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ORIGINAL RESEARCH

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Self-reported dental pain in Mexican schoolchildren: a national ecological study

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Abstract

The objective of this study was to quantify the prevalence of and identify the factors associated with dental pain among elementary- and middle-school students in Mexico. An ecological study was carried out with data from the 2008 National School-based Student-Health Survey. Information on dental pain from schoolchildren (aged 5 to 16 years) was collected from public schools across the 32 states of Mexico. In the original study, a questionnaire was used to explore various factors that affect the oral and dental health status of schoolchildren. The outcome variable was the prevalence rate (for dental pain) reported at state level. Various contextual socioeconomic variables were included, in addition to dental caries. Analyses were performed using Stata software. 52.9% of interviewees were girls; 26.9% of male and female schoolchildren in Mexico experienced gum or dental pain during the period analyzed (95% Confidence Interval = 26.02, 27.77%); according to the Spearman correlation results, self-reported dental pain was unrelated ($p > 0.05$) to the socioeconomic and sociodemographic variables that make up the Gross Domestic Product (GDP) and the Human Development (HDI), as well as the marginalization and the Gini indices. However, the estimated percentages of self-reported dental pain and caries were positively correlated in the elementary- ($r = 0.8958$, $p < 0.0001$), middle-school ($r = 0.8958$, $p < 0.0001$) and total populations ($r = 0.8542$, $p < 0.0001$). Prevalence of self-reported dental pain was 28%, or about one in three, of the Mexican children and adolescents in the study sample. The state-level sociodemographic and socioeconomic risk indicators were not associated with the prevalence of dental pain. Self-reported caries was positively correlated with self-reported dental pain.

Keywords

Oral health; Dental pain; Caries; Children; Survey; Mexico

1. Introduction

Oral disorders and diseases take a heavy toll on the world's population; untreated caries in the primary and permanent dentition are among the most prevalent health conditions [1]. Moreover, oral disorders and diseases are not only a major source of pain and suffering: they affect quality of life [2]. Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage [3]. Treated primarily by dentists and emergency physicians, dental pain has been defined as oral/buccal pain, often originating from teeth or adjacent structures, or attributed to conditions such as periodontal disease, dental caries, occlusal dysfunction, trauma or abscess [4]. Because of its high prevalence and adverse consequences in the economic and social spheres, dental pain is considered an important challenge to public health [5–9]. The prevalence of dental pain throughout the lives of children and adolescents varies considerably among countries. Two recent systematic reviews involving both groups reported an overall combination of dental pain rates reaching 36.2% (95% CI = 33.0–39.4) [8] and 32.7% (95% CI = 29.6–35.9, range: 1.33% to 87.8%) [9]. The rate difference may reside in the methods employed to assess pain, or pertain to different age groups, participant characteristics, regions and public policies; specifically, studies differed in the prior time used to ask about dental pain (most often, 3, 6 or 12 months). Pain is one of the oral conditions most easily perceived by children and parents since it causes suffering, problems with mastication, trouble sleeping and school absenteeism. Additionally, it carries adverse social, psychological and economic consequences that may impair quality of life [10].

Socioeconomic position (SEP) is a multidimensional concept, commonly used in health research, encompasses a wide

range of social and economic components that influence the positions of individuals and groups within the structure of societies. Given its diverse historical and disciplinary origins [11], SEP can be derived from an array of perspectives including educational level, occupation, income, housing conditions, personal well-being and number of children [12]. Separate from individual indicators, social factors such as the socioeconomic characteristics of the area of residence are often taken into account when analyzing the impact of the social environment on health; said characteristics include the town/city, neighborhood and even smaller demarcations within census tracts. Other contextual influences for SEP include average income, maternal and infant mortality rates, unemployment and the percentage of the population living in poverty. SEP may be measured based on composite indicators integrating several of the above [13]. Although this SEP concept is commonly used in oral epidemiological research, the multiple ways for measuring it reflect the complexity of its attributes. SEP is one of the variables that has consistently been associated with diverse oral conditions [14–18] and dental pain [5–8]. Diverse studies have pointed out, *e.g.*, to the association between tooth loss and SEP variables in China, where low school attainment and living in a rural location were linked to tooth loss [14]. Data from Brazil identified an association between higher SEP and both better self-appraisal of oral Health and fewer missing teeth [15]. Just like in Chile, where severe poverty was associated with higher caries experience in primary and permanent dentitions [16], in Colombia individual and ecological SEP measures showed that low and very low SEP were associated with higher early tooth decay and untreated caries experiences [17]. However, the Colombian contrasts failed to show a link between those two dental conditions and the Gini Coefficient, Unmet Basic Needs Index, or Gross Domestic Product. In terms of dental pain, previous studies have shown that SEP variables tend to be associated to dental health disadvantage [18].

Unmet dental care needs and felt health needs are essential building blocks for health policy planning in terms of services and human resources. Individual and group experiences with pain of dental origin offer an important input for decision makers and health policy planners to adequately estimate the magnitude of dental problems; in this fashion, informed perspectives may be added to actions addressing prevention, diagnosis and treatment of pain-related oral conditions. Accurate descriptions of prevalence may also be used to adapt dental training curricula so that dental professionals are well trained and prepared to address painful conditions in patients. It is felt appropriate to offer a design caveat to contextualize our research objective: in epidemiology, ecological studies differ from other approaches in their units of observation, since they are directed at studying groups rather than individuals. They are commonly known as exploratory or hypothesis-generating studies, while experimental designs and some observational designs are known as etiological studies or hypothesis-testers. To compare disease rates and other group characteristics, the observation units are often different geographic areas or different time periods in the same area [19]. The present study purported to ameliorate such knowledge gap through appraising data pertinent to the entire country, and placing data in the context of variables potentially associated. It was hypothesized that SEP ecological variables and dental caries would be associated with dental pain in schoolchildren. The twofold objective of this study was to quantify the prevalence of dental pain among Mexican elementary- and middle-school students, and to determine its association with contextual socioeconomic factors and dental caries.

2. Materials and methods

2.1 Design and study population

An ecological study was conducted using data on self-reported dental pain from public schools in all 32 states of Mexico. Ecological studies assess the association between average exposure levels and disease frequency, usually from groups living in a single geopolitical region. Please note the term orofacial pain is purposefully not used despite its wider coverage of pain in the face and mouth; the survey targeted dental pain, not orofacial pain, to enhance the accuracy of self-reported information.

This is a secondary analysis of previously collected data; dental caries [20] and tobacco and alcohol consumption [21] data have been previously reported. The information used in the present study pertained to students from 5 to 16 years of age who participated in the National School-based Student Health Survey 2008 (ENSE for its acronym in Spanish). The present analysis included children and adolescents from public elementary and middle schools in Mexico. Their ages ranged from 5 to 12 years for elementary- and from 12 to 16 years for middle-school participants, with some variation owing to early school entry and retention of some students across school years [22].

2.2 Description of the source data

Data collection was performed by the ENSE in schools through a self-administered computer-based questionnaire filled by students (or their parents) paying due attention to privacy and ensure confidentiality. The parents/caregivers of children under 10 filled out the questionnaire concerning their children's health. Students aged 10 years and older completed the questionnaire themselves. The survey covered 73,560 schoolchildren from 644 public schools across the 32 states of Mexico and it is representative at the national level: a total population of 19,745,366 students enrolled in elementary and middle schools. Up to 43,316 elementary- and 30,244 middle-school students were interviewed, having previously obtained informed consent from parents or caregivers.

As in other studies [20, 21], socioeconomic variables were obtained from the National Population Council (CONAPO, for its acronym in Spanish) and from the National Council for the Evaluation of Social Development Policy (CONEVAL, for its acronym in Spanish). Additional socioeconomic indicators were used; one was the Gross Domestic Product (GDP) per state, that is, the ratio between the total value of all final goods and services generated by the economy of each state and the number of its inhabitants during the period analyzed. The GDP was outlined in market prices. The Human Development Index (HDI), a summary measure of human development, was

measured from zero to one, in which values closer to one mean greater human development. It measures the average progress of a country in three basic aspects of human development: a long and healthy life measured by life expectancy at birth; education, measured by the adult literacy rate and the combination of the primary, secondary and tertiary education school enrollment ratios; and having a minimum acceptable standard of living, measured by GDP per capita. Additionally, the Social Gap Index was also used. This is a weighted measure that summarizes four indicators of social deprivation (education, health, basic services and size of the household) in a single index. Finally, the Gini Index was included: a measure of income concentration. It is a number between 0 and 1, where 0 corresponds to perfect equality (everyone receives the same income) and 1 to perfect inequality (one person receives all the income and the rest none).

2.3 Study variables

Presence of dental pain was ascertained through a question: In the last 6 months, (have you) (has your child) had pain in their teeth or gums? The response categories "yes", "no" and "no response/does not know" were recorded in the ENSE. The prevalence rates were computed (for the dental pain variable) at state level; this was the dependent variable. Dental pain in the present manuscript encompasses only pain in teeth and gums and explicitly does not address orofacial pain (a larger concept, beyond mouth structures).

Independent variables included the following: the socioeconomic variables for level of marginalization were made up of the percentages of illiterate ≥15-year-olds, ≥15-year-olds with incomplete elementary education, inhabitants of private dwellings without running water, without sewage or sanitation, without electricity, dwellings with dirt floors, dwellings with household overcrowding (>2.5 persons per bedroom), those residing in locations with <5000 inhabitants, and those with incomes of up to two minimum wages. The Gross Domestic Product, Human Development Index, Social Gap Index, and Gini Index were also included.

Presence of dental caries [20] was ascertained through a question: Do you think (you have) (your child has) tooth decay/cavities/caries? Yes/No.

2.4 Statistical analysis

First, the data on dental pain, dental caries and socioeconomic status were entered into an Excel database using figures estimated for each Mexican state. A Spearman's correlation test was performed because the parametric assumptions were not achieved. The criterion for statistical significance was $p < 0.05$ (two-tailed testing). At the state level, no data were missing for any reason. The Stata statistical package version 14 was used for all analyses (Copyright StataCorp LP; College Station, TX 77845, USA).

3. Results

It was found that 52.9% of survey participants were girls. Overall, prevalence of dental pain by state ranged from 11.3% to 37.9% for elementary-school students and from 14.9% to 27.1% for middle-school students. At the national level, 26.9% (95% CI = 26.02–27.77%) of all schoolchildren had experienced gum or dental pain. Table 1 presents the analysis by state: Chiapas (15%) reported the lowest prevalence of dental pain, while Nayarit (33.5%) reported the highest. The largest percentages of those stating that they were unsure of having suffered dental pain resided in Guanajuato.

TABLE 1. Gum and dental pain in the last six months, self-reported by students: national estimates, by state.

State	Sample	Yes %	No %	Does not know %
Aguascalientes	1758	27.4	70.1	2.5
Baja California	2230	28.8	65.1	6.2
Baja California Sur	1794	26.0	65.9	8.1
Campeche	1448	27.2	68.7	4.1
Chiapas	1401	15.0	76.2	8.8
Chihuahua	1948	27.2	66.3	6.5
Mexico City	1244	25.4	73.0	1.7
Coahuila	1878	32.8	64.6	2.6
Colima	1599	19.1	74.2	6.6
Durango	1623	27.3	71.0	1.7
Guanajuato	2018	19.6	67.5	12.9
Guerrero	1856	26.1	70.2	3.7
Hidalgo	1827	27.0	69.4	3.6
Jalisco	2081	29.4	68.4	2.2
Mexico	1789	33.7	65.5	0.8
Michoacan	1566	33.4	64.5	2.2
Morelos	1624	28.9	69.8	1.3
Nayarit	1823	33.5	64.4	2.2
Nuevo Leon	1848	28.4	64.9	6.7
Oaxaca	2096	20.9	63.2	15.9
Puebla	1526	28.4	70.2	1.4
Queretaro	1608	21.1	76.4	2.5
Quintana Roo	2275	26.4	62.4	11.2
San Luis Potosi	1539	28.2	71.1	0.7
Sinaloa	1641	22.7	71.3	6.1
Sonora	1561	18.6	73.6	7.8
Tabasco	1035	30.1	66.6	3.3
Tamaulipas	1980	23.9	73.3	2.7
Tlaxcala	1715	34.6	61.6	3.8
Veracruz	1392	22.8	76.7	0.5
Yucatan	1896	23.2	70.7	6.1
Zacatecas	1738	32.9	64.6	2.4

The study determined that 28.7% (95% CI = 27.6–29.8%) of elementary-school students had experienced dental pain. The state reporting the lowest levels of dental pain was Chiapas (11.3%), while Tlaxcala (36.4%), had the highest level. The largest percentages of students declaring that they were unsure of having experienced dental pain lived in Chiapas (Table 2).

TABLE 2. Presence of gum or dental pain in the last six months, self-reported by elementary-school children: percentages by state.

State	Sample	Yes %	No %	Does not know %
Aguascalientes	1183	29.4	68.2	2.5
Baja California	1347	30.2	63.7	6.1
Baja California Sur	1035	26.2	65.6	8.2
Campeche	879	28.6	67.0	4.4
Chiapas	689	11.3	77.4	11.4
Chihuahua	1172	29.0	63.8	7.2
Mexico City	999	26.0	72.5	1.5
Coahuila	1193	35.5	62.0	2.5
Colima	939	19.9	71.5	8.6
Durango	969	30.2	69.0	0.7
Guanajuato	1153	21.0	64.7	14.3
Guerrero	967	27.7	68.6	3.7
Hidalgo	1110	27.0	68.7	4.3
Jalisco	1464	30.8	67.0	2.3
Mexico	1257	35.8	63.3	0.9
Michoacan	1071	37.7	60.7	1.6
Morelos	978	31.3	67.4	1.3
Nayarit	1279	37.9	60.0	2.1
Nuevo Leon	1046	30.8	60.4	8.8
Oaxaca	1081	21.2	58.3	20.6
Puebla	678	33.6	64.4	2.0
Queretaro	1062	22.1	75.1	2.8
Quintana Roo	1208	28.6	62.2	9.2
San Luis Potosi	901	29.3	70.1	0.6
Sinaloa	992	22.0	71.8	6.2
Sonora	939	18.0	73.3	8.6
Tabasco	757	31.1	65.4	3.5
Tamaulipas	1120	26.7	71.3	1.9
Tlaxcala	1142	36.4	59.2	4.4
Veracruz	959	26.3	73.3	0.4
Yucatan	1210	24.0	69.6	6.4
Zacatecas	986	34.5	62.6	2.8

Table 3 shows that 21.7% (95% CI = 20.87–22.55%) of middle-school students had had dental pain: Veracruz (14.9%), exhibited the lowest proportion, while Tabasco (26.7%), had the highest. Baja California Sur recorded the largest proportion of students reporting that they were unsure of having experienced dental pain.

TABLE 3. Presence of gum or dental pain in the last six months, self-reported by middle-school children: percentages by state.

State	Sample	Yes %	No %	Does not know %
Aguascalientes	575	23.4	74.0	2.6
Baja California	883	23.3	70.3	6.4
Baja California Sur	759	25.2	67.1	7.7
Campeche	569	23.2	73.4	3.4
Chiapas	712	23.1	73.8	3.2
Chihuahua	776	21.9	73.3	4.7
Mexico City	245	21.5	75.7	2.8
Coahuila	685	21.6	75.6	2.8
Colima	660	16.9	81.7	1.4
Durango	654	19.9	75.8	4.3
Guanajuato	865	15.9	75.2	8.9
Guerrero	889	22.3	74.1	3.7
Hidalgo	717	27.1	71.9	1.0
Jalisco	617	25.8	72.3	2.0
Mexico	532	24.8	74.9	0.3
Michoacan	495	21.8	74.6	3.6
Morelos	646	22.9	75.9	1.2
Nayarit	544	22.7	74.9	2.4
Nuevo Leon	802	22.5	76.3	1.2
Oaxaca	1015	20.1	76.4	3.5
Puebla	848	19.0	80.6	0.4
Queretaro	546	18.1	80.7	1.2
Quintana Roo	1067	21.8	62.7	1.5
San Luis Potosi	638	24.5	74.3	1.2
Sinaloa	649	24.3	70.0	5.7
Sonora	622	20.1	74.4	5.5
Tabasco	278	26.7	70.7	2.6
Tamaulipas	860	18.2	77.4	4.4
Tlaxcala	573	26.8	72.3	0.9
Veracruz	433	14.9	84.3	0.8
Yucatan	686	21.0	74.0	5.0
Zacatecas	752	24.4	75.4	0.3

The results of the Spearman correlation analysis showed no association ($p > 0.05$) between self-reported dental pain and the socioeconomic and sociodemographic variables. However, when the relationship between self-reported dental pain and self-reported caries was analyzed by state, the latter were positively correlated with dental pain in elementary- ($r = 0.8958$, $p < 0.0001$) and middle- ($r = 0.5338$, $p = 0.0017$) school students, as well as in the total population of children analyzed ($r = 0.8542$, $p < 0.0001$) (Table 4).

TABLE 4. Correlation of dental pain with caries and the socioeconomic variables that make up the Marginalization Index, the Gini index and the percentages of poverty and extreme poverty.

	Dental pain in elementary-school students	Dental pain in middle-school students	Total
V1			
Spearman *r*	0.8958	0.5338	0.8542
p value	<0.0001	0.0017	<0.0001
V2			
Spearman *r*	−0.1309	−0.0821	−0.1740
p value	0.4751	0.6550	0.3409
V3			
Spearman *r*	−0.1685	−0.1545	−0.2191
p value	0.3566	0.3984	0.2284
V4			
Spearman *r*	−0.0565	0.0044	−0.0713
p value	0.7589	0.9809	0.6981
V5			
Spearman *r*	0.2402	−0.1302	−0.2913
p value	0.1855	0.4777	0.1058
V6			
Spearman *r*	−0.0007	0.0937	−0.0385
p value	0.9968	0.6101	0.8343
V7			
Spearman *r*	−0.1678	0.0015	−0.1974
p value	0.3588	0.9936	0.2788
V8			
Spearman *r*	−0.1824	−0.0678	−0.2372
p value	0.3177	0.7122	0.1911
V9			
Spearman *r*	−0.0002	0.1413	−0.0180
p value	0.9992	0.4403	0.9223
V10			
Spearman *r*	−0.0136	−0.0163	−0.0467
p value	0.9413	0.9294	0.7995
V11			
Spearman *r*	−0.0728	−0.0112	−0.1179
p value	0.6922	0.9516	0.5205
V12			
Spearman *r*	0.1759	0.0992	0.1400
p value	0.3355	0.5891	0.4448
V13			
Spearman *r*	0.0728	0.0520	0.0396
p value	0.6921	0.7775	0.8296
V14			
Spearman *r*	0.0613	0.0312	0.0160
p value	0.7387	0.8655	0.9309

TABLE 4. Continued.

	Dental pain in elementary-school students	Dental pain in middle-school students	Total
V15			
Spearman *r*	0.0061	0.0300	−0.0288
p value	0.9738	0.8706	0.8757
V16			
Spearman *r*	−0.0622	−0.0024	−0.0766
p value	0.7354	0.9897	0.6768
V17			
Spearman *r*	−0.0926	−0.0277	−0.1285
p value	0.6143	0.8805	0.4833
V18			
Spearman *r*	−0.0622	−0.0488	−0.1052
p value	0.7354	0.7910	0.5665
V19			
Spearman *r*	−0.1094	0.0051	−0.0659
p value	0.5512	0.9777	0.7200
V20			
Spearman *r*	−0.0674	0.0339	−0.0216
p value	0.7139	0.8537	0.9068
V21			
Spearman *r*	−0.1401	−0.0473	−0.1045
p value	0.4445	0.7971	0.5693
V22			
Spearman *r*	−0.1399	−0.0511	−0.1049
p value	0.4451	0.7810	0.5679

V1 = percentage of caries; V2 = percentage of illiterate population aged ≥15 years; V3 = percentage of population aged ≥15 years with incomplete elementary education; V4 = percentage of occupants of inhabited private dwellings without sewage, sewage or sanitation; V5 = percentage of occupants of inhabited private dwellings without electricity; V6 = percentage of occupants of inhabited private dwellings without piped water; V7 = percentage of occupants of inhabited private dwellings with some level of overcrowding; V8 = percentage of occupants of inhabited private dwellings with dirt floor; V9 = percentage of population of localities with less than five thousand inhabitants; V10 = percentage of employed population with an income of up to two minimum wages; V11 = state Marginalization Index; V12 = poverty by income, 2008; V13 = poverty by income, 2010; V14 = extreme poverty by income, 2008; V15 = extreme poverty by income, 2010; V16 = Gini Index; V17 = Social Gap Index 2005; V18 = Social Gap Index 2010; V19 = Human Development Index 2008; V20 = Human Development Index 2010; V21 = Gross domestic product 2007; V22 = Gross domestic product 2010.

4. Discussion

This study aimed to quantify prevalence of self-reported dental pain among Mexican schoolchildren and to ascertain whether it was associated at the ecological level with socioeconomic variables and dental caries prevalence. Prevalence by state varied in different ways between elementary- and middle-school students. Overall, just over one in four schoolchildren (26.9%) experienced dental pain in the six months prior to the study. This rate of national-level prevalence is similar to what has been documented in other countries with comparable populations; such is the case of Brazil, where at the national level pain prevalence was 21.8% [7]. In contrast, higher prevalences of dental pain have been reported for children and adolescents in other countries including Saudi Arabia (+50%) [23], Nigeria (61.4%) [24], India (63.3%) [25], Chad (64.1%) [26] and South Africa (70%) [27]. Global estimates encompassing children and adolescents reported pain rates reaching 36.2% [8] or 32.7% [9]. A direct comparison across research studies must be cautious because methods used varied substantially. Regarding the time window, a recent systematic review [9] concluded that there was no consensus across studies on how to record dental pain. Single-item questions or questionnaires have been used to assess the history of dental discomfort. Additionally, the recall time intervals employed in the trials varied, including present time, one week, one month, three, six and twelve years ago, as well as a lifetime of dental discomfort.

Few research employed multiple intervals, which may lead to lack of clarity in prevalence estimates.

Dental pain represents a public health problem not only by virtue of its relatively high prevalence but also because of its negative impact on the quality of life [9, 28]. According to a review of studies pertaining to children and adolescents conducted two decades ago as well as a more recent systematic survey, the prevalence of dental pain in this population varies greatly [8, 9]. These wide ranges are probably affected by multiple factors: the characteristics of each country studied, the predominance of socioeconomic groups within these countries, the response of the health systems to the oral health needs of the population, the age groups included, the methodology utilized to collect data, the time interval used to estimate prevalence rates, and the way cases are defined. Therefore, direct comparisons between the present results and those of other studies may allow only partial conclusions. However, it is important to highlight that studying the prevalence of dental pain in schoolchildren can be a valuable indicator of the need for curative and preventive treatment. In addition, these studies help estimate the proportion of the population expected to use dental services in the future, thereby providing information essential for planning clinical services and human resources.

It is generally accepted that low SEP is strongly associated with adverse behavioral, general health and oral health outcomes among children worldwide, and, in fact, is partially responsible for these effects [29–33]. Although previous studies have established SEP as a potent determinant of health, the biological mechanisms underlying this relationship are not fully understood [34]. Epidemiological research has yielded similar results [35]; in a similar fashion, the present ecological analysis failed to support the hypothesis that the prevalence of dental pain in elementary- and middle-school children at the national level was associated with socioeconomic indicators. Several studies exploring contextual socioeconomic variables are consistent with the present findings; for example, Macedo *et al*. [36] reported that dental pain was unrelated to the Human Development Index (HDI), the Gini coefficient, the illiteracy rate, unemployment, those households earning between 25% and 50% of the Brazilian monthly minimum wage, primary care coverage, dental coverage and supervised tooth brushing. However, at the individual level, low income was clearly associated with dental pain. Conversely, another study found that contextual variables such as living in cities with lower HDI scores and a higher percentage of the population with incomplete elementary-level education were associated with dental pain [37]. It is also possible that there was no sufficient variation within the pool of school children when ENSE data were only collected from public schools. Subjectively speaking, the public school system caters to most of the Mexican population, which is often located towards the lower end of the SEP spectrum.

The prevalence of caries in Mexico has decreased in recent decades, but a substantial proportion of the population still needs treatment in both primary and permanent dentition, with this figure reaching almost 100% in some regions [2]. This suggests that both dental pain and caries may constitute common problems among Mexican schoolchildren, as untreated caries are associated with dental pain [2, 20, 35, 38]. The present study found a correlation of dental pain with dental caries, a finding similar to the results described in the literature [37–39]. The presence of severe caries is often associated with dentin exposure and, in the most severe cases, with pulpal inflammation. Because advanced stages of caries are more likely to involve pain, such feature can be seen as a consequence of limited access to dental care. This is common in Mexico. Strategies aimed at improving living conditions and promoting healthy behaviors have the potential to reduce the prevalence of dental problems leading to dental pain and impacting, *e.g.*, quality of life or school absenteeism. The present findings contribute to the building blocks for health policy planning in terms of services and human resources, as they offer decision makers and health policy planners an estimate the size of the problem, and therefore the size of the complexities implementing prevention, diagnosis and treatment actions.

This study had limitations that should be taken into account to achieve an appropriate interpretation of the results. First, ecological studies may be more susceptible to bias than those based on individual observations: the major limitation of an ecological study is that it implies drawing individual-level inferences from group-level data, which may lead to an ecological fallacy. Second, results may have been affected by the endogenous nature of the data because of the narrow age range included, as well as from having limited the study population to only children enrolled in the public education system (still, the vast majority of children in Mexico). Third, it is unfeasible to infer causality from the factors analyzed and results must be interpreted exclusively as statistical associations. Fourth, the presence of dental pain was narrowly defined as it was worded in the national survey; while orofacial pain could be encompassing all manifestations of pain in craniofacial area, the concept was not used in ENSE. Many terms may be loosely used in the literature, such as dental pain, oral pain, mouth pain, facial pain, and orofacial pain. Dental pain, as opposed to oral pain, is "*pain that originates from innervated tissues within the tooth or immediately adjacent to it*" [9]. "*Oral pain indicates that the pain is originating from structures within the mouth, whereas facial pain includes pain whose origin is below the canthomeatal line, above the neck, and anterior to the ears*" [9], which encompasses temporomandibular disorders (TMD). This is defined as a generic condition including musculoskeletal and neuromuscular structures of the masticatory apparatus, TMD and associated anatomic entities [9, 40]. Fifth, the 2008 ENSE data are the most recent national dataset—yet still, not as up to date as public health data should ideally be. Finally, even though self-report and actual presence of clinical conditions tend to be correlated and are commonly used worldwide, it is unfeasible to quantify whether self-reported caries presence was an under-estimate, or how large this could have been.

5. Conclusions

In conclusion, dental pain in Mexico is an important challenge to public health. Children who attended public schools had disproportionately high rates of caries and associated dental pain. Pediatric dentists have an important role to reduce their consequences and ensuing effects for the individual pa-

tient. Approximately 28% of Mexican children and adolescents suffered from dental pain. The present ecological study found no association between the prevalence of dental pain and sociodemographic and socioeconomic risk indicators at the state level. It was found, however, that the proportion of children and adolescents at the state level reporting having dental caries was positively correlated with self-reported dental pain. Although the results of the study did not show an association between socioeconomic contextual variables with dental pain, the high percentage of child who suffer from dental pain justifies increased efforts to prevent its causes.

ABBREVIATIONS

GDP, Gross Domestic Product; HDI, Human Development; CI, Confidence Interval; SEP, Socioeconomic Position; ENSE, National School-based Student Health Survey 2008; GDP, Gross Domestic Product; HDI, Human Development Index.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

VJDP, ENSV, NLRB, CEMS and GM—were involved in the design and development of the study as well as in data analysis and in the writing of the first draft of the manuscript. SELR, MIO, RRS, AJCR and MMR—were involved in the conceptualization of the study, as well as in the analysis and interpretation of the results. All the authors were involved in the critical review of the manuscript, made intellectual contributions and accepted the final version.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was based on secondary data drawn from a publicly available dataset. Prior informed consent/assent was obtained from tutors/participants during the original study. The protocol for this ecological study was approved by the IRB committee of the Center for Research and Advanced Studies in Dentistry, School of Dentistry, the Autonomous University of the State of Mexico (CEICIEAO-2021-006).

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest with respect to the submitted work. None of the authors have had institutional, private or corporate grant support for the work in the manuscript. Carlo Eduardo Medina-Solis is serving as one of the Editorial Board members of this journal. We declare that Carlo Eduardo Medina-Solis had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to FSS.

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