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The relationship between neighborhood empowerment and dental caries experience: a multilevel study in adolescents and adults

A relação entre empowerment de vizinhança e experiência de cárie: um estudo multinível em adolescentes e adultos

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ABSTRACT: ***Objective:*** To investigate the relationship of contextual social capital (neighborhood empowerment) and individual social capital (social support and social network) with dental caries experience in adolescents and adults. ***Methods:*** A population-based multilevel study was conducted involving 573 subjects, 15-19 and 35-44 years of age, from 30 census tracts in three cities of Paraíba, Brazil. A two-stage cluster sampling was used considering census tracts and households as sampling units. Caries experience was assessed using the DMFT index (decayed, missing and filled teeth) and participants were divided into two groups according to the median of the DMFT index in low and high caries experience. Demographic, socioeconomic, behaviors, use of dental services and social capital measures were collected through interviews. Neighborhood empowerment was obtained from the mean scores of the residents in each census tract. Multilevel multivariate logistic regression was used to test the relationship between neighborhood empowerment and caries experience. ***Results:*** High caries experience was inversely associated with neighborhood empowerment (OR = 0.58; 95%CI 0.33 – 0.99). Individual social capital was not associated with caries experience. Other associated factors with caries experience were age (OR = 1.15; 95%CI 1.12 – 1.18) and being a female (OR = 1.72; 95%CI 1.08 – 2.73). ***Conclusion:*** The association between neighborhood empowerment and caries experience suggests that the perception of features of the place of residence should be taken into account in actions of oral health promotion.

Keywords: Dental caries. Oral health. Social inequity. Social capital. Socioeconomic factors. Multilevel analysis.

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RESUMO: ***Objetivo:*** Investigar a relação entre capital social contextual (*empowerment* de vizinhança) e individual (rede e apoio social) com a experiência de cárie dentária em adolescentes e adultos. ***Métodos:*** Estudo multinível de base populacional, envolvendo 573 indivíduos de 15 a 19 e 35 a 44 anos, realizado em 30 setores censitários de três municípios no Estado da Paraíba, Brasil. A amostragem foi por conglomerados em dois estágios, considerando-se setores censitários e domicílios como unidades amostrais. Aferiu-se a experiência de cárie dentária pelo índice CPOD (dentes cariados, perdidos e obturados), sendo os participantes divididos em dois grupos segundo a mediana desse índice: baixa e alta experiência de cárie dentária. Informações demográficas, socioeconômicas e comportamentais, uso de serviços odontológicos e medidas de capital social coletivo e individual foram coletadas por meio de entrevistas, obtendo-se o *empowerment* de vizinhança pela média dos escores individuais de cada setor censitário. A análise logística multinível multivariada foi empregada para testar a associação entre *empowerment* de vizinhança e experiência de cárie. ***Resultados:*** A alta experiência de cárie foi inversamente associada com *empowerment* de vizinhança (OR = 0,58; IC95% 0,33 – 0,99). Não foi observada relação entre capital social individual e experiência de cárie. Os demais fatores associados à cárie foram idade (OR = 1,15; IC95% 1,12 – 1,18) e sexo feminino (OR = 1,72; IC95% 1,08 – 2,73). ***Conclusão:*** A associação entre *empowerment* de vizinhança e experiência de cárie dentária sugere que a percepção das características do local de residência devem ser consideradas nas ações de promoção de saúde bucal.

Palavras-chave: Cárie dentária. Saúde bucal. Iniquidade social. Capital social. Fatores socioeconômicos. Análise multinível.

INTRODUCTION

Reducing inequalities in oral health is one of the main challenges that health policy makers have to face[1], with the identification of social determinants of oral health being one of the possible ways to overcome this difficulty[2,3]. Socioeconomic factors are considered determinants of health conditions in populations[4] and, more recently, there has been a growing interest in understanding how the characteristics of societies and the various forms of social organizations influence the health and well-being of individuals and groups[5,6]. There is evidence that individual health vary in different social contexts, and that many measures at the individual level are strongly conditioned by social processes that operate at the group level[7].

Epidemiological studies in Brazil show that lower income, lower education, non-white skin color and inadequate housing are individual socioeconomic determinants of dental caries[8-12]. Furthermore, contextual social determinants were associated with caries experience. Access to piped water, the Human Development Index (HDI) and the Gini Index, which assesses income inequality, were related to caries in children and adolescents[8,12].

Over the years, the epidemiology field has been incorporating sociology concepts and theories in the study of social determinants of health. For some decades, the use of "social

capital" has been observed as a possible characteristic associated to health conditions, although there is no consensus on its definition and measurement. Bordieu[13] and Coleman[14] define social capital as the reciprocity in social relations, while for Putnam[15] it is the set of norms and social structure networks that empower individuals to act together and more effectively in pursuit of common goals. Therefore, the concept encompasses civic culture, trust among members of the community, involvement in community affairs and good relationship between neighbors, and concerns norms and networks that foster collective action aimed at the common good[16-18].

According to Kawachi et al.[19], there are three main types of social capital: bonding, bridging and linking. Bonding is represented by horizontal close relationships between individuals or groups with similar demographic characteristics, such as relationships between family members and close friends. These bonds influence the quality of life through the promotion of mutual understanding and support. Bridging stands for the most extensive relationships networks with other individuals and communities, and are vital to connect individuals and communities to resources or opportunities that are outside of their networks of personal relationships. Finally, linking refers to alliances with individuals in positions of power, that is, those who have the necessary resources for social and economic development, and it can be characterized as political awareness while integrating with other communities.

In general, social capital can be considered both at an individual and at a contextual level. The individual social capital is defined as resources and different forms of support that are within the individuals' social networks[20]. Thus, measures of social and support networks have been used to assess individual social capital[21,22]. On the other hand, contextual or collective social capital emphasizes the resources that can be built collectively by individuals who are socially interconnected aiming to achieve collective goals, and has been evaluated and studied both in local levels of aggregation, such as neighborhoods, census tracts or neighborhoods, and in broader levels, such as municipalities, states or countries[20]. The neighborhood social capital is linked to the relationship between individuals and the social groups inserted into neighborhoods, and is a product derived from the continuous interaction between neighbors[23]. Neighborhoods can be defined geographically and correspond to social structures that include, in addition to individual social networks, shared norms and mutual trust, promoting cooperation for mutual benefit[24,25]. The measurement of neighborhood social capital may be an aggregate measure obtained from individual responses. Some dimensions used include social trust, social control, empowerment, political efficacy and safety in the neighborhood[26].

Despite the growing number of studies that linked the social capital to oral health[21,22,26-30], there are few studies involving adults, and those who assess both the effect of individual and of collective social capital[18,21,22,30]. Specifically for the outcome of dental caries, Patussi et al.[26], in a multilevel study in the Federal District, Brazil, found a negative association between neighborhood empowerment and caries in adolescents. In an ecological study in 39 Japanese cities, it was found that the variance of the distribution of caries experience in 3 year-old children was explained in 6.6% of cases by individual variables and in 47.2% of cases for variables in the community level, suggesting that the community context

affects the distribution of caries[29]. Therefore, there is a scarcity of studies on social capital and dental caries in Brazilian adults, and an absence of studies to evaluate simultaneously the individual and contextual social capitals. The aim of this study was to investigate the relationship between contextual (neighborhood empowerment) and individual (network and social support) social capital and caries experience in adolescents and adults.

METHODOLOGY

A cross-sectional, population-based study was conducted with individuals in the 15 – 19 and 35 – 44 years old age groups, between 2010 and 2011, in three randomly selected cities of the First Health Macroregion in the State of Paraíba, Northeastern Brazil. Paraiba was chosen because of the lack of studies on social determinants and oral health in the Northeast region of the country. The state is administratively divided into four Health Macroregions, and the sample sought to represent the First Macroregion, as it is the most populous (1,513,173 inhabitants, according to the 2008 census made by the Brazilian Institute of Geography and Statistics).

The sampling was made by conglomerates, in two stages. First, we selected a random sample of 30 census tracts (primary sampling unit). Then we proceeded to the enrollment of blocks and households in each sector, in order to guide the selection of individuals with probability proportional to size of the census tract. Households (secondary sampling unit) were then selected based on a systematic sampling with an interval proportional to the number of households in the census tract, and within those, all individuals who met the age range of interest were invited to participate in the study.

The inclusion criterion was restricted to age (birth year between 1991 and 1995 and between 1966 and 1975) and the exclusion criterion was residing outside the territorial area of the selected census tract.

The variable "caries experience", as measured by the DMFT index (mean number of permanent teeth affected – decayed, missing and filled – per individual), was used for sample size calculation. The minimum sample size estimated was of 571 individuals selected proportionally from 30 census tracts, with a significance level of 5%, power of test of 80% and a design effect of 1.5 to detect a difference of 10% for the high prevalence of caries experience (DMFT > median) among census tracts with high and low empowerment.

DATA COLLECTION

Individual data were obtained from oral examinations conducted in the households, and from individual interviews structured for measurement of individual social capital and neighborhood empowerment, in addition to covariates.

DENTAL CARIES EXPERIENCE

The outcome of interest was the experience of dental caries assessed by the DMFT index. Clinical examination was performed by three previously calibrated examiners (Kappa intra and inter-rater coefficients greater than 0.93 and 0.89, respectively, for the DMFT index). The final score was converted into a dichotomous variable using the median as the cutoff: low caries experience (DMFT ≤ 9) and high caries experience (DMFT > 9)[26].

MEASUREMENT OF INDIVIDUAL-LEVEL VARIABLES

The individual variables included individual social capital, sociodemographic and behavioral characteristics and use of dental services.

Social support (bonding) and social network (bridging) were used to assess the individual social capital. The social support scale used in this study consisted of 19 items representing five dimensions of functional support: material, affective, emotional, informational and positive interaction[31,32]. The social network was assessed with 5 questions regarding the individual's relationship with their family and friends and their participation in social groups[32].

The individual covariates collected included demographic and socioeconomic characteristics (age, gender, ethnicity, education, family income and health conditions), risk behaviors related to oral health (frequency of intake of sweets and tooth brushing) and use of dental services (having at least one dental appointment and time elapsed since the last one).

MEASUREMENT OF NEIGHBORHOOD-LEVEL VARIABLES

The neighborhood variable was the perception of empowerment in the area of residence by the participants, defining neighborhood empowerment as social interaction processes that enable people to improve their individual and collective skills and exercise better control over their lives[26,27]. The instrument used was previously developed and used in a Brazilian population with good psychometric properties[26,27]. Still, the questionnaire was pre-tested in a pilot study involving 20 individuals from the same population and not participating in the main study, in order to assess its reliability. An intraclass correlation coefficient (7 day interval) of 0.808 and Cronbach's α of 0.887 were obtained, showing a good temporal reliability and excellent internal consistency. The empowerment was measured with a scale of 5 items related to the possibility with which each individual, if deemed necessary, would sign a petition, make formal complaints, contact local authorities, participate in meetings and form groups to talk about problems plaguing their neighborhood in order to improve their area of residence[33]. Three response options were provided: "I disagree" (code = 0),

"I somewhat agree" (code = 1) and "I Agree" (code = 2), allowing, by adding the items, a score that ranges from 0 (lowest empowerment) to 10 (highest empowerment) for each individual. Subsequently, the final score of each participant was added in the census tract (area) level, since the chosen items reflect the idea that empowerment is an ecological feature[19], characterizing a representative dimension of the census tract in this study[26,27]. The thirty sectors were then categorized into low, intermediate and high neighborhood empowerment, according to the tertiles of the sectors' score distribution[22,26].

STATISTICAL ANALYSIS

A multilevel logistic model was used to estimate the association between contextual social capital, measured in this research by neighborhood empowerment (area level variable), individual social capital (social support and network) and caries, controlled for possible confounding factors.

A bivariate analysis was performed, testing the crude association between covariates and caries experience. At this stage, the estimated odds ratios (OR) and confidence intervals of 95% (95%CI) were used. The variables with a p value lower than 0.10 (Wald Statistical Test) were selected to enter the multilevel modeling. The collinearity between variables was detected for: age and education; education and family income; frequency of intake of sweets and frequency of tooth brushing; frequency of intake of sweets and of dental appointments; having at least one dental appointment and time elapsed since the last one. The selection criterion to include the variable in the multivariate analysis was the degree of statistical significance in the bivariate obtained. Thus, the covariates considered in the multivariate analysis were age, gender and frequency of intake of sweets.

As the caries experience was dichotomized, a multilevel logistic model, based on the logarithm of odds ("logit"), was used. Multilevel models allow the estimation of the contextual effect of a variable measured at the area level, considering the spatial distribution of individuals within the areas. The structure of a model with two levels of random intercepts and two fixed angles was adopted to group the individuals in the census tracts and estimate the cumulative distribution probability of the groups under comparison. Estimates of fixed and random parameters of the two ordered logarithm models were calculated by predictive/penalized quasi-likelihood (PQL) procedures, with a second-order Taylor expansion.

The strategy adopted in the modeling consisted of first estimating the gross association between neighborhood empowerment and caries experience, and then gradually adjusting for factors that could explain this association. The unadjusted association of neighborhood empowerment (Model 1) was sequentially adjusted for

individual social capital in Model 2, for demographic variables (age and gender) in Model 3 and for frequency of intake of sweets in Model 4. Significance adopted for the multilevel analysis was 5%.

Statistical analyzes were performed in the following software: SPSS 17.0 (Statistical Package for Social Sciences for Windows®, SPSS Inc., Chicago, IL, USA) and MLwiN 2.24 (Centre for Multilevel Modeling, Bristol, UK).

The study was approved by the Ethics Committee on Human Research of the Health Department of the State of Paraíba, Protocol no. 0001.0.349.000-09.

RESULTS

Initially, 685 individuals were invited to participate and 583 (response rate of 85.1%) agreed by signing the free and informed consent form. Participants without information for the outcome of interest or to any of the selected variables for multilevel modeling were excluded (n = 10), resulting in a final analysis sample of 573 individuals. The mean DMFT was 10.5 (± 7.6), ranging from 0 to 32, with a median of 9.0, with only 4.5% of individuals free of caries (DMFT = 0).

Table 1 shows the distribution of individual characteristics of the sample and the unadjusted association between these variables (level 1 - individual) and the caries experience. Considering the significance level of 10%, an unadjusted association between age, gender, education (completed years of studies), family income and caries experience was observed. All variables of the blocks of behaviors related to oral health and use of dental services were associated with caries experience ($p < 0.10$).

The distribution of caries experience according to the social capital variables is arranged in Table 2. No crude association was observed between empowerment and caries experience. However, considering the purpose of this study, it was decided to introduce it in modeling. None of the dimensions of social support reached significance for only one item selected, and the social network (frequency of sports or artistic activities in the last year) was associated with caries experience.

The results of the analysis of the multilevel logistic regression between empowerment and caries experience can be seen in Table 3. Although empowerment was not associated with caries experience in the unadjusted model (Model 1), it was maintained throughout the modeling due to the purpose of the study. In the second model (Model 2), the individual social capital (social network) was added, noting its association with the outcome. Then, the model was gradually adjusted to individual variables considered as potential confounders, such as demographic variables (Model 3) and behaviors related to oral health (Model 4).

According to the final model, individuals living in census tracts with intermediate empowerment had a 43% lower chance of having high caries experience than those

from census tracts with low empowerment (OR = 0.57; 95%CI 0.33 – 0.99). Additionally, no relationship between individual social capital and caries experience was observed (OR = 1.42; 95%CI 0,87 – 2,31). Among the other individual factors, age (OR = 1.15;

Table 1. Sample distribution according to individual characteristics and Unadjusted Odds Ratios, with respective 95% confidence intervals, estimated from variables for Dental Caries Experience.

	Dental caries experience				p-value
	High n = 271 n (%)	Low n = 302 n (%)	OR	95%CI	
Sociodemographic characteristics					
Age[&]	31.3 ± 11.1	18.2 ± 6.1	1.14	1.12 – 1.17	< 0.001
Gender					
Male	75 (27.7)	136 (45.0)	1		
Female	196 (72.3)	166 (55.0)	2.14	1.51 – 3.04	< 0.001
Ethnicity					
White	64 (23.6)	72 (23.8)	1		
Mulatto	188 (69.4)	210 (69.5)	1.01	0.68 – 1.49	0.971
Black	19 (7.0)	20 (6.6)	1.07	0.52 – 2.18	0.855
Years of education[&]	6.6 ± 3.4	7.9 ± 2.4	0.86	0.81 – 0.92	< 0.001
Family income*					
≤ R$250	15 (10.3)	23 (9.2)	1		
R$251 – 500	70 (28.9)	68 (27.2)	0.95	0.49 – 1.83	0.871
R$501 – 1.500	128 (52.9)	120 (48.0)	0.98	0.53 – 1.82	0.952
> R$1.500	19 (7.9)	39 (15.6)	0.45	0.20 – 0.99	0.046
Sanitary conditions of household**					
Piped water inside the house	240 (88.6)	277 (92.0)	1		
No piped water/outside of the house	31 (11.4)	24 (8.0)	1.49	0.85 – 2.61	0.162
Behaviors related to oral health					
Frequency of intake of sweets					
≤ 3 times a week	188 (69.4)	163 (54.0)	1		
≥ 4 times a week	83 (30.6)	139 (46.0)	0.52	0.37 – 0.73	< 0.001
Frequency of tooth brushing**					
≥ 3 times a day	162 (60.0)	197 (65.2)	1		
2 times a day	89 (33.0)	95 (31.5)	2.31	1.04 – 5.11	0.039
1 time a day	19 (7.0)	10 (3.3)	1.14	0.80 – 1.63	0.473
Use of dental services					
Had at least 1 dental appointment					
No	2 (0.7)	17 (5.6)	1		
Yes	269 (99.3)	285 (94.4)	8.02	1.84 – 35.05	0.006
Time since last appointment					
Never had an appointment	3 (1.1)	17 (5.6)	1		
Less than one year	161 (59.4)	168 (55.6)	5.43	1.56 – 18.88	0.008
One year or more	107 (39.5)	117 (38.7)	5.18	1.48 – 18.18	0.010

*n = 492; **n = 572; [&]mean±standard deviation.
Exchange rate of 1 real = 1.70 American dollars at the time of the study.

95%CI 1.12 – 1.18) and female gender (OR = 1.62; 95%CI 1.01 – 2.58) were associated with dental caries experience (Table 3).

DISCUSSION

In this study, the variation in caries experience among census tracts was explained by the levels of empowerment perceived by residents. Adolescents and adults living in areas with intermediate empowerment had lower caries experience than those who lived in

Table 2. Distribution of variables related to Social Capital: Contextual (neighborhood empowerment) and Individual (Bonding and Bridging). Crude Odds Ratios, with respective 95% confidence intervals, estimated by multilevel analysis for Dental Caries Experience.

	Dental caries experience				p-value
	High n = 271 n (%)	Low n = 302 n (%)	OR	95%CI	
Census tract empowerment					
Low	83 (30.6)	87 (28.8)	1		
Intermediate	77 (28.4)	109 (36.1)	0.74	0.48 – 1.13	0.157
High	111 (41.0)	106 (35.1)	1.10	0.73 – 1.65	0.644
Social support*[&]					
Affective support	92.7 ± 13.5	92.4 ± 13.6	1.02	0.91 – 1.15	0.786
Emotional support	85.0 ± 19.2	82.6 ± 20.1	1.06	0.98 – 1.15	0.148
Informational support	86.7 ± 18.1	86.3 ± 17.4	1.01	0.92 – 1.11	0.805
Positive interaction	87.6 ± 17.4	87.7 ± 16.3	1.00	0.91 – 1.10	0.939
Material support	88.4 ± 16.3	88.7 ± 14.8	0.99	0.90 – 1.09	0.811
Social network					
Sports and artistic activities in the last year					
≥ 1	106 (39.1)	175 (57.9)	1		
0	165 (60.9)	127 (42.1)	2.14	1.54 – 3.00	<0.001
Meetings/gatherings in the last year					
≥ 1	40 (14.8)	32 (10.6)	1		
0	231 (85.2)	270 (89.4)	0.68	0.42 – 1.12	0.135
Volunteer work in the last year**					
≥ 1	52 (19.2)	66 (22.0)	1		
0	219 (80.8)	234 (78.0)	1.19	0.79 – 1.78	0.408
Relatives***					
≥ 1	245 (90.7)	275 (91.1)	1		
0	25 (9.3)	27 (8.9)	1.04	0.59 – 1.84	0.895
Friends**					
≥ 1	184 (68.1)	214 (71.1)	1		
0	86 (31.9)	87 (28.9)	1.15	0.80 – 1.64	0.444

*Social support: OR estimates evaluated at each 10-point increase in the scale; **n = 571; ***n = 572; [&]mean±SD. Exchange rate of 1 real = 1.70 American dollars at the time of the study.

neighborhoods with low levels of empowerment. However, the individual social capital was not associated with caries. It was also observed that the caries experience was related to age and female gender. These findings suggest that the perception of the characteristics of the individual's context of residence is important for caries experience.

These results are consistent with previous studies that consider the social capital as a possible contextual factor influencing caries[26,29,34]. The relationship between social capital and oral health can be explained by three mechanisms. First, social capital generates benefits to health by influencing behaviors from the dissemination of information on health and from a greater likelihood of the population adopting these positive behaviors[27]. According to Turrel et al.[35], neighborhoods with high social capital are possibly characterized by shared norms and a general consensus on what would be "appropriate" practices, not only to the benefit of the individual, but to the benefit of the neighborhood as a whole. This "moral" dimension of social capital could influence people's behavior, since it would approve some actions such as regular check up dental appointments, and disapprove others, such as smoking in public places, thus producing a positive impact on health.

A second explanation is that neighborhoods with high social capital can promote and protect the psychosocial health, as they are supposed to be communities in which greater trust, reciprocity and mutual concern among people can be observed. Therefore, to live

Table 3. Multilevel Logistic Regression Models for the association between Empowerment and Dental Caries Experience, controlled for confounders.

Independent variables	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Individual level variables				
Age			**1.15 (1.12 – 1.18)**	**1.15 (1.12 – 1.18)**
Gender				
Male			1	1
Female			**1.63(1.02 – 2.61)**	**1.62 (1.01 – 2.58)**
Frequency of intake of sweets				
≤ 3 times a week				1
≥ 4 times a week				0.93 (0.60 – 1.46)
Individual social capital				
Social network/Sports and artistic activities				
≥ 1		1	1	1
No		**2.27 (1.59 – 3.12)**	1.45 (0.89 – 2.36)	1.42 (0.87 – 2.31)
Area level variables Empowerment				
Low	1	1	1	1
Intermediate	0.73 (0.48 – 1.13)	0.68 (0.44 – 1.05)	0.60 (0.34 – 1.04)	**0.57 (0.33 – 0.99)**
High	1.10 (0.73-1.65)	1.05 (0.69-1.59)	1.05 (0.63-1.76)	1.02 (0.60-1.71)

[a]Model 1 unadjusted; [b]Model 2, Model 1 adjusted for individual social capital (Social network); [c]Model 3, Model 2 adjusted for sociodemographic confounders (age and gender); [d]Model 4, Model 3 adjusted for frequency of intake of sweets. Exchange rate of 1 real = 1.70 American dollars at the time of the study.

within this context could imply lower levels of fear, anxiety and stress, as well as an increased self-esteem of individuals, with some of these as mediators of behaviors related to oral health[27,35]. As a third mechanism, there is the fact that high levels of social capital in the neighborhood are usually accompanied by a greater number of social networks between people, forming groups and organizations that rely on the participation of its residents not only in civic activities, but also in political processes related to various fields of social welfare, such as education, security, transportation and recreation[35]. Thus, social capital can influence health by creating a more participatory, humane, efficient, appropriate and better coordinated health care system[27]. There is evidence that communities with shared values and a strong sense of belonging can be better organized and are more successful in structuring processes for modifying the health care system to be consistent with local standards of behavior, shared values and community goals[36]. Pattussi et al.[27] add that, in such circumstances, the social capital would still assist communities or populations to make more efficient use of physical resources available locally.

In this study, empowerment was used to measure social capital at the collective level, since it is considered a dimension of social capital[26,27]. The items used for its measurement covered a range of attitudes that could be taken by individuals to improve their neighborhood. Such actions require that communities have goals, and see them as a collective thing, as opposed to individual interests. They relate to the desire to act for the common good, a condition which, in turn, implies mutual trust and solidarity among residents. Thus, cohesive communities have more organizational capacity to decide their common interests and to demand the provision of appropriate local services[37]. From this perspective, the results in this study can be explained by the influence of neighborhood social capital on increased access and better organization of health services.

The lack of association between individual behaviors related to oral health and caries experience in the adjusted analysis corroborates the mechanism that links the neighborhood social capital with the diffusion of health-promoting behaviors, i.e. a contextual effect. Unlike observed by Pattussi et al.[26], in a study conducted in the Federal District and restricted to adolescents, this study could not relate the experience of dental caries with the frequency of intake of sweets and with having dental appointments. These discrepancies may be due to methodological differences in the measurement of behavioral variables or variations on the age group investigated and on the study location.

There are few studies that evaluated the relationship between contextual and individual social capital and oral health in adolescents and adults through a multilevel approach. The findings of this study are consistent with previous studies on the independent effect of contextual social capital in the occurrence of dental caries. However, previous studies were conducted with children and adolescents[26,29,34]. The inclusion of the simultaneous analysis of the collective and individual social capital was planned to verify if the probable influence of this social determinant in the occurrence of dental caries would be attributed to its contextual effect or its compositional effect. It is known that the place where people live influences their health, but this influence can be explained by the effect of the context itself

or assigned to the individual characteristics of their residents[38,39]. Thus, this study sought to investigate what would be more important for caries experience: the empowerment of the neighborhood where the individual resides (contextual social capital) or their social links and connections in the neighborhood (individual social capital). The answer to that question is that the characteristics of the area play a more prominent role than the social network and social support. This type of evaluation is only possible through the use of multilevel analysis, still not very explored in studies on oral health inequities[35]. This approach allows the distinction of the contextual effect from the compositional, since it considers the influence of the variables measured at different levels[35,38,39].

The sectional design of this study is one of its limitations, since it is not possible to establish a causal relationship between the exposed and the outcome[26,34]. Furthermore, one must consider the possibility of reverse causality, since the concentration of individuals with more caries in areas with less social capital would occur as a result of their low socioeconomic status. While the inclusion of adolescents and adults is positive due to the lack of studies that consider these age groups, it is not possible to rule out the possibility of residual bias of age, since both caries and age were analyzed as dichotomous variables and are strongly related to each other. Another relevant aspect to be discussed is the non-investigation of the systemic exposure to fluoride as a possible confounder of the association between neighborhood empowerment and caries, as done in previous studies[26,29]. This occurred because there is no fluoridation of the water supply in municipalities selected to compose this study's sample.

In research on social capital and health, there is no consensus on the geographical unit used to define neighborhood. In the present study, the use of census tracts as neighborhoods was based on the convenience to the sampling process, as the census tract is considered by IBGE as the smallest territorial unit, and maps and information on these áreas are available. However, this definition may not match the perception that individuals have of the neighborhood, both geographically and in relation to the sense of belonging to that area[35]. The average of 19 respondents per census tract in this study can be considered short of ideal, because the recommended number of individuals allocated per unit of aggregation is between 25 and 35 in multilevel studies[40]. Yet, the association observed between neighborhood empowerment and caries suggests that the average number of individuals per tract in this study achieved sufficient power to test the hypothesis. The variation in the number of respondents per census tract may also explain the association of empowerment and caries only in the intermediate level of empowerment. Finally, despite the low response rate (14.9%), it was impossible to estimate its variation among the 30 census tracts. Pattussi et al.[26] reported that, despite areas with lower response rates showing less accurate and valid neighborhood empowerment measures, this aspect did not affect the outcome.

The findings of this study present implications for policy makers and leaders in the health field. In general, the major questions faced by these people concern the levels at which the actions and programs should be targeted. In other words, when faced with the question

"At what level is most appropriate to intervene in order to improve oral health? In individuals or places where they reside?", the answer should be: both. Health promotion measures should not be restricted only to individuals because they are ineffective in modifying their health-related behaviors. New perspectives in this regard emphasize that the adoption of healthy behaviors is linked to changes in the environment where people live and work, for they allow the creation of conditions in which healthy choices are the easiest to be taken[1,2]. This would be one of the viable ways to deal with the causes of the causes, called "upstream social conditions", which originate inequities in health in modern society[1]. Future prospective studies are necessary to confirm the hypotheses raised, as well as to better guide public dental health policies.

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