Introduction

The national epidemiological oral health surveys conducted in the last few decades have shown evidence of the decline and polarization of caries experienced in different countries in the world, as has also been verified in Brazil. The action of fluoridated water supply and dentifrices (McDonagh et al., 2000; Marinho et al., 2004), potentiated by the impact of public health policies have contributed to the present profile of this disease in Brazil (Brasil, 2011). Together to the effects of fluorides and public health policies, various authors have reported the effect of individual and contextual variables, to some degree, on the health-disease process relative to oral conditions, showing evidence of its multifactorial nature. Among these variables, income has been one of the most widely studied and reported as being associated with caries prevalence. The importance of the education of the parents’ of children and adolescents in determining the etiology of caries, has also been consolidated. In addition to these factors, self-perception of oral health status and forms of access to public oral health services have also been found to be associated with the prevalence of caries in diverse populations (Borges et al., 2008; Brasil, 2011). In the context in which the individual is inserted, the Family Financial Grant Program is emphasized. This is a Brazilian program for the distribution of income to families in a situation of poverty and extreme poverty, with the goal of overcoming the situation of vulnerability to which these families are exposed, with regard to their basic social rights in the areas of education health and social assistance. To elucidate the manner in which these variables are related to the prevalence of caries must be the trigger for more precise planning of actions in health, with a view to improving of the oral health condition of populations. Thus, the aim of this study was to identify individual and contextual variables associated with caries prevalence in 12,614 individuals allocated to the age group of 12, and group from 15 to 19 years, examined in the last epidemiological oral health survey in Brazil–SB Brasil 2010.

Methods

This article was prepared from the analysis of secondary data originated in the “Projeto SB Brasil 2010”, and obtained from the public and inter-institutional databases available at the following electronic address http://dab.saude.gov.br/cnsb/solicitacao_bd_sb2010.php, of the Department of Primary Care (DAB) of the Ministry of Health of Brazil. The project SB Brasil 2010, was approved by the Ethics Committee on Research with Human Beings, Protocol No.009/2010. The Term of Free and Informed Consent was obtained from all individuals who participated in the study. This project consisted of an epidemiological survey of the oral health conditions of the Brazilian population in diverse age groups, in order to obtain epidemiological data capable of subsidizing the elaboration of guidelines for a national oral health policy, in addition to actions to strengthen the management of oral health public services in the different spheres of government. Clinical data were obtained from dental exams performed in accordance with the methodology proposed by the World Health Organization, while data relative to the
socioeconomic condition, self-evaluation of oral health, and access to dental services were collected by means of questionnaires. A number from 01 to 250 participants per city were evaluated in 176 cities in Brazil, totaling a final study sample of 12614 individuals allocated to the group of 12 years old, and the age group from 15 to 19 years of age. The sampling technique used by SB Brasil 2010 was probabilistic by/through conglomerates. For this purpose, three stratifications were used: The first used Domains and Primary Sampling Units: capitals and municipalities of the interior, according to macro-region. The second consisted of subdivision of the participating municipalities: 27 capitals plus 30 municipalities in the interior in each region. The third was performed by lottery to guarantee representativeness in the municipalities, census sectors and domiciles. The individual independent variables (relative to age group, demographic data, oral health diseases, socioeconomic data, educational level, morbidity, use of dental services and self-perception and impact of oral condition on health), and the contextual variables (Family Financial Grant-‘Child Benefit’, National Health System Development Index (IDSUS), Human Development Index (HDI) and Interaction GNP/fluoridated water initially analyzed by descriptive statistics. Subsequently we proceeded with multilevel multiple logistic regression analysis. Adopting a level of significance α=0.05 (5%), performed in the statistical software package SAS System 9.2 for Windows®. The prevalence of caries in permanent teeth was considered dichotomized into zero, and higher than zero as response variable. Initially bivariate analyses between the studied variables and response variable were performed by means of the Chi-square or Exact Fisher tests. After this, a multilevel logistic regression model was estimated, considering the individual variables as Level 1 and the contextual variables as Level 2. For this purpose, the PROC GLIMMIX procedure was used; that is, “Generalized Linear Models-Mixed”, specifying the logit link function and binary response variable. Adjustment of the model was evaluated by -2 Res Log Likelihood. In all the statistical models of this analysis, the significances were controlled by the other predictors of the model.

Results

Descriptive analysis of the individual independent variables may be observed in Table 1.

The sample was composed of 12614 participants; of these 57.45% were composed of 12-year-old children, and 42.55% of adolescents in the age-range from 15 to 19 years. The major portion of those examined (81.50%) resided in the capitals of the different Brazilian states selected in the Project SB Brasil 2010. (18.55%) of the individuals researched had severe, or very severe malocclusion. The majority, (69.70%), of the participants needed some type of treatment. Approximately 71% of the individuals came from families with a monthly income of up to 1500 reais, among whom fewer than 42% of the parents and/or those responsible for the home were studying at, or had a university title. As regards the self-reported oral health status, 68.51% perceived they needed treatment, and 24.02% informed having felt toothache in the 6 months prior to the dental exams of the SB Brasil 2010 Project. With respect to the manner in which individuals had access to oral health services, 83.74% were found to have access to the dentist, and of these, 59.86% had visited the dentist in a period shorter than 1year, and 51.45% used the public dental service. Pain, tooth extraction and other types of curative treatment still persist as the main cause of making an appointment with the dentist, and this was reported by 63.89% of the individuals. The majority of those examined (63.86%) did not report any dental impact on the performance of their daily activities. With regard to the contextual variables, it was verified that 51.57% of the cities from which the participants came, were contemplated by the Family Financial Grant Program (Bolsa Familia-BF). The majority of these municipalities (63.56%) received scores higher than 5.76 for IDSUS. Nevertheless, these scores will still lower than score 7.00, the cut-off score for a satisfactory performance of SUS. A high HDI, over 0.80 was found in 47.62% of the municipalities in which the dental exams were performed. The interaction between GNP and fluoridated water was found in the majority of the municipalities of this study (Table 2). As follows, we present the different multilevel models estimated for this study (Table 3). In Model 1, it may be observed that the mean caries prevalence in the cities of the sample was 0.671, with standard error of 0.019. When the variables of the individual level were included (Model 2) higher prevalence was observed in individuals in the age-range from 15 to 19 years of age, with an income lower than R$1500 (p<0.001), who needed treatment (p<0.001), had higher CPI scores (p<0.001), with greater perception of treatment need (p<0.001), had toothache (p<0.001) and who had greater oral impact on daily performance (OIDP). The influence of individual and contextual variables on the variability of caries prevalence is presented in Model 3 (Table 4).

Table 1 Frequency and percentage per category of individual qualitative independent variables

| Variables                  | Frequency | Percentage (%) |
|----------------------------|-----------|----------------|
| General Information        |           |                |
| Age                        |           |                |
| 12years                    | 7247      | 57.45          |
| 15 to 19 years             | 5367      | 42.55          |
| Capital                    |           |                |
| Capital                    | 9672      | 78.5           |
| Interior                   | 2196      | 18.5           |
| North                      | 3047      | 31.42          |
| Demographic                |           |                |
| Region                     |           |                |
| Northeast                  | 2224      | 22.93          |
| Southeast                  | 1299      | 13.39          |
| South                      | 1066      | 10.99          |
| Midwest                    | 2063      | 21.27          |
| DAI Classification         |           |                |
| Without malocclusion/Malocclusion defined | 8202 | 81.45 |
| Severe malocclusion/Very severe malocclusion | 1907 | 18.55 |
| Oral Health Diseases       |           |                |
| Treatment Need             |           |                |
| Does not require           | 3835      | 30.4           |
| Does require               | 8779      | 69.7           |
| CPI - Community Periodontal Index | 6654 | 54.24 |
| Healthy                    | 5614      | 45.76          |

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Table 2 Frequency and percentage per category of contextual qualitative independent variables

| Variables                     | Frequency | Percentage (%) |
|-------------------------------|-----------|----------------|
| Family Financial Grant        | ≤55.81    | 51.57          |
|                               | >55.81    | 48.73          |
| IDSUS (scores)                | ≤5.76     | 36.44          |
|                               | >5.76     | 63.56          |
| HDI                           | ≤0.800    | 52.38          |
|                               | >0.800    | 47.62          |
| Interaction (GNP and fluoridated water) | ≤14921.92 without Fluoride | 15.46 |
|                               | ≥14921.92 with Fluoride | 39.16 |

Table 3 Multilevel multiple logistic regression analysis (Models 1 and 2) for individual variables in 12-year-old children and adolescents from 15 to 19 years of age, Brasil, 2010

|                        | Model 1         | Model 2         |
|------------------------|-----------------|-----------------|
|                        | (Only the intercept) | (Individual Variables) |
| Intercept              | 0.671 (0.019)   | -1.546 (0.062)  |
| p-value                | <0.001          | <0.001          |
| Individual             |                 |                 |
| Age (Ref.: 12 years)   | 1.383 (0.053)   | 3.98            |
| p-value                | <0.001          | <0.001          |
| Treatment Need (Ref.: No) | 1.962 (0.053)   | 7.11            |
| p-value                | <0.001          | <0.001          |

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Table 4 Multilevel multiple logistic regression analysis (Model 3) for individual and contextual variables in 12-year-old children and adolescents from 15 to 19 years of age, Brasil, 2010

| Model 1 (Only the intercept) | Model 2 (Individual Variables) |
|-------------------------------|---------------------------------|
| Intercept                     | Intercept                       |
| Age (Ref.: 12 years)          | CPI (Ref.: Healthy)              |
| Treatment Need (Ref.: No)     | IDSUS4 (Ref.: ≤5.76)            |
| CPI (Ref.: Healthy)           | GNPS low with fluoride (Ref: Low and with) |
| Income (Ref.: ≤1500)          | GNP high with fluoride (Ref: Low and without) |
| Perceived of Dental Treatment Need (Ref.: No) | OIDS (Ref.: zero) |
| Toothache (Ref.: Yes)         | OIDS (Ref.: zero)               |
| OIDS (Ref.: zero)             | -2 Res Log Likelihood           |

| Estimate (SE)  | Odds ratio | p-value |
|----------------|------------|---------|
| 0.262 (0.048)  | 1.3        | <0.001  |
| 0.555 (0.065)  | 1.74       | <0.001  |
| 0.171 (0.054)  | 1.18       | 0.015   |
| 16143.01       |            |         |
| 11284.7        |            |         |

1Ref.: Reference; 2CPI: Community Periodontal Index; 3OIDS: Oral Impact on Performance

The aim of the present study was to identify the individual and contextual variable that showed some impact on the prevalence of caries in the sample of the last national epidemiological oral health survey, the Project SB Brasil 2010. The multifactorial nature of the etiology of this disease, recognized for decades in the scientific literature, was corroborated by the results found. Among the individuals examined, it was observed that those who presented a Community Periodontal Index differing from zero also presented greater risk for presenting caries prevalence differing from zero. This result was corroborated by the study of Merchant, in which the direct relationship between periodontal disease, notably in its severe form, and caries was reported. However, only 0.7% of the sample between the ages of 15 to 19 years presented a deep periodontal pocket. Previous studies have related a better family income as protective factor, including the study of Borges et al., 2008, in which the secondary data of Project SB Brasil, in its 2002-2003 edition, were also verified in the present study. It should be emphasized that income is normally articulated with other variables that also have an impact on the health of individuals, such as, for example, educational level, number of individuals and consumer goods in a home (Gonçalves et al., 2002; Borges et al., 2008; Leão et al., 2012). Nevertheless, no other socioeconomic variable obtained significance to compose the statistical model.

The self-reported, subjective need for treatment in health has also been explored in epidemiological surveys, since it is simple to obtain, and it is possible to associate it with objective traditional health indicators (Reichert et al., 2012). The assumption of need for dental treatment shows the importance individuals attribute to oral health, and together with the objective indicators of oral health, guides the planning and execution of dental actions in the sphere of public oral health care. The presence of pain and the definition of the extent to which dental problems have impact on the daily life of individuals has been shown to be important in determining how individuals access the public dental services, because up to now, no interval between routine consultations, proved to be scientifically efficient, has yet been defined (Davenport et al., 2003). Nevertheless, periodic visits are important for maintenance of dentition (Cunha-Cruz et al., 2004). Thus, individuals who reported pain in any tooth during a dental exam, present more chance of having a DMF index differing from zero (OR=1.81). In the studied sample, individuals who perceived the need for treatment (OR=1.39) or who had an OIDS index differing from zero (OR=1.23) also presented greater chance of having a DMF index differing from zero. One of the strategies for reducing the inequalities in oral health, resulting from the unequal distribution of public health services and income, is public water supply fluoridation. This measure, in addition to the growing consumption of fluoridated dentifrices, has been recognized worldwide as contributing to the reduction of the burden of caries (McDonagh et al., 2000; Marinho et al., 2004). However, later studies conducted in the State of São Paulo, Brazil, found no statistically significant difference in the prevalence of caries between municipalities with and without water supply fluoridation for the 12-year-old Group and the age Group from 15 to 19 years. The protective factor of fluoridated water was found in this study.

**Discussion**

The aim of the present study was to identify the individual and contextual variable that showed some impact on the prevalence of
The study found that the protective effect of fluoridated water on the prevention of caries was more evident in municipalities whose GNP was higher, reinforcing the multifactorial nature itself of the etiology of caries disease. In spite of being discrete, the protective effect of a higher income (individual variable) and a higher IDSUS value (contextual variable), although still below the ideal, must be equally considered in the planning of actions in health with a view to improve the nosological condition relative to oral diseases, considering that the importance of these variables will be perceived in the short and long term in the health of the population.

**Conclusion**

From the results found, it was possible to delineate the behavior of individual and contextual variables in the etiology and prevalence of caries in Brazil in the year 2010, for the studied age range. Therefore, health managers and professionals directly involved in public health must pay special attention to the policies of strengthening SUS, with a view to its better qualification, and access to users, in addition to the maintenance and/or expansion (where necessary) of the policy of public water supply fluoridation. Health professionals must also pay special attention to identifying the health status and self-reported need for treatment, which are also risk factors for the development of caries in the Brazilian population.\(^\text{15-19}\)

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None.

**Conflict of interest**

The authors declare that there is no conflict of interest.

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