalities in oral health behaviors. This implies that other mechanisms may also play an important role in these inequalities, such as contextual factors and income.[2,13] In addition, dentistry is largely a demand-driven service that is often poorly planned as a result of market choices and therefore poorly matched to the oral health needs of the population.[3,13,23]

Income inequality can affect population health through several mechanisms, including the psychosocial conditions of individuals, which can have a direct influence on physiological responses and an indirect influence through oral health behaviors.[31] Despite the scientific evidence on the influence of and interactions among intrapersonal, behavioral, and psychosocial determinants of oral health, policies and research directions have closely followed the behavioral agenda, neglecting the broader social determinants.[3,26] Oral diseases disproportionately affect the poorest and most underprivileged groups in society and are closely linked to SES and broader social and economic determinants.[5,23]

Depressive symptoms and the use of dental services played a minor role in mediating the effect of socioeconomic inequalities on oral health behaviors in this study. However, studies have shown that the use of services is considered an important element in the evaluation of health behaviors, as it is related to treatment need and self-care perception.[13,32] Psychosocial well-being contributes to the adoption of attitudes toward the improvement of individual oral health, such as brushing frequency, daily flossing, and use of dental services for preventive reasons.[33] Thus, depressive symptoms are associated with oral health as they can impair oral hygiene behaviors, which leads to an increased risk of oral diseases.[28,34]

These findings should be interpreted with caution due to some study limitations. This study did not consider the homeless people and people in long-term care facilities, meaning that vulnerable

populations were not represented in the sample, limiting the external validity of the findings. The cross-sectional design does not allow inference of causality and makes determination of temporal sequence impossible, precluding meaningful analysis of potential mediators. Therefore, prospective studies are highly recommended. In addition, self-reported data are subject to response bias, particularly social desirability bias. This could underestimate the role of these factors in explaining oral health inequalities.

A systemic approach to socioeconomic inequalities in oral health should take into account the complex relationship between socioeconomic factors, such as psychosocial factors, and access to services. It is important that future research examine the mediating factors between socioeconomic factors and oral health behaviors. Longitudinal nation-wide surveys and data stratified by age group would be useful to support and guide strategies that minimize inequities in oral health.

Conclusion

In conclusion, the findings showed that depressive symptoms and dental service utilization partially mediate the effect of socioeconomic status on oral health behaviors. Actions to promote fair access to health services and reduce poverty may be important resources for tackling oral health inequalities.

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