





Dental pain and associated factors in Mexican adolescents and young adults: a cross-sectional study

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Objective: To identify the factors associated with the prevalence of dental pain in Mexican adolescents and young adults. **Material and methods:** This is a cross-sectional study in which data from 638 Mexican subjects, 16–25 years of age, who were randomly selected from college applicants, were analysed. Questionnaires were administered to collect sociodemographic, economic and behavioural variables. Clinical examinations were carried out to determine the decayed, missing and filled teeth (DMFT) index. The outcome variable was dichotomised as 0 (no dental pain in the last 12 months) or 1 (dental pain in the last 12 months). Statistical analyses included binary logistic regression. **Results:** Average age was 18.76 ± 1.76 years, and 49.2% of participants were women. Prevalence of dental pain was 34.0%. In the final model, variables significantly ($P < 0.05$) associated with the experience of dental pain were the use of preventive dental services (OR = 0.34), being a former smoker (OR = 2.37), self-report of very poor/poor oral health (OR = 1.94) or fair oral health (OR = 1.94), self-reported dental disease (OR = 2.06) or gingival disease (OR = 2.84). **Conclusions:** The prevalence of dental pain was associated with self-reported oral health status, preventive dental visits and smoking; these results have implications for dental practice. We found that recent experience of dental pain was common in young adults, being reported by one out of three subjects.

Key words: Oral health, dental pain, adolescents, young adults, Mexico

INTRODUCTION

Oral diseases, such as untreated caries and severe periodontitis, present a significant global burden of disease. It is estimated that 3.9 billion people are affected by at least one of the above conditions¹. In Mexico, dental caries in the primary and permanent dentition is a public health problem^{2,3} among children and adolescents. A large proportion of the population presents considerable dental treatment needs⁴. Approximately 75% of young Mexican adults are afflicted by untreated caries⁵.

Untreated oral disease is often associated with pain. The International Association for the Study of Pain⁶ defines pain as a sensorial and emotionally unpleasant experience that promotes behavioural changes in a person, often impeding normal daily activities. Dental pain has been defined as orofacial pain originating in

dental or adjacent structures. This may be a consequence of multiple diseases, such as dental caries, periodontal disease, trauma, occlusal dysfunction and abscess^{7–9}. Dental pain may lead to sleep loss and a poor work or academic performance. It may be associated with truancy or job absenteeism, weight loss and avoidance of certain foods^{10–13}.

Dental pain among children, adolescents and adults has been recognised as an important public health problem^{7,8}. Few epidemiological oral health studies include questions about dental pain, despite its effect on daily activities and quality of life^{10,12}. Because of the biological and psychosocial components of dental pain, its perceptions are moderated by sociodemographic and socio-economic status, individual characteristics (such as knowledge, beliefs and expectations), as well as oral health status¹⁴. Studies have revealed a varying prevalence of dental pain in different

countries and in across age groups: in Mexico, prevalence of dental pain was 50% in children between 6 and 12 years of age¹³; in Uganda, prevalence of dental pain was 66% in 12- to 14 year-old children¹⁴; in India, prevalence of dental pain was 71% in 12-year-old children¹⁵; in Brazil, prevalence of dental pain was 17.5% among 20- to 59-year-old adults¹⁶ and in another study, also from Brazil, prevalence of dental pain was 18.7% in subjects 11–19 years of age¹⁷.

Slade¹⁸ conducted a review and found that most studies asked parents if their children had ever experienced a toothache; the proportion of ‘yes’ responses ranged from 5% to 33%. Prevalence of dental pain throughout life was higher among older children and in children with low socio-economic status, and the authors found an association between presence of caries and dental pain prevalence. Another review, by Pau *et al.*⁷ in adults (≥ 19 years of age), also identified a wide range of prevalence of pain in the mouth, teeth and gums, ranging from 7% to 66%. Younger subjects and those with lower socio-economic status are more likely to report pain. The body of literature is rather sparse for various countries^{7,19}, and most studies have targeted preschoolers, schoolchildren and adults²⁰, omitting adolescents and young adults. With the exception of Brazil^{10,17,19–24}, there is a paucity of such data in Latin America and Mexico¹³.

The present study aimed to identify factors associated with the prevalence of dental pain among Mexican adolescents and young adults.

MATERIAL AND METHODS

Design, population and study sample

A cross-sectional study was undertaken in adolescents and young adults, 16–25 years of age. The subjects were randomly selected from all college applicants to the Autonomous University of San Luis Potosí (UASLP), the public university of the state of San Luis Potosí (a northern state of Mexico). UASLP is the institution in which the largest number of students in this state are enrolled.

The present report is part of a project in which multiple oral health indicators were measured. The methodology to collect data on dental caries, treatment needs and use of dental health services has been reported previously^{25–27}. The sample size of 653 was calculated taking into consideration the following criteria: proportion to estimate of 75%, confidence of 95%, precision of 3.5% and a non-response rate of 10%. The final sample comprised 638 subjects. The inclusion criteria were: either female or male; 16–25 years of age; and a college applicant to the UASLP. The exclusion criteria were: failure to attend

the appointment for the clinical oral examination and/or having a fixed orthodontic appliance. Selection of participants for the study was performed using random numbers. Subjects were not compensated for their time but they received a summary of the oral examination findings.

Data collection and variables conformation

Data were collected through a self-administered questionnaire completed by applicants. The survey was structured into several sections that allowed collection of sociodemographic and economic information, smoking status, oral health practices, satisfaction with oral appearance and use of oral health services. The decayed, missing and filled teeth (DMFT) index was used to measure the prevalence of dental caries. Clinical examinations were carried out in a dental chair under artificial light using a dental mirror and a World Health Organization (WHO)-type probe, by two trained and standardised ($\kappa > 0.80$) dentists.

The dependent variable was self-reported oral pain, assessed through the question: In the last 12 months, have you had any pain or discomfort in your mouth, teeth or gums? It was created with the following answer, dichotomised as 0 = no pain in the previous 12 months or 1 = any report of pain in the last 12 months.

Independent variables were sex, age, number of individuals who share the same household expenses, individuals who study and have a remunerated job at the same time, financial dependence on parents, level of mother’s and father’s education, parents’ socio-economic status (in tertiles), having a vehicle in the household, having health-care insurance, use of dental hygiene aids (number of items used: toothbrush, toothpaste, floss and mouthwash), preventive dental health services utilisation (DHSU) in the 12 months prior to the study, number of decayed teeth, smoking, self-perception of oral health status, dental disease self-report, gum disease self-report and oral health knowledge.

Principal components analysis (polychoric correlation) was used to estimate socioeconomic status and oral health knowledge indicators. The polychoric correlation allows incorporation of interrelated categorical variables into a single indicator variable²⁸. The first group encompassed variables indicating socioeconomic position, referring to household appliances (e.g., refrigerator, stove, television, telephone, computer, internet, etc.). Regarding knowledge about oral health, we used a set of questions that we validated (Cronbach’s $\alpha > 0.70$) in previous research and have used in various earlier publications^{3,13,25–27}. Tertiles were calculated for each generated variable, in which the first tertile corresponded to the group with

the worst condition and the third tertile to the group with the best condition.

Statistical analysis

Univariate analyses were performed; results are presented as central tendency and dispersion measures for continuous variables and as frequencies and percentages for categorical variables.

We used binary logistic regression models in the bivariate and multivariate analyses. The strength of association between the dependent variable and independent variables is presented as odds ratio (OR) with 95% CI. The variance inflation factor (VIF) test was performed to analyse and minimise multicollinearity between independent variables. Variables with a value of $P < 0.25$ in the bivariate analysis were included in the model construction. Global model adjustment was performed with the Hosmer–Lemeshow goodness-of-fit test²⁹. The statistical package used was STATA 11.0 (StataCorp., College Station, TX, USA).

Ethical considerations

The present study was conducted following the scientific principles of Helsinki and the Mexican law in general health and research. The protocol was approved by the Autonomous University of San Luis Potosí IRB (MC016). All participants signed a letter of informed consent, and data were treated as confidential.

RESULTS

Data from 638 subjects were analysed, with a response rate above 90%. *Table 1* shows the overall characteristics of the sample. Average age was 18.76 ± 1.76 years, and 49.2% of participants were women. Almost one-third (31.8%) of the sample had planned to be enrolled in college and to hold some level of employment at the same time, but most (90.1%) also indicated that they were financially dependent on their parents. The prevalence of dental pain in the 12 months prior to the study was 34.0% ($n = 217$, 95% CI = 30.3%–37.7%).

Table 2 shows the results of the bivariate logistic regression analysis. The variables that demonstrated statistical significance (i.e., had a value of $P < 0.05$) were: number of decayed teeth; sex; preventive DHSU in the previous 12 months; oral health self-perception; dental disease self-report; and gum disease self-report.

In the multivariate logistic regression (*Table 3*), subjects who had a dental visit for preventive reasons in the last year had a lower likelihood of having experienced dental pain (OR = 0.41; 95% CI: 0.25–0.67) than those who did not have a dental visit for preventive reasons. Those who reported being former

Table 1 Descriptive analysis of the variables included in the study

| Variable | Result |
|---|----------------------|
| Age (years) | 18.76 ± 1.76 (16–25) |
| Number of household members | 4.01 ± 1.78 (1–11) |
| Number of dental hygiene devices used | 2.89 ± 0.91 (1–4) |
| Number of decayed teeth | 1.69 ± 2.49 (0–14) |
| Number of missing teeth | 0.31 ± 0.92 (0–5) |
| Number of filled teeth | 2.24 ± 3.40 (0–16) |
| DMFT index | 4.24 ± 3.85 (0–17) |
| Sex | |
| Male | 324 (50.8) |
| Female | 314 (49.2) |
| Preventive DHSU in the previous 12 months | |
| No | 492 (77.1) |
| Yes | 146 (22.9) |
| Works in addition to studying | |
| No | 435 (68.2) |
| Yes | 203 (31.8) |
| Financial dependence on parents | |
| No | 63 (9.9) |
| Yes | 575 (90.1) |
| Mother's education | |
| High school and more | 273 (42.8) |
| Lower than high school | 365 (57.2) |
| Father's education | |
| High school and more | 360 (56.4) |
| Lower than high school | 278 (43.6) |
| Vehicle in the household | |
| Yes | 513 (80.4) |
| No | 125 (19.6) |
| Socio-economic status | |
| First tertile (Lowest) | 217 (34.0) |
| Second tertile | 219 (34.3) |
| Third tertile (Highest) | 202 (31.6) |
| Health insurance | |
| With insurance | 410 (64.3) |
| Without insurance | 228 (35.7) |
| Smoking | |
| Never | 469 (73.5) |
| Former smoker | 36 (5.6) |
| Current smoker | 133 (20.9) |
| Oral health self-perception | |
| Very poor/Poor | 84 (13.2) |
| Fair | 324 (50.8) |
| Good/Very good | 230 (36.0) |
| Dental disease self-report | |
| No/Do not know | 406 (63.6) |
| Yes | 232 (36.4) |
| Gum disease self-report | |
| No/Do not know | 548 (85.9) |
| Yes | 90 (14.1) |
| Oral health knowledge | |
| Poor | 248 (38.9) |
| Basic | 184 (28.8) |
| Broad | 206 (32.3) |

Values are given as mean ± SD (limit) and n (%).

DHSU, dental health services utilisation; DMFT index, decayed, missing and filled teeth index.

smokers were 2.37 (95% CI: 1.12–5.01) times more likely to have experienced dental pain than those who had never smoked. Those who perceived their health as very poor/poor (OR = 1.94; 95% CI: 1.05–3.57) or fair (OR = 1.94, 95% CI: 1.27–2.97) had higher odds of having had dental pain. The likelihood of experiencing dental pain was higher among those who

Table 2 Bivariate analysis of binary logistic regression for dental pain and independent variables

| Variable | Prevalence | OR (95% CI) | P value |
|---|------------|------------------|------------------|
| Age | 34.1 | 0.99 (0.90–1.09) | 0.863 |
| Members in the household | 34.1 | 1.01 (0.92–1.11) | 0.768 |
| Dental hygiene devices | 34.1 | 0.97 (0.81–1.17) | 0.791 |
| Number of decayed teeth | 34.1 | 1.09 (1.02–1.16) | 0.010 |
| Number of missing teeth | 34.1 | 1.02 (0.86–1.22) | 0.809 |
| Number of filled teeth | 34.1 | 1.01 (0.97–1.06) | 0.561 |
| DMFT index | 34.1 | 1.05 (1.01–1.09) | 0.026 |
| Sex | | | |
| Male | 30.2 | 1* | |
| Female | 37.9 | 1.41 (1.01–1.95) | 0.042 |
| Preventive DHSU in the previous 12 months | | | |
| No | 38.8 | 1* | |
| Yes | 17.8 | 0.34 (0.21–0.54) | <0.001 |
| Works in addition to studying | | | |
| No | 32.2 | 1* | |
| Yes | 37.9 | 1.29 (0.91–1.82) | 0.154 |
| Financial dependence on parents | | | |
| No | 36.5 | 1* | |
| Yes | 33.7 | 0.88 (0.51–1.52) | 0.660 |
| Mother's education | | | |
| High school and more | 33.7 | 1* | |
| Lower than high school | 34.2 | 1.02 (0.73–1.43) | 0.885 |
| Father's education | | | |
| High school and more | 30.8 | 1* | |
| Lower than high school | 38.1 | 1.38 (0.99–1.92) | 0.054 |
| Vehicle in the household | | | |
| Yes | 32.7 | 1* | |
| No | 39.2 | 1.32 (0.88–1.98) | 0.173 |
| Socio-economic status | | | |
| First tertile (lowest) | 35.5 | 1* | |
| Second tertile | 33.8 | 0.93 (0.62–1.38) | 0.710 |
| Third tertile (highest) | 32.7 | 0.88 (0.59–1.32) | 0.544 |
| Health insurance | | | |
| With insurance | 36.1 | 1* | |
| Without insurance | 30.3 | 0.79 (0.54–1.09) | 0.136 |
| Smoking | | | |
| Never | 31.6 | 1* | |
| Former smoker | 47.2 | 1.94 (0.98–3.84) | 0.057 |
| Current smoker | 39.1 | 1.39 (0.93–2.07) | 0.104 |
| Oral health self-perception | | | |
| Very poor/Poor | 47.6 | 3.64 (2.13–6.22) | <0.001 |
| Fair | 40.4 | 2.71 (1.83–4.02) | <0.001 |
| Good/Very good | 20.0 | 1* | |
| Dental disease self-report | | | |
| No/Do not know | 25.4 | 1* | |
| Yes | 49.1 | 2.84 (2.02–4.00) | <0.001 |
| Gum disease self-report | | | |
| No/Do not know | 29.7 | 1* | |
| Yes | 60.0 | 3.54 (2.24–5.61) | <0.001 |
| Oral health knowledge | | | |
| Poor | 37.9 | 1* | |
| Basic | 30.4 | 0.71 (0.47–1.07) | 0.107 |
| Broad | 32.5 | 0.78 (0.53–1.16) | 0.233 |

Significance ($P < 0.05$) is indicated in bold.

DMFT index, decayed, missing and filled teeth index.

*Reference category.

self-reported having dental disease (OR = 2.06; 95% CI: 1.41–3.02) or gum disease (OR = 2.84; 95% CI: 1.73–4.65).

DISCUSSION

The present study aimed to identify key factors associated with the prevalence of dental pain among Mexican adolescents and young adults entering college. It

was observed that slightly more than one in three (34.0%) subjects had experienced dental pain in the previous 12 months. Dental pain is a public health problem because of its relatively high prevalence and its negative impact on quality of life¹⁶. A review by Slade¹⁸ indicates that dental pain prevalence ranges from 5% to 33% in children and adolescents, and a review by Pau *et al.*⁷ reports a prevalence of dental pain of 7% to 66% among adults. These wide ranges

Table 3 Multivariate model of binary logistic regression for dental pain

| Variable | OR (95% CI) | P value |
|---|------------------|---------|
| Preventive DHSU in the previous 12 months | | |
| No | 1* | |
| Yes | 0.41 (0.25–0.67) | <0.001 |
| Smoking | | |
| Never | 1* | |
| Former smoker | 2.37 (1.12–5.01) | 0.023 |
| Current smoker | 1.25 (0.79–1.97) | 0.342 |
| Oral health self-perception | | |
| Very poor/Poor | 1.94 (1.05–3.57) | 0.034 |
| Fair | 1.94 (1.27–2.97) | 0.002 |
| Good/Very good | 1* | |
| Dental disease self-report | | |
| No/Do not know | 1* | |
| Yes | 2.06 (1.41–3.02) | <0.001 |
| Gum disease self-report | | |
| No/Do not know | 1* | |
| Yes | 2.84 (1.73–4.65) | <0.001 |

Estimates were adjusted according to age and sex.

Hosmer–Lemeshow $\chi^2(8) = 12.19$; $P = 0.1429$.

DHSU, dental health services utilisation.

*Reference category.

may be explained by multiple factors, including the study's geographical location, population groups within the country, age groups included in the study, the methodology employed in data collection, time interval to define prevalence and even case definition. Therefore, direct comparisons of our results with other studies may only allow tentative conclusions to be reached.

Although several studies have observed that caries experience or untreated dental caries experience were risk factors for dental pain^{10,14,19,23}, in the present study these factors were only associated at the bivariate analysis level. In the final model, self-perception of dental or gingival health status was more important. It is necessary to highlight that unlike other studies in which large percentages of untreated dental caries were observed, this population in Mexico had considerable experience of dental services (a care index of 52.8%). This, in turn, may explain why oral health perception variables were more important than clinical variables. Santiago *et al.*²³ also found that in subjects ≥ 15 years of age, perception of oral health status was associated with dental pain. Health perception is a subjective measure generally based on existing dental knowledge and personal experience, which correlates moderately with clinical indicators. This association is related to perceived health needs; for example, oral rehabilitation needs²⁴. Needs assessment based entirely on a normative point of view does not consider the functional, social and psychological consequences of diseases of the teeth and oral cavity; this situation further supports the importance of subjective or perceived health in this context^{30,31}.

Tobacco use has been related to oral diseases^{32–34}, such as in the association between smoking and dental caries. Root caries is associated with smoking through breakdown of periodontal attachment; root exposure may not only facilitate root caries but may also lead to dental pain^{19,20}. In the present study, being a former smoker increased the likelihood of experiencing dental pain compared with those who had never smoked, but such a relationship was not observed in current smokers. Bastos *et al.*¹⁹ found that people who smoked had 70% more dental pain than non-smokers. Freire *et al.*¹⁷ and Kuhnen *et al.*²⁰ also found an association between tobacco consumption (current and former) and the presence of dental pain.

The association between caries and dental pain is stronger in population groups with reduced access to dental care. On one hand, less frequent dental-care patterns have been associated with a low prevalence of dental pain in other countries^{14,20}. However, this trend can be expected to vary depending on the actual reasons for the dental visit. In the present study, just as in the research conducted by Constante *et al.*¹⁶, we observed that the reason for the last dental visit was related to dental pain experience; subjects who visited the dentist for preventive or for check-up reasons presented a lower prevalence of dental pain. People who regularly use health services, including dental health services for preventive reasons, may have particular characteristics. The use of dental services for preventive purposes reduces the risk of having oral diseases^{35,36} or at least allows the early detection of these diseases. It would then be reasonable to assume that dental pain would also be affected by the pattern of use of dental services and the motive driving the last dental visit¹⁶. Building on such assumptions, health policies and programmes aimed at reducing dental diseases could also reduce the financial and social impact caused by dental pain in terms of suffering, quality of life, dental care financing and services availability³⁷.

Several studies have reported differences in dental pain across different socio-economic groups: those with a lower socio-economic status show higher prevalence of dental pain^{10,16,17,21,22,38}. Likewise, it has been noted that sex and age variables are influencing factors of dental pain^{17,20,38}. In this study, socio-economic inequalities were not observed despite the inclusion of several socio-economic indicators. Similarly, no difference was found according to age and sex.

Findings from the present study shed new light on a hitherto sparsely studied age group within the Mexican population. Although our results add to the state of epidemiological knowledge for this location, there are some limitations in our research, primarily that cross-sectional studies cannot establish causal

relationships between dependent and independent variables because of temporal ambiguity. In addition, the present study collected the information by questionnaire, and the inherent recall bias might have affected these results.

CONCLUSIONS

One out of three subjects presented dental pain experience in this sample of Mexican adolescents and young adults. The prevalence of dental pain was associated with self-reported oral health status, preventive dental-health services utilisation and smoking. No socio-economic inequalities were observed despite multiple use of indicators examining socio-economic categories. We found no sex differences in self-reported dental pain.

Conflict of interest

The authors declare that they have no conflict of interest.

Authors' contributions

JOGC, JJNH, 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. JMC, RMR, RIZ and RRS were involved in the conception 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.

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REFERENCES

- Marcenes W, Kassebaum NJ, Bernabé E *et al.* Global burden of oral conditions in 1990–2010: a systematic analysis. *J Dent Res* 2013 92: 592–597.
- Lucas-Rincón SE, Robles-Bermeo NL, Lara-Carrillo E *et al.* Interproximal caries and premature tooth loss in primary dentition as risk factors for loss of space in the posterior sector: a cross-sectional study. *Medicine (Baltimore)*. 2019 98: e14875.
- Medina-Solís CE, Ávila-Burgos L, Márquez-Corona ML *et al.* Out-of-pocket expenditures on dental care for schoolchildren aged 6 to 12 years: a cross-sectional estimate in a less-developed country setting. *Int J Environ Res Public Health* 2019 16: 1997.
- Medina-Solís CE, Ávila-Burgos L, Borges-Yañez SA *et al.* Ecological study on needs and cost of treatment for dental caries in schoolchildren aged 6, 12 and 15 years: data from a national survey in Mexico. *Medicine (Baltimore)* 2020 99(7): e19092.
- García-Cortés JO, Medina-Solís CE, Loyola-Rodríguez JP *et al.* Dental caries' experience, prevalence and severity in Mexican adolescents and young adults. *Rev Salud Publica (Bogota)* 2009 11: 82–91.
- International Association for the Study of Pain [homepage on the Internet]. *Task Force on Taxonomy. Part III: Pain Terms, a Current List with Definitions and Notes on Usage*. Seattle: IASP Press; 1994.
- Pau AK, Croucher R, Marcenes W. Prevalence estimates and associated factors for dental pain: a review. *Oral Health Prev Dent* 2003 1: 209–220.
- Pau A, Viswanath KP, Croucher R. Validation of a dental pain screening questionnaire in a semi-urban hospital setting in South India. *Int Dent J* 2010 60: 113–121.
- Cohen LA, Bonito AJ, Akin DR *et al.* Toothache pain: behavioral impact and self-care strategies. *Spec Care Dentist* 2009 29: 85–95.
- Nomura LH, Bastos JL, Peres MA. Dental pain prevalence and association with dental caries and socioeconomic status in schoolchildren, Southern Brazil, 2002. *Braz Oral Res* 2004 18: 134–140.
- Krisdapong S, Prasertsom P, Rattanarangsima K *et al.* School absence due to toothache associated with sociodemographic factors, dental caries status, and oral health-related quality of life in 12- and 15-year-old Thai children. *J Public Health Dent* 2013 73: 321–328.
- Guskuma RC, Lages VA, Hafner MB *et al.* Factors associated with the prevalence and intensity of dental pain in children in the municipalities of the campinas region, são paulo. *Rev Paul Pediatr* 2017 35: 322–330.
- Escoffé-Ramirez M, Ávila-Burgos L, Baena-Santillan ES *et al.* Factors associated with dental pain in mexican schoolchildren aged 6 to 12 years. *Biomed Res Int* 2017 2017: 7431301.
- Kiwanuka SN, Åström AN. Self-reported dental pain and associated factors in Ugandan schoolchildren. *Norsk Epidemiol* 2005 15: 175–182.
- Dandi KK, Rao EV, Margabandhu S. Dental pain as a determinant of expressed need for dental care among 12-year-old school children in India. *Indian J Dent Res* 2011 22: 611.
- Constante HM, Peres MA, Schroeder FC *et al.* Mediators between education and dental pain: a cross-sectional study to assess the role of dental services utilization. *Eur J Oral Sci* 2016 124: 62–67.
- Freire Mdo C, Leles CR, Sardinha LM *et al.* Dental pain and associated factors in Brazilian adolescents: the National School-Based Health Survey (PeNSE), Brazil, 2009. *Cad Saude Publica* 2012 28(Suppl): s133–s145.
- Slade GD. Epidemiology of dental pain and dental caries among children and adolescents. *Community Dent Health* 2001 18: 219–227.
- Bastos JL, Nomura LH, Peres MA. Dental pain, socioeconomic status, and dental caries in young male adults from southern Brazil. *Cad Saude Publica* 2005 21: 1416–1423.
- Barrêto EP, Ferreira EF, Pordeus IA. Determinant factors of toothache in 8- and 9-year-old schoolchildren, Belo Horizonte, MG, Brazil. *Braz Oral Res* 2009 23: 124–130.
- Kuhnen M, Peres MA, Masiero AV *et al.* Toothache and associated factors in Brazilian adults: a cross-sectional population-based study. *BMC Oral Health* 2009 9: 7.
- Hafner MB, Zanatta J, Rasera Zotelli VL *et al.* Perception of toothache in adults from state capitals and interior cities within the Brazilian geographic regions. *BMC Oral Health* 2013 13: 35.
- Santiago BM, Valença AM, Vettore MV. Social capital and dental pain in Brazilian northeast: a multilevel cross-sectional study. *BMC Oral Health* 2013 13: 2.

24. Zucoloto ML, Maroco J, Campos JA. Psychosocial and behavioral aspects of pain and perception of oral health. *J Oral Facial Pain Headache* 2017 31: 210–216.
25. Medina-Solís CE, García-Cortés JO, Robles-Minaya JL *et al.* Clinical and non-clinical variables associated with preventive and curative dental service utilisation: a cross-sectional study among adolescents and young adults in Central Mexico. *BMJ Open* 2019 9: e027101.
26. García-Cortés JO, Mariel-Cárdenas J, Gutiérrez-Cantú F *et al.* Prevalence and factors associated with tooth loss in Mexican university students: a cross-sectional study. *Acta Bioclínica* 2019 9: 5–22.
27. García-Cortés JO, Loyola-Rodríguez JP, Loyola-Leyva A, *et al.* Socio-behavioral factors associated to caries prevalence and DMFT index in adolescents and young adults in a developing country. *West Indian Med J*; in press. <https://doi.org/10.7727/wimj.2016.515>.
28. Kolenikov S, Angeles G. The Use of Discrete Data in Principal Component Analysis With Applications to Socio-Economic Indices. CPC/MEASURE Working paper No. WP-04-85; 2004.
29. Bagley SC, White H, Golomb BA. Logistic regression in the medical literature: Standards for use and reporting, with particular attention to one medical domain. *J Clin Epidemiol* 2001 54: 979–985.
30. David J. *Dental Caries Among Adolescents Implications for Planning Oral Health Services in India and Norway [dissertation]*. Bergen: University of Bergen; 2006. p. 55.
31. Sheiham A, Maizels JE, Cushing AM. The concept of need in dental care. *Int Dent J* 1982 32: 265–270.
32. Sutton JD, Salas Martinez ML, Gerkovich MM. Environmental tobacco smoke and periodontitis in United States non-smokers, 2009 to 2012. *J Periodontol* 2017 88: 565–574.
33. Sharma S, Mishra SK, Mittal N. Influence of tobacco dependence on caries development in young male adults: a cross-sectional study. *J Conserv Dent* 2018 21: 597–601.
34. Nayani AA, Iqbal R, Azam SI *et al.* Association between environmental tobacco smoke and dental caries amongst 5–14 years old children in Karachi, Pakistan. *J Pak Med Assoc* 2018 68: 203–209.
35. Celeste RK, Nadanovsky P, De Leon AP. Association between preventive care provided in public dental services and caries prevalence. *Rev Saude Publica* 2007 41: 830–838.
36. Mullally BH, Linden GJ. The periodontal status of irregular dental attenders. *J Clin Periodontol* 1994 21: 544–548.
37. Hyde S, Dupuis V, Mariri BP *et al.* Prevention of tooth loss and dental pain for reducing the global burden of oral diseases. *Int Dent J* 2017 67(Suppl 2): 19–25.
38. Pau A, Croucher RE, Marcenes W. Demographic and socio-economic correlates of dental pain among adults in the United Kingdom, 1998. *Br Dent J* 2007 202(9): E21.

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