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Toothache prevalence and associated factors: a life course study from birth to age 12 yr

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This study estimated the lifetime prevalence of toothache at ages 6 and 12 yr, the prevalence of toothache during the last month, and their association with social, behavioural and clinical exposures in the course of life of 339 12-yr-old children from a birth cohort in Pelotas, Brazil. Exploratory variables were collected in the perinatal study and during several follow-up studies. Prevalence ratios were calculated using Poisson regression, following a hierarchical conceptual model. The lifetime prevalence of toothache at ages 6 and 12 yr were 39% [95% confidence interval (CI) = (34;45)] and 63% [95% CI = (58;69)], respectively. Toothache during the last month was reported by 11% [95% CI = (8;15)]. Children who did not live with their biological father at birth, and children with higher dmf-t counts, reported a higher lifetime prevalence of toothache at age 6 yr. Children experiencing poverty between ages 0 and 4 yr, with higher dmf-t and DMF-T indexes presented a greater lifetime prevalence of toothache at 12 yr. Toothache within the last month was more likely to be reported by girls and by children who did not live with their biological father at birth. Preventive strategies should be implemented in early stages of the life cycle, taking into account the socio-economic and family context in which pain mostly occurs.

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An emerging approach in public health dentistry highlights the limitations of normative criteria for the identification of dental treatment needs, and toothache has been suggested as a useful indicator of need (1). Dental pain has great potential to decrease quality of life and to interfere with the performance of daily activities (2).

To date, dental pain has received little attention in epidemiological investigations. Moreover, the literature currently available is of questionable methodological quality (3) and little data are available for younger individuals (4). In children and adolescents, toothache affects important dimensions of life, causing suffering, disturbing eating and sleep, impeding participation in recreational activities, and interfering with school attendance (5–7).

In a review of the literature on the relationship between pain and dental caries in individuals up to 18 yr of age, SLADE (7) found 17 published studies, all with a cross-sectional design. The studies reviewed were conducted in the USA, Canada, Australia, England, and Wales, with no studies identified as coming from developing regions.

In a search for articles in the databases PubMed, Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), Scientific Electronic Library (Scielo), and Bibliografia Brasileira de Odontologia (BBO) up to December 2007, containing the terms toothache, dental pain, oral pain, tooth pain, teeth pain, dental pulp pain, prevalence, and epidemiology, 11 additional cross-sectional studies were found of individuals between 0 and 18 yr of age (6, 8–17). Seven of these publications were from developing countries (8, 12–17), especially Brazil.

One of the most commonly studied age groups among children and adolescents was that of 5-yr-old children, in whom the prevalence of dental pain varied from 5 to 33%, according to SLADE (7). The experience of pain in younger children has frequently been recorded based on parental reporting. For children over 5 yr of age, MCGRATH & GILLESPIE (18) recommend that self-report should be used, as it is considered to be the gold standard in the assessment of paediatric pain. Self-report facilitates studies on dental pain in children and older adolescents because information is easily collected and is free of any input from parents and/or guardians.

A high frequency of toothache in children and adolescents has been associated with severe dental caries, poor socio-economic conditions, and infrequent toothbrushing (4, 7, 10, 19). As a means to advance our understanding of dental pain, the investigation of more complex causal hypotheses has to be considered, including the adoption of a life course approach.

This relatively new development in oral epidemiology (20) considers the individuals' biological status to be influenced by social and biological exposures at critical or sensitive moments of intra-uterine life and during the

very early stages of infancy (21). Equally, biological and social factors can be responsible for the accumulation of advantages or disadvantages over the course of life, with potentially important reflections on health (22).

The influence of factors occurring in early stages of life on oral health conditions in later stages of life, including dental caries (23), malocclusions (24), and periodontal conditions (25), have been demonstrated. The above-mentioned search of databases did not reveal any studies that had used the life course approach to investigate the occurrence of, and factors associated with, tooth pain.

From a life course perspective, it can be assumed that individuals experiencing events of poverty in early life may have less access to (and use of) a variety of oral hygiene items, and may be more likely to develop harmful oral health behaviours later in life. These might predispose individuals to higher caries risk, which, in turn, may increase the risk of toothache.

Furthermore, hypothetically, children born in single-parent families may be exposed to less than optimum childcare because the father or, more probably, the mother may experience an overload of activities during the child's early life. This could also result in poor oral health habits and in conditions such as dental pain. The same situation may occur in children born in larger families. Possible end points to these above-mentioned chains of events are toothache 'bursts' occurring at different time-points later in the life cycle.

Moreover, social and biological factors have been proposed to explain gender differences in pain perception and modulation (26), so the inclusion of gender as a covariate in life course analyses could help to identify whether these factors exert their effects at early ages, such as 6 or 12 yr. In this sense, if gender differences in dental pain are already present at early stages of life, this could give some indication as to whether biological or social factors are more likely to be at play.

Dental pain has also been associated with caries experience and toothbrushing (7, 10), such that the inclusion of these variables in life course analyses could also elucidate their potential contribution as risk factors for dental pain, after controlling for early life circumstances.

Thus, the life course approach seems to be useful in elucidating when and how risk factors occur, in order to identify the most appropriate time for preventive interventions. The objective of the present investigation was to estimate the prevalence of dental pain and its association with social, behavioural, and clinical exposures in the life course of 12-yr-old children belonging to a population-based birth cohort study from Pelotas, southern Brazil.

Material and methods

The present study was part of a population-based birth cohort study from Pelotas, which started in 1993. The main objective was to study the perinatal and infant health of the children being followed (27). Pelotas is located in the far south of Brazil and had 323,158 inhabitants in the year 2000, 93% of whom lived in the urban zone of the municipality (28).

All hospitals in Pelotas were visited daily from January 1 to December 31, 1993. All mothers who had given birth at these institutions were contacted and invited to take part in the study. Few home births are registered in Pelotas, so the children included in the cohort (n = 5,249) represented 99% of the total births. At the hospitals, the height and weight of the mothers were recorded and the mothers responded to a questionnaire eliciting information on socio-economic and demographic factors, as well as issues related to pregnancy, health behaviours, access to services, and morbidity. In turn, the children were examined, and had their weight and height recorded by a team of doctors and medical students (27).

The individuals in the cohort were followed during the 1st (n = 655), 3rd (n = 655), 6th (n = 1,460), and 12th (n = 1,460) months of life, with the objective of assessing breastfeeding patterns, growth, psychomotor development, and associated factors (27). In the first two follow-up studies, a systematic sample of 13% of the total cohort was visited. In the 6th and 12th months of life, all children with a low birth weight (< 2,500 g) and 20% of the remainder were visited.

In 1998, when the children had reached 4 yr of age, another follow-up study was undertaken with a sampling strategy similar to that adopted at 6 and 12 months. Between July 2004 and March 2005, a new follow-up study was begun with the objective of interviewing all 11–12-yr-old children. On this occasion, socio-economic information about the families was collected, as well as the nutritional status and lifestyle habits of the child, the standard of the diet, and the presence of morbidities, among other items. For a detailed description of the response rates obtained in the main follow-up visits to the Pelotas 1993 birth cohort members, the reader is referred to an article published by Victora *et al*. (27).

Over the course of these visits, two oral health studies (OHS) were carried out, which will be referred to in the following text as OHS 1998–1999 and OHS 2005. For the OHS 1998–1999, a random subsample of 400 children was obtained from the follow-up study of 1998. In this OHS, carried out when the children were 6 yr of age, information was collected relating to oral health-related habits, dental pain, oral health-related behaviours, and the use of dental services by means of a pretested questionnaire. Dental examinations were also performed in the children to obtain the decayed, missing or filled deciduous teeth (dmf-t) and decayed, missing or filled permanent teeth (DMF-T) counts according to World Health Organization criteria (29), the pattern of tooth eruption, and the presence of malocclusions, in agreement with the Foster & Hamilton criteria (30).

The response rate for the 1998–1999 OHS was 90% (n = 359) and the main reason for losses was families having moved away. The data collected and the calculated sample size enabled the examination of hypotheses related to the influence of early exposures on the occurrence of dental caries, open bite, and dental emergence patterns (23, 31, 32). Further information regarding the methods employed in the OHS 1998–1999 can be found in other publications (23, 31, 32).

In the 2005 OHS, the 359 children who participated in the OHS 1998–1999 were approached at home, when they were approximately 12 yr of age. A pretested questionnaire was used that contained items referring to the use of dental services, episodes of toothache, and habits related to oral health; in addition, an instrument was employed to assess

the impact of oral health on the quality of life (33). Clinical information was collected concerning dental caries (29), gingival bleeding (29), malocclusions (29), fluorosis, and dental trauma (34) in order to explore life course factors associated with these outcomes.

A pilot study involving 40 children was carried out to calibrate four examiners. The intra-examiner and inter-examiner diagnostic reliabilities were checked by means of the Kappa statistic, weighted Kappa, and the intraclass correlation coefficient, according to the type of variable analysed. The lowest scores obtained were 0.6 for gingival bleeding, with the majority of the results equal to 1.0.

Quality control for the data from the OHS 2005 was assured by conducting a telephone questionnaire, containing a reduced number of items, on 10% of the sample, selected at random. Children who could not be contacted after four visits, including one visit during the weekend and another in the evening, were regarded as losses. Families who had moved up to 300 km from Pelotas were visited by the fieldwork team. The fieldwork covered the period between April and June 2005.

In the present study, variables that had been collected during both the OHS 1998–1989 and the OHS 2005 were used, in addition to data originating from the various follow-up studies of the cohort. From the OHS 1998–1989, the outcome was: lifetime prevalence of toothache at age 6 yr, collected through the question 'Have you ever had a toothache?'. From the OHS 2005, the outcomes were: lifetime prevalence of dental pain and prevalence of dental pain occurring during the last month. These were collected through the questions 'Have you had toothache at some time in your life?' and 'During the last month, have you had toothache?', respectively.

From the perinatal study, the variables gender, birth order of the child, and presence of the biological father in the home were used. Household income information collected at birth and when the child was 4 yr of age was categorized into tertiles and combined in such a way as to generate a variable known as 'trajectory of household income'. Given that inequalities in Brazil are characterized by strata of high and intermediate income that are similar to one another, and lower strata presenting poor health conditions (bottom-up inequities) (24, 35), the higher tertiles of the income distributions were grouped in a single category. In this way, it was possible to identify four trajectories from birth to 4 yr of age: (i) permanence in the higher-income categories (never poor); (ii) moving from a stratum of higher income to one of lower income (not poor/poor); (iii) moving from a stratum of lower income to one of higher income (poor/not poor); and (iv) permanence in the poor stratum (always poor). This classification followed the proposal of Barros *et al*. (36). Analysis of income trajectories between birth and 12 yr of age were not feasible because income data collected when children were 12 yr of age presented too many missing values.

The dmf-t counts and information on frequency of toothbrushing were obtained from the OHS 1998–1999. Similar variables (DMF-T counts and frequency of toothbrushing) were also obtained from the OHS 2005. Details of financial problems occurring during the last year were obtained from the 2004–2005 follow-up study. The three last-mentioned variables were not taken as risk factors for the lifetime prevalence of dental pain at age 6 yr because, as such, they could not temporally precede this outcome.

The data were electronically stored using the EPI INFO 6 program (Centers for Disease Control and Prevention, Atlanta, GA, USA), with double entry and automatic checks for consistency and range. The analyses were conducted in STATA, version 9 (Stata Corp LP, College Station, TX, USA). As all of the low-birth-weight children were included in the follow-up at 6 and 12 months of age and at 4 yr of age, they were equally over-represented in the OHS 1998–1999 and the OHS 2005. All analyses were weighted to represent the proportion of births of low weight observed in the cohort as a whole (≅10%).

The absolute and relative distributions of the sample were calculated, as well as the occurrence of toothache and the respective 95% confidence intervals (95% CI), according to the categories of the independent variables. In the results presented in the first table of this article, proportions were adjusted by the weighting factor, while the absolute values correspond to the frequencies effectively observed. In the remaining tables all results were adjusted for the weighting factor.

Bivariable and multivariable associations between the lifetime prevalence of pain at 6 and 12 yr of age, pain during the last month, and the independent variables, were tested using the Poisson regression model (37), given that the frequency of the outcomes was considered high. Independent variables whose level of significance was ≤ 0.25 in the unadjusted analysis were included and maintained in the multivariable models. These analyses followed a hierarchical theoretical model of determination, in which it was assumed that distal variables temporally (and causally) preceded the intermediate/proximal variables and, as such, the outcome (Fig. 1) (38). This form of analysis adjusts for the effect of variables of the same hierarchical level and higher levels. The level of significance adopted was 5% for Wald two-tailed tests for linear trend and heterogeneity, where appropriate.

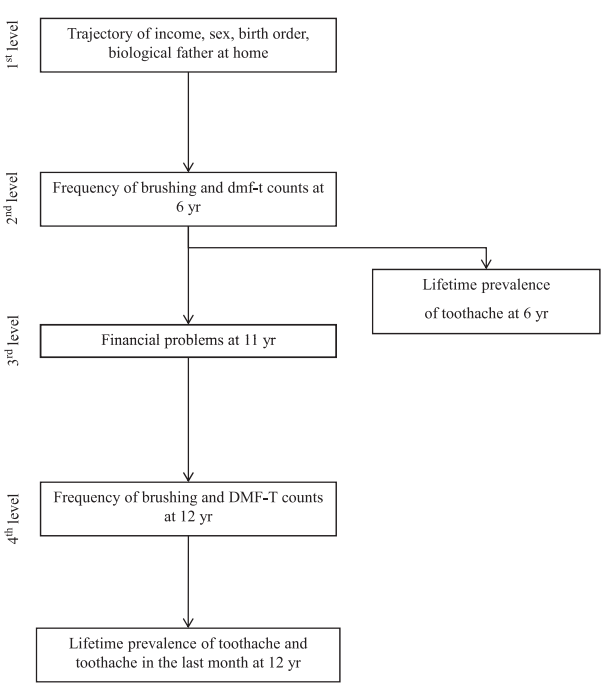

Fig. 1. Hierarchical model of determination to investigate the associations between exploratory variables and the occurrence of toothache in 6- and 12-yr-old children. DMF-T, decayed, missing or filled permanent teeth; dmf-t, decayed, missing or filled deciduous teeth.

Both OHS 1998–1999 and OHS 2005 were approved by the Committee for Ethics in Research of the Faculty of Medicine at the Universidade Federal de Pelotas, with the confidentiality of information being guaranteed and consent of all participants and/or those legally responsible for them being obtained prior to the interview and the examination. Children requiring urgent dental treatment were directed to the clinic of the Faculty of Dentistry at the Universidade Federal de Pelotas.

Results

Among the 359 individuals examined and interviewed, when 6 yr of age, in the OHS 1998–1999, 339 could be located and included in the OHS 2005, which corresponds to a response rate of 94%. No statistically significant differences were found between the individuals lost and those effectively included in this analysis with regard to any of the characteristics studied. The main reason for losses was the family moving to a location more than 300 km from Pelotas.

Table 1 presents the distribution of the sample according to the independent variables investigated. More than 40% of the families remained in the stratum of highest income between the birth of the child and their reaching the age of 4 yr, 23% moved upwards, and an equal proportion remained in the stratum of lowest income. When questioned about the occurrence of financial problems in the family during the last year, 11% responded positively in the 2004–2005 follow-up study.

The proportion of children according to the category of birth order was practically the same among the three groups (1, 2, and ≥ 3), and 22% of the children did not live with their biological father at the time of birth. Forty-five per cent of the individuals were female.

With regard to oral health conditions and related behaviours, 15% of the children brushed their teeth once

Table 1

Distribution of the sample and prevalence of toothache occurring at some point in life and during the last month according to categories of independent variables (n = 339), Pelotas, RS, 2005

	Distribution of the sample		Pain at some point in life (6 yr)		Pain at some point in life (12 yr)		Pain in the last month (12 yr)	
Variable	*n*	%	Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI
Trajectory household of income								
Never poor	144	44.5	37.5	29.5;45.5	54.6	46.4;62.8	13.1	7.5;18.7
Not poor/poor	46	12.1	51.1	36.1;66.2	70.9	57.3;84.5	12.7	2.7;22.7
Poor/not poor	64	22.9	32.2	20.5;43.9	70.5	59.0;82.0	2.3	0.0;6.1
Always poor	84	22.5	42.8	31.8;53.7	70.0	60.0;80.0	15.3	7.4;23.1
Birth order								
1	118	33.9	42.8	33.6;51.9	64.1	55.3;72.9	9.0	3.7;14.2
2	91	27.1	34.0	24.0;43.9	62.7	52.5;72.8	12.6	5.7;19.6
≥ 3	130	39.0	39.8	31.2;48.4	63.1	54.7;71.5	12.5	6.7;18.3
Biological father at home at birth?								
Yes	262	78.2	35.9	30.0;41.7	61.5	55.5;67.4	9.5	5.9;13.1
No	77	21.8	51.3	39.8;62.9	70.0	59.5;80.4	17.8	9.1;26.6
Gender of the newborn								
Male	182	55.0	39.9	32.7;47.1	62.0	54.9;69.2	7.5	3.6;11.4
Female	157	45.0	38.4	30.6;46.1	64.9	57.3;72.4	16.0	10.2;21.8
Frequency of brushing at 6 yr of age								
Twice daily or more	271	84.8	38.5	32.7;44.4	61.7	55.9;67.5	8.8	5.4;12.2
Once per day or less	56	15.2	42.6	29.2;56.0	72.4	60.3;84.5	18.7	8.2;29.3
dmf-t at 6 yr of age								
0	121	37.3	16.9	10.0;23.7	44.2	35.1;53.2	8.5	3.4;13.6
1–4	115	32.5	35.7	26.8;44.5	65.1	56.2;73.9	10.8	5.0;16.6
≥ 5	103	30.2	70.9	61.9;79.9	84.9	77.8;91.9	15.4	8.3;22.4
Financial problems at 11 yr*								
No	295	88.7	–	–	62.4	56.8;67.9	10.6	7.0;14.1
Yes	39	11.3	–	–	71.0	56.1;85.9	18.8	6.0;31.6
Frequency of brushing at 12 yr*								
Twice daily or more	260	20.8	–	–	72.3	61.3;83.2	10.3	6.5;14.0
Once per day or less	68	79.2	–	–	60.8	54.9;66.8	16.6	7.5;25.7
DMF-T at 12 yr*								
0	163	49.7	–	–	52.0	44.3;59.8	9.4	4.9;13.9
1–2	112	32.6	–	–	71.7	63.3;80.2	11.4	5.4;17.4
≥ 3	63	17.7	–	–	79.5	69.2;89.8	16.6	7.2;26.1
Total	339	100.0	39.2	34.0;44.5	63.3	58.2;68.5	11.3	7.9;14.7

95% CI, 95% confidence interval; DMF-T, decayed, missing or filled permanent teeth; dmf-t, decayed, missing or filled deciduous teeth.

*The maximum number of values ignored was 11.

a day or less when they were 6 yr of age, with this proportion being increased to 80% at 12 yr of age. The mean dmf-t index at 6 yr of age was 3.2 [standard deviation (SD) = 3.8] and dental caries in this dentition affected 63% of the children. At 12 yr of age, the DMF-T count was, on average, equal to 1.2 (SD = 1.6) and the prevalence of caries in this age group was nearly 50%.

The overall lifetime prevalence of toothache was 39% [95% CI = (34;45)] and 63% [95% CI = (58;69)] at 6 and 12 yr of age, respectively. Dental pain during the last month reached a prevalence of 11% [95% CI = (8;15)] (Table 1). There was a wide variation in the frequency of the outcomes according to the categories of the independent variables investigated. The lowest prevalences of toothache occurring at some time in life at 6 and 12 yr of age were observed in children with a dmf-t of 0. The lowest prevalence of pain during the last month was seen among those whose trajectory of household income from birth to 4 yr of age was characterized by upward mobility. On the other hand, the highest lifetime prevalences of toothache at 6 and 12 yr of age were detected in children with a dmf-t count of ≥ 5. Dental pain in the last month was highest in 11-yr-old children who reported financial problems in the family (Table 1).

In the unadjusted analysis, the variables associated with the lifetime prevalence of toothache at age 6 yr were the presence of the biological father in the home at birth and the dmf-t index. Children whose biological fathers were not living with them when they were born, and those presenting a dmf-t equal to 1–4 or ≥ 5, showed a prevalence of toothache that was 40, 110, and 320% higher than their respective counterparts. Such associations remained statistically significant in the adjusted analysis, with prevalence ratios of similar magnitude (Table 2).

The income trajectory, and the dmf-t and DMF-T counts were associated with a lifetime prevalence of toothache at age 12 yr in the unadjusted analysis. Children from families who experienced an episode of poverty between the birth of the child and when it reached 4 yr of age, children with dmf-t counts from 1–4 and ≥ 5, and children with DMF-T counts from 1–2 and ≥ 5 exhibited a prevalence of toothache that was 30, 40, 90, 20, and 20% greater than their respective counterparts. These associations remained statistically significant in the multivariable analysis, with a slight change in their effect measures (Table 3).

The variables associated with the prevalence of toothache during the last month in the unadjusted analysis were gender and the frequency of toothbrushing, with prevalence ratios of 2.1 for girls as well as for children who brushed their teeth less than once daily at age 6 yr (Table 4). Also, in the unadjusted analysis, there was a borderline association ($P = 0.063$) between the prevalence of toothache during the last month and the

Table 2

Unadjusted and adjusted analyses (PR) of the association between independent variables and lifetime prevalence of toothache at age 6 yr (n = 339)

Level*	Variable	Unadjusted analysis		Adjusted analysis	
		PR (95% CI)	*P*-value	PR (95% CI)	*P*-value
1	Trajectory of household income		0.804†		0.946†
	Never poor	1		1	
	Not poor/poor	1.4 (0.9;2.0)		1.2 (0.8;1.8)	
	Poor/not poor	0.9 (0.6;1.3)		0.8 (0.6;1.3)	
	Always poor	1.1 (0.8;1.6)		1.1 (0.7;1.5)	
1	Birth order		0.881†		0.751†
	1	1		1	
	2	0.8 (0.5;1.2)		0.8 (0.5;1.2)	
	≥ 3	0.9 (0.7;1.3)		0.9 (0.7;1.3)	
1	Biological father at home at birth?		0.018‡		0.018‡
	Yes	1		1	
	No	1.4 (1.1;1.9)		1.4 (1.1;1.9)	
1	Gender of the child		0.785‡		0.879‡
	Male	1		1	
	Female	1.0 (0.7;1.3)		1.0 (0.7;1.3)	
2	Frequency of brushing at 6 yr		0.604‡		0.498‡
	Twice daily or more	1		1	
	Once per day or less	1.1 (0.8;1.6)		0.9 (0.6;1.3)	
2	dmf-t at 6 yr		< 0.001†		< 0.001†
	0	1		1	
	1–4	2.1 (1.3;3.5)		2.2 (1.3;3.6)	
	≥ 5	4.2 (2.7;6.6)		4.3 (2.8;6.7)	

95% CI, 95% confidence interval; DMF-T, decayed, missing or filled permanent teeth; dmf-t, decayed, missing or filled deciduous teeth; PR, prevalence ratio.
*Level of the variable in the hierarchical model.
†Wald test for linear tendency.
‡Wald test for heterogeneity.

Table 3

Unadjusted and adjusted analyses (prevalence ratios, PR) of the association between independent variables and lifetime prevalence of toothache at age 12 yr (n = 339)

Level*	Variable	Unadjusted analysis		Adjusted analysis	
		PR (95% CI)	*P*-value	PR (95% CI)	*P*-value
1	Trajectory of household income		0.016†		0.016†
	Never poor	1		1	
	Not poor/poor	1.3 (1.0;1.7)		1.3 (1.0;1.7)	
	Poor/not poor	1.3 (1.0;1.6)		1.3 (1.0;1.6)	
	Always poor	1.3 (1.0;1.6)		1.3 (1.0;1.6)	
1	Birth order		0.881†		0.775†
	1	1		1	
	2	1.0 (0.8;1.2)		1.0 (0.8;1.3)	
	≥ 3	1.0 (0.8;1.2)		1.0 (0.8;1.2)	
1	Biological father at home at birth?		0.185‡		0.280‡
	Yes	1		1	
	No	1.1 (0.9;1.4)		1.1 (0.9;1.3)	
1	Gender of the child		0.619‡		0.522‡
	Male	1		1	
	Female	1.0 (0.9;1.2)		1.1 (0.9;1.3)	
2	Frequency of brushing at 6 yr		0.139‡		0.374‡
	Twice daily or more	1		1	
	Once per day or less	1.2 (0.9;1.5)		1.1 (0.9;1.3)	
2	dmf-t at 6 yr		< 0.001†		< 0.001†
	0	1		1	
	1–4	1.5 (1.1;1.9)		1.4 (1.1;1.9)	
	≥ 5	1.9 (1.5;2.4)		1.9 (1.5;2.4)	
3	Financial problems at 11 yr		0.295‡		0.860‡
	No	1		1	
	Yes	1.1 (0.9;1.5)		1.0 (0.8;1.3)	
4	Frequency of brushing at 12 yr		0.082‡		0.259‡
	Twice daily or more	1		1	
	Once per day or less	1.2 (1.0;1.4)		1.1 (0.9;1.3)	
4	DMF-T at 12 yr		< 0.001†		0.032†
	0	1		1	
	1–2	1.4 (1.1;1.7)		1.2 (1.0;1.5)	
	≥ 3	1.5 (1.2;1.9)		1.2 (1.0;1.5)	

95% CI, 95% confidence interval; DMF-T, decayed, missing or filled permanent teeth; dmf-t, decayed, missing or filled deciduous teeth; PR, prevalence ratio.
*Level of the variable in the hierarchical model.
†Wald test for linear tendency.
‡Wald test for heterogeneity.

presence of the biological father in the home at birth. With regard to the adjusted analysis, individuals whose biological fathers did not live in the family home at the time of birth exhibited a twofold higher prevalence of pain. Girls, in turn, presented a prevalence of toothache that was 120% greater than that of boys.

Discussion

To the best of our knowledge, the present investigation is the first to use a prospective cohort design to investigate factors associated with toothache in 12-yr-old children, adopting a life course approach (20).

Also in relation to the methods, notable highlights of the present study were the long period of follow-up, the training and calibration of the team (which contributed to the high reproducibility among observers), the fact that the interviewers were blinded to the study hypothesis, and the high response rates obtained. These characteristics contributed to a greater internal validity of the study. On the other hand, one of the main limitations of the present study was that it was not specifically planned to test the hypotheses presented here. This prevented an in-depth examination of the relationships between dental pain and associated factors, and impeded the study of the impact of toothache on different dimensions of life.

The lifetime prevalences of dental pain at 6 and 12 yr and during the last month (39, 63, and 11%, respectively) were considerably high. In 8–9–yr-old children attending primary schools in Maryland, USA, Vargas *et al.* (4) found a prevalence of 16% for toothache occurring at some point in life. In Sri Lanka, the prevalence of oral pain occurring at some time in life was recorded as 49%, according to the report of 8-yr-old schoolchildren (15). Among 8-yr-old children from the town of Harrow, England, prevalences of 48 and 8% were described for

Table 4

Unadjusted and adjusted analyses (PR) of the association between independent variables and prevalence of toothache occurring during the last month at 12 yr (n = 339)

Level*	Variable	Unadjusted analysis		Adjusted analysis	
		PR (95% CI)	*P*-value	PR (95% CI)	*P*-value
1	Trajectory of household income		0.721†		0.570†
	Never poor	1		1	
	Not poor/poor	1.0 (0.4;2.5)		0.8 (0.3;2.3)	
	Poor/not poor	0.2 (0.1;0.9)		0.2 (0.1;0.9)	
	Always poor	1.2 (0.6;1.4)		1.1 (0.5;2.2)	
1	Birth order		0.409†		0.393†
	1	1		1	
	2	1.4 (0.6;3.3)		1.4 (0.6;3.2)	
	≥ 3	1.4 (0.6;3.1)		1.4 (0.6;3.1)	
1	Biological father at home at birth?		0.063‡		0.043‡
	Yes	1		1	
	No	1.9 (1.0;3.6)		2.0 (1.0;3.8)	
1	Gender of the child		0.026‡		0.018‡
	Male	1		1	
	Female	2.1 (1.1;4.2)		2.2 (1.1;4.2)	
2	Frequency of brushing at 6 yr of age		0.045‡		0.072‡
	Twice daily or more	1		1	
	Once per day or less	2.1 (1.0;4.4)		1.9 (0.9;4.0)	
2	dmf-t index at 6 yr of age		0.140†		0.148†
	0	1		1	
	1–4	1.3 (0.5;2.9)		1.3 (0.5;3.1)	
	≥ 5	1.8 (0.8;4.0)		1.9 (0.8;4.5)	
3	Financial problems at 11 yr		0.161‡		0.128‡
	No	1		1	
	Yes	1.8 (0.8;4.0)		1.8 (0.8;3.8)	
4	Frequency of brushing at 12 yr of age		0.165‡		0.285‡
	Twice daily or more	1		1	
	Once per day or less	1.6 (0.8;3.2)		0.6 (0.3;1.5)	
4	DMF-T index at 12 yr of age		0.182†		0.528†
	0	1		1	
	1–2	1.2 (0.6;2.6)		1.0 (0.4;2.2)	
	≥ 3	1.8 (0.8;3.9)		1.3 (0.6;3.2)	

95% CI, 95% confidence interval; DMF-T, decayed, missing or filled permanent teeth; dmf-t, decayed, missing or filled deciduous teeth; PR, prevalence ratio.
*Level of the variable in the hierarchical model.
†Wald test for linear tendency.
‡Wald test for heterogeneity.

toothache occurring at some time in life and in the last 4 wk, respectively (5). On the other hand, the prevalence of toothache occurring during the last 4 wk was found to be 37% among 10–14 yr-old schoolchildren in Stayroypoli, Greece (6). Naidoo *et al.* (12) identified a prevalence of 88% for toothache occurring at some time in life among 8–10–yr-old schoolchildren from the Western Cape, South Africa. The high prevalences of toothache found in the present study should encourage preventive policies and support the planning of local dental health services, including urgent dental care.

The differences found between the prevalences of toothache mentioned in the previous paragraph and those demonstrated in this study may be attributed to numerous factors. The form in which the questions were elaborated is directly related to the results obtained (39), and variation in the questions concerning pain could have contributed to these discrepancies. Pau *et al.* (6) and Shepherd *et al.* (5) requested information on dental pain in the last 4 wk, whereas in the present study this information was collected for the last month. It is difficult to confirm whether this question overestimated or underestimated the prevalence of toothache, although its use probably affected comparability with the findings cited above. Furthermore, it is necessary to take into account precisely who is the respondent in an investigation on pain. Vargas *et al.* (4) asked the parents or guardians of the children for information concerning the occurrence of toothache, a fact that may have reduced the magnitude of the prevalence recorded.

Social, demographic, and cultural factors may also have contributed to these differences (7). The distinct composition of the samples by gender, age, access to and use of medical and dental services, as well as cognitive factors (beliefs, expectations and previous experiences), are also likely to have influenced the results. Finally, in contrast to other investigations, the present study was not restricted to children attending schools. If school attendance rates are associated with socio-economic status of the children in the regions where the studies

were carried out, it is possible that the restriction of studies to schoolchildren may have jeopardized comparability among them.

When dealing with factors associated with lifetime prevalence of toothache at age 12 yr, the trajectory of household income should be highlighted. With the exception of the dmf-t count, this was the variable with the strongest association with the outcome in question. Children whose families had experienced an event of hardship between the birth of the child and the child reaching 4 yr of age presented a prevalence of toothache that was 30% higher. This is in agreement with the results of Peres *et al*. (24), who found in another birth cohort from Pelotas that the experience of an episode of poverty between birth and the age of 15 yr contributed to a greater occurrence of caries, behaviour that is risky with regard to oral health, and less frequent use of dental services, all of which are potential determinants of toothache. In the case of the present investigation and from a life course perspective, events of hardship in early infancy may trigger risky health behaviours, less frequent use of health services, and psychosocial characteristics, which, later in life, may have an important influence over dental pain occurrence.

The remaining factors associated with toothache occurring at some time in life up to age 12 yr were the dmf-t and the DMF-T counts. Lifetime prevalence of dental pain at age 6 yr was also associated with the dmf-t count. Such associations would be expected because dental caries constitutes one of the main proximal determinants of these outcomes (7). It is also important to highlight that the strongest associations were found between dmf-t and lifetime prevalence of toothache at ages 6 and 12 yr. The association between dmf-t and dental pain at age 6 yr was specifically stronger, and this result supports the idea that children presented toothache in a period around this age. Such data suggests that interventions and initiatives in oral health should be implemented in the early stages of life (40), preferably before age 6 yr. Factors that have an influence over dental caries, such as socio-economic conditions at childbirth (23), should be of concern when implementing preventive strategies.

With regard to toothache during the last month, the variable with the strongest association was gender; girls exhibited a prevalence of pain that was 2.2 times greater than that in boys. This difference may, in part, represent social norms for the expression of pain, although it is also possible that it results from distinct biological mechanisms through which the painful phenomenon is processed in men and women (26). It is probable that this difference reflects, generally, socially learned behaviours because children at this age have already had much contact with social norms and values. The stereotype of masculinity, for example, may have produced a necessity for boys to appear more resistant to pain (the stoic ideal) (41) and this may have led them to report pain less frequently in the previous month. However, because lifetime experience with dental pain tends to be a widespread phenomenon at this age, this may have obscured gender differences for this latter outcome in children aged 12 yr.

The absence of the biological father from the home at the time of the child's birth was associated with a lifetime prevalence of toothache at age 6 yr and during the last month. A recent study indicated that children living with only one of their biological parent were 2.7 times more likely to present toothache in relation to their peers (6). Some authors have explained the relationship between aspects of family structure and oral health outcomes by means of a psychosocial approach (42, 43). In the context of the present investigation, it seems reasonable to assume that an adverse socio-economic and family environment at the beginning of the life cycle, such as divorce, that results, more often than not, in the child living without the presence of their biological father, can lead to the adoption of behaviour that is deleterious to oral health and, consequently, create a greater risk for the occurrence of toothache in different stages of the life cycle (6). For example, the absence of the biological father and the possible overloading of activities for the mothers of these children may result in less than optimum child care and, subsequently, poor oral habits and oral health conditions. These poor oral habits and oral health conditions may produce 'bursts' of dental pain in subsequent periods of the life cycle. Again, this means that the prevention of toothache should take into account the early life context in which pain tends to be produced. However, these preliminary hypotheses deserve to be examined in more depth in other studies planned with this specific aim in mind.

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