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Social and biological early life influences on severity of dental caries in children aged 6 years

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Abstract – Objective: To investigate the relationship between social and biological conditions experienced in very early life and dental caries in children aged 6 years. *Methods:* The design was a dental caries cross-sectional study nested in a birth cohort study started in Pelotas, Brazil, in 1993. The cross-sectional study was carried out in 1999. A random sample of 400 6-year-old children was selected from among 5249 live births in 1993. The World Health Organization (1997) criteria were used to diagnose dental caries. Results from the oral health study were linked to the data concerning perinatal and childhood health and illnesses and family social conditions collected at birth, 1, 3, 6 and 12 months, and in the sixth year of life. Dental caries was the outcome measured at two levels of severity (very low: dmft ≤ 1; high: dmft ≥ 4). Unconditional univariate and multiple logistic regression analysis were performed. *Results:* Self-employed and employees/unemployed, fathers with <8 years of education at time child was born, child's height deficit for age at 12 months; child who did not attend day care centre in sixth year of life; brushing teeth less than once a day, and children with sweet consumption of at least once a day at 6 years were risk factors for high dental caries after controlling for possible confounders. *Conclusions:* Harmful social and biological risk factors accumulated in early life contributed to the development of a high level of dental caries in childhood.

Key words: cohort; dental caries; early life; risk factors; social class

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Dental caries is a common childhood disease in Brazil. Nevertheless, there are few data related to caries in the primary dentition (1). Nationally the mean dmft among children aged 6 was 3.6 (2) and regionally the prevalence ranged from 60.9% to 71.6% (3, 4) while mean dmft ranged from 2.4 to 3.9 (3, 4).

Although the aetiological mechanisms of dental caries are well known, the early life events, which may contribute to caries, continue to be poorly understood. In particular, whereas there has been some discussion of early sociobiological factors (5–10) affecting dental caries later in life, very little research exists on early social conditions and their influence on the later development of dental caries.

There are associations between early life events and adult chronic diseases such as cardiovascular disease and cancer (11, 12). Two main theories have been proposed to explain these links. First, the early life theoretical model hypothesizes that adult chronic diseases are biologically programmed *in utero* and in early childhood (11). The term 'programming' is used to describe this process, which occurs during a critical period of foetal life. The second theory proposes that social and biological risks accumulated during the course of life, especially in critical periods during early life, are the key determinants of health in later years. Kuh and Ben-Shlomo (12) highlighted the concepts of 'chain of risk' to describe how experiences in early life increase the likelihood of future events.

The life course approach offers an alternative way of linking early life factors to later disease suggesting that throughout the life course exposures or insults gradually accumulate through developmental factors such as low birth weight, episodes of illness, adverse environmental conditions and behaviours. If there are numerous insults along the life course the risk of chronic disease is increased. There are three types of processes by which very early life environments may affect health and behaviours later in life (12). The processes frequently interact with each other. They are: (i) latent effects of early life environments affect health in later life. A specific biological disadvantage at a sensitive period in early life, such as low birth weight, developmental delay, may have an impact on health and well-being that emerges in later life; (ii) cumulative effects are those in which the health effects of advantage or disadvantage accumulate over time, at a rate depending upon the duration and intensity of 'exposure'; and (iii) pathway effects that operate through a more complex interaction between individual and environment. Early life environments influence the different trajectories of life experiences and opportunities on which individuals find themselves. Reactions to those experiences, which are conditioned by early life experience, have the potential to modify their subsequent trajectories.

As common risk factors are involved in general and chronic oral diseases (13), it is logical that the life course theories put forward for general health should apply to oral health. However, the application of life course theory to dental caries has never been tested. The life course approach could help to elucidate when and how the risk factors occur and thereby indicate the most appropriate time for preventive interventions.

Nutritional status is a reliable marker of stressors in early life. Low scores on one or more of the anthropometric indices are often regarded as evidence of past or current malnutrition. Height deficit by age 12 months is recommended as an indicator because low height for age (stunting) reflects long-term, cumulative inadequacies of health or nutrition (14). In Brazil, prevalence of stunting was 10.5% among children under 5 years old (15). The biological pathways that could explain the link between undernutrition and dental caries are if nutritional insults are early in the formation of the organic dental matrix, hypoplasia can develop (16). Enamel hypoplasia and the consequent enamel defects are more readily colonized by mutans Streptococci (17). Enamel hypoplasia is associated with dental caries later in life and could be a good dental caries predictor (18). In addition, Johansson et al. (10, 19) reported that malnourished children had reduced saliva secretion rate, buffering capacity, lower Ca^{2+} and protein secretion in stimulated saliva and impaired immunological and agglutinating defence factors in unstimulated saliva.

Because the life course approach links insults at different stages of life the objective of this study was to investigate the relationship between social and biological conditions experienced in very early life and dental caries in children aged 6 using a life course approach.

Methods

The Pelotas birth cohort commenced in 1993. The main objective was to assess perinatal and infant health. In the 1993 Pelotas birth-cohort, there were five sub-projects: perinatal morbidity, follow-up, infant mortality, hospital admissions and psychological development. In the perinatal morbidity project, the five hospitals in Pelotas were visited daily from 1 January to 31 December in 1993 to interview all mothers attending the hospital for childbirth. The questionnaire for mothers included questions about social and economic variables, demography, pregnancy, behavioural, health care and morbidity. The children were weighed, measured and examined at birth by a team of doctors and medical students. The follow-up study concentrated on the children's first year of life. The home visits included questionnaires and anthropometric assessments (20).

For the follow-up, a sample of 20% of all 5249 children was selected and followed up in their homes at birth, at 1, 3, 6 and 12 months. In addition, all children born with low birth weight (<2500 g) were also included to test specific hypothesis related to this high-risk morbidity group. The hospital admissions sub-project provided information on all cohort children who were hospitalized in their first year of life. From January 1993 to December 1994, all hospitals in the city were visited daily. The psychological development sub-project included home visits in 1998 when the children were 5 years old. Details of the methodology have been described (20).

The Oral Health Study (OHS) that started in 1999, is on a sub-sample of the Pelotas birth cohort study. The design was an oral health cross-sectional study nested in a birth cohort study. A minimum random sample size of 352 6-year-old children was obtained from among the children included in the follow-up study. More children were added because of possible nonresponse and the multiple outcomes studied. The estimated sample size was 400 children.

As the proportion of low birth weight children in the follow-up study was 29.7% whilst in the original cohort it was 9.7% it was necessary to calculate a weighted factor in order to perform statistical analysis. Therefore, for the OHS a weight factor of 0.34 was used for children born with low birth weight and 1.27 was applied to those born with adequate birth weight.

Results from the OHS were linked to the data concerning perinatal and childhood health and family social conditions collected at birth and at the first, third, sixth and 12th months, and the sixth year of life (20).

The dental research team of three dentists and three scribes visited the sample children at home between December 1998 and July 1999. Their parents were informed about the objectives of this study. Consent for interviews and examinations was obtained and the project was approved by the Pelotas Federal University Ethics Committee. If required, each house was visited up to four times, including at least an evening visit and another on the weekend to examine the children and interview the mothers.

The dental examinations were carried out in the child's home by three examiners. Examiner calibration exercises were carried out twice, in December 1998 and May 1999. One of the authors was the standard examiner (MAP). Intra and inter-examiner agreement was high. Scores for the measures of agreement calculated on a tooth-by-tooth basis (21) were high in the first and in the second calibration (minimum kappa values were 0.81 and 0.75, respectively). The World Health Organization (22) criteria were used for diagnosing dental caries. In addition, oral mucosa lesions and the occlusion were examined. A pilot study involving 40 children at home was carried out prior to the data collection. Dental caries was the outcome measured by decay, missing and filled teeth index (dmft index) at two levels of severity (very low dental caries: dmft ≤ 1; high dental caries: dmft ≥ 4).

The independent variables included social and economic conditions [social class (23), family income, parental educational levels and water supply]; parental employment status; child's sex; tooth age measured as the number of erupted teeth at 12 months; development variables (birth weight; height by age deficit at 12 months (below -2 *Z*-scores of the National Centre for Health Statistics/World Health Organization reference (24)]; weight by height deficit at 12 months (as above); weight by age deficit at 12 months (as above); history of breast- and bottle-feeding; past use of medicine; and past childhood diseases, and dental habits and children care (day-care centre attendance at 6, 12 months and at sixth year of life); current dental hygiene habits such as tooth brushing frequency, use of toothpaste and dental floss and type and use of dental services, access to fluoridated water and current sweet consumption was recorded. The current international growth reference, the National Centre for Health Statistics (NCHS) reference was used to assess nutritional status. Those children who presented height by age below 2 *Z*-scores were considered as suffering long-standing malnutrition (24).

The associations were tested using univariate analysis between independent variables and the outcome. The variables were grouped into a hierarchical model (25, 26) from distal to proximate determinants performed at four levels (Fig. 1). For each hierarchical level, unconditional logistic regression analysis was performed to exclude variables with a *P*-level of 0.20 or more. To these variables, those in the second hierarchical level were added and excluded if $P > 0.05$ and so forth. The *P*-level for keeping variables in the model was set at 0.05. Variables were considered as risk factors if the significance was 0.05 or less. The fit of final model was assessed using the Hosmer and Lemeshow test (27). The best value for this test is 1.

The software SPSS (28) was used for the analysis. Figure 1 summarizes the theoretical model adopted in this study.

Results

The response rate was 89.7%. Nonresponses were mainly due to families moving out of the city. All the proportions are presented as weighted values whilst frequency values are shown as original. The mean dmft was 3.29. Approximately 97% of the dmft index was decay and missing while filled teeth were uncommon. For the analysis, 62 children with a dmft of 2 and 3 were excluded. Caries-free children and those with a dmft equal to 1 accounted for 156 (53.4%) children while 136 (46.6%) had dmft ≥ 4. In the univariate analysis related to distal determinants, almost all social indicators were

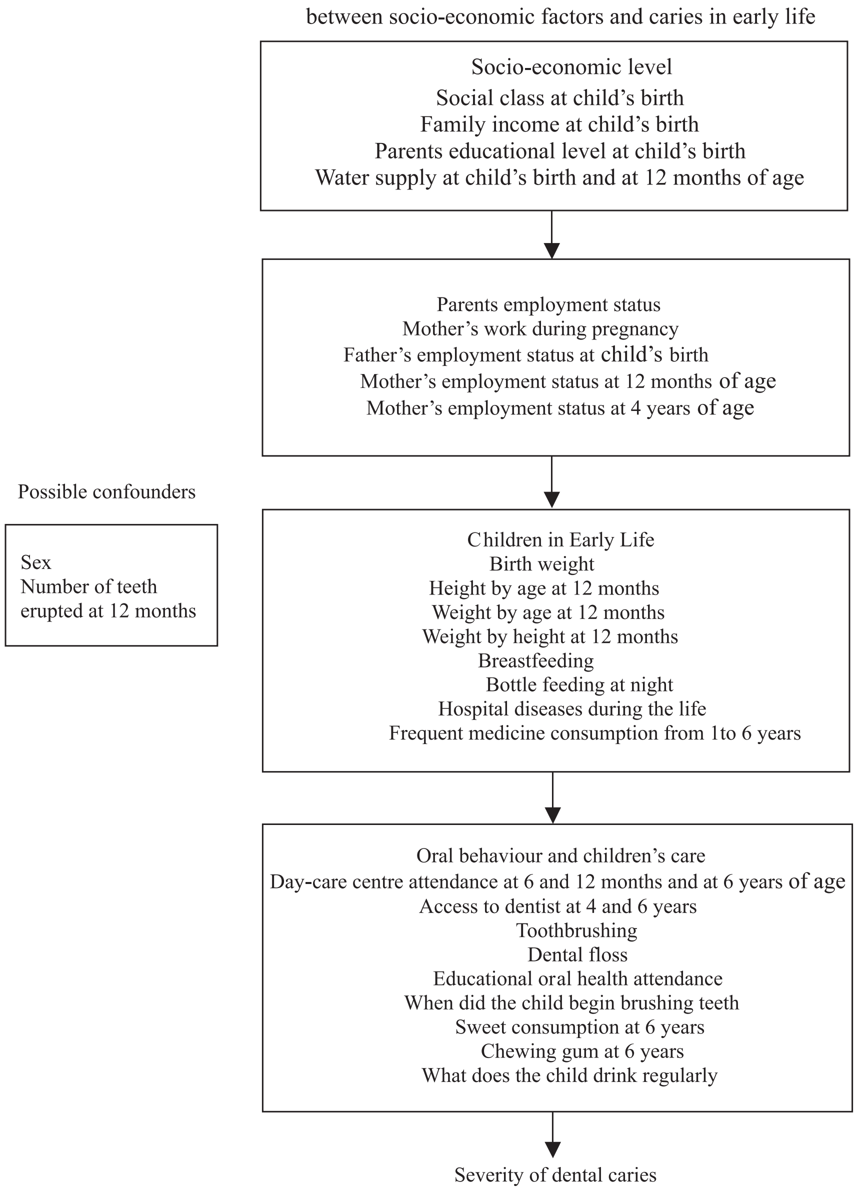

Fig. 1. Theoretical model of the relationship between socioeconomic factors and caries in early life.

strongly and significantly associated with high dental caries, except for water supply at 12 months. After adjusting by all socioeconomic variables, only social class and father's educational levels remained associated with high levels of dental caries (Table 1). While maternal work during pregnancy was associated with high levels of dental caries, the other variables related to parental work were not (Table 2). Of the child growth measures studied, the only variable associated with the dmft ≥ 4 was the deficit in height for age at 12 months; stunted children had odds ratios of 4.1 and 4.5 for presenting a high caries score, compared to those with adequate height for age, in the unadjusted and adjusted models, respectively. Sex and number of teeth at 12 months were not associated with high levels of dental caries but these remained in the model as possible confounders. Despite the high level of sugar in infant medicines, there were no significant associations between infant medicines and dental caries (Table 3).

Table 4 shows the more proximal variables related to dental caries. Nonattendance at day care centres at 6 and 12 months and in the sixth year of life, brushing teeth less than three times a day, starting brushing teeth late, not using dental floss at 6 years; and eating sweets at least once a day at 6 years, were all associated with the outcome measure ($P < 0.20$) and were entered in the model. After adjustment, the following variables remained significant: nonattendance at day care centre in sixth year of life, brushing teeth less than three times a day; and eating sweet at least once a day at 6 years.

Table 1. Associations between family socioeconomic variables and high level of childhood dental caries (dmft ≥ 4). Pelotas, Brazil, 1999 ($n = 359$)

Variables	dmft ≤ 1%	dmft ≥ 4%	OR (95% CI)[a]	OR (95% CI)[b]
Social class at child's birth				
Employers/professionals	95.2	4.8	1.0	1.0
Self-employed	51.9	48.1	14.4 (2.2–94.1)	8.7 (1.3–58.9)
Employees/unemployed	53.4	46.6	13.5 (2.2–82.9)	7.7 (1.2–49.6)
P[c]			<0.01	0.08
Family income at child's birth				d
>6 Brazilian minimum wage (BMW)	74.5	25.5	1.0	
1.1–6 BMW	52.0	48.0	2.6 (1.2–5.3)	
≤1 BMW	46.7	53.3		
P			0.01	
Mother's educational level at child's birth				d
>8 years	68.6	31.4	1.0	
≤8 years	49.0	51.0	2.3 (1.3–3.9)	
P			<0.01	
Father's educational level at child's birth				
>8 years	74.1	25.9	1.0	1.0
≤8 years	48.2	51.8	3.1 (1.7–5.4)	2.2 (1.2–4.1)
P			<0.01	0.03
Water supply at child's birth				d
Yes	58.5	41.5	1.0	
No	35.7	64.3	2.5 (1.3–5.0)	
P			0.01	
Water supply at 12 months old				e
Yes, into the house	55.6	44.4	1.0	
Yes, but out the house	33.3	66.7	2.2 (0.7–6.5)	
No	62.5	37.5	0.7 (0.2–3.0)	
P			0.219	

[a]Unadjusted crude univariate analysis.
[b]Adjusted for socioeconomic variables.
[c]Chi-squared test.
[d]Variable excluded of the multiple logistic regression analysis after lost statistic significance when it was controlled by other socioeconomic variables ($P < 0.2$).
[e]Variable not included in the multiple logistic regression analysis ($P > 0.2$ when chi-squared test was performed).

The final hierarchical model of the relationship between children's life course variables and a high level of dental caries is shown in Table 5. Self-employed [odds ratio (OR) 8.7; 95% confidence interval (CI) = 1.3–58.9]; employees/unemployed (OR = 7.7; 95% CI = 1.2–49.6); fathers with <than 8 years of study when child was born (OR = 2.2; 95% CI = 1.2–4.1), child height by age deficit at 12 months (OR = 3.6; 95% CI = 1.1–11.1); child who did not attend day care centre at 6 years (OR = 2.3; 95% CI = 1.2–4.7); children with sweet consumption of at least once a day at 6 years (OR = 2.3; 95% CI = 1.3–3.9); and children brushing their teeth less than once a day (OR = 3.1; 95% CI = 1.1–9.0) were independent risk factors for high dental caries through the life course. Each level was controlled by the level above according to the theoretical model (Fig. 1). The final model showed a god fit (Hosmer and Lemeshow test, $P = 0.91$).

Discussion

The hypotheses was confirmed that social and biological factors in very early life influence dental caries levels later in life. The very early life variables remained in the final logistic regression model for each of the ages that the children were medically examined suggesting that the risks related to caries are accumulated during the life course. Low social class increased the risk of developing high levels of dental caries. A related variable, father's low educational level, also played an independent role. Long-standing malnutrition, evidenced by height by age deficit at 12 months, represented the main risk factor for high levels of dental caries during the first year of life. Not attending a day care centre was the most important risk factor in the sixth year of life, while sweet consumption at least once a day and brushing teeth less than once a day were the main proximal

Table 2. Associations between parents' work-related variables and high level of dental caries (dmft ≥ 4). Pelotas, Brazil, 1999 ($n = 359$)

Variables	dmft ≤ 1 (%)	dmft ≥ 4 (%)	OR (95% CI)[a]	OR (95% CI)[b]
Mother's work during pregnancy				
8–9 months	66.2	33.8	1.0	1.0
1–7 months	40.5	59.5	2.9 (1.3–6.3)	2.9 (1.3–6.3)
Did not work	53.8	46.2	1.7 (0.9–3.0)	1.7 (0.9–3.0)
P[c]			0.03	0.03
Father's employment status at child's birth				[d]
Employed	56.1	43.9	1.0	
Unemployed/retired	50.0	50.0	1.2 (0.5–3.1)	
P			0.79	
Mother's employment status at children aged 12 months				[d]
Yes	54.2	45.8	1.0	
No	55.5	44.5	0.9 (0.6–1.5)	
P			0.92	
Mother's employment status at sixth year of children life				[d]
Worked during the last year	58.8	41.2	1.0	
Worked only few months	57.1	42.9	1.0 (0.5–2.0)	
Did not work in the last year	51.4	48.6	1.4 (0.8–2.4)	
P			0.52	

[a]Unadjusted crude univariate analysis.
[b]Adjusted for parents' work-related variables.
[c]Chi-squared test.
[d]Variable not included in the multiple logistic regression analysis ($P > 0.2$ when chi-squared text was performed).

behaviour risk factors at 6 years. All variables related to dental attendance and those well known preventive measures such as fluoride were not significant. These latter findings were not surprising. Dental attendance has little effect on reducing dental caries (29, 30) although access to dentists does improve the quality of life by mitigating suffering from toothache. The lack of significance of dental attendance for caries development in this study may be due to the universal use of fluoridated water since birth and the fact that 95% of the children used fluoride toothpaste regularly. The city has water fluoridation system, which benefits almost the whole population. Universal use of fluorides also explains why water fluoridation and fluoride toothpaste, both effective measures for preventing dental caries, were not associated with high level of dental caries. However, the association between brushing teeth less than once a day with fluoride toothpaste in a fluoridated area, and caries levels, suggests that the fluoride levels were insufficient to prevent dental caries.

The link between socioeconomic status and health is very well established. Several measures have been used to assess socioeconomic position. All of them have limitations (31). Furthermore, many studies related to child health and family socioeconomic position have failed to adjust one social indicator for another (32). In our study, we considered several dimensions of social position; social class, family income, parents education and parent employment status. In the univariate analysis all variables, except those related to water supply and employment status, were strongly associated with high dental caries. However, after adjusting each one for other variables, only social class and fathers' level of education remained significant. Level of education is an important marker of socioeconomic position. It is useful because it can be applied to both sexes, is applicable to persons not in the labour force, has stability over the adult lifespan, and is comparable between different regions. In addition, higher education level generally is predictive of better jobs, higher incomes, better housing and socioeconomic position (33–35). One question that remains unclear is why fathers' level of education was more important than mother's level of education, one of the best predictors for children health, especially in developing countries (35). Perhaps in Brazilian society the role of the male as the head of the family is still very important despite the increase of women in the labour force.

Another important finding was the role of long-term malnutrition on dental caries. Possibly the only field where it is possible to identify studies related to early life and dental diseases are those about nutritional assessment and dental caries and dental eruption (5, 6, 36) and enamel hypoplasia and their link with very early life environmental

Table 3. Associations between demographic and children's life course variables and high level of dental caries (dmft ≥ 4). Pelotas, Brazil, 1999 (n = 359)

Variables	dmft ≤ 1 (%)	dmft ≥ 4 (%)	OR (95% CI)[a]	OR (95% CI)[b]
Sex				
Male	52.9	47.1	1.0	1.0
Female	56.5	43.5	0.9 (0.5–1.4)	0.9 (0.6–1.4)
P[c]			0.615	0.659
Birth weight				[d]
Adequate (>2500 g)	55.5	44.5	1.0	
Low (≤2500 g)	48.3	51.7	1.3 (0.6–2.9)	
P			0.587	
Height by age at 12 months				
Adequate (>2 Z-scores)	56.8	43.2	1.0	1.0
Inadequate (≤2 Z-scores)	22.2	77.8	4.1 (1.4–12.3)	4.5 (1.5–13.6)
P			0.009	0.022
Weight by age at 12 months				[d]
Adequate (>2 Z-scores)	55.0	45.0	1.0	
Inadequate (≤2 Z-scores)	50.0	50.0	1.2 (0.3–3.9)	
P			0.759[e]	
Weight by height at 12 months				[d]
Adequate (>2 Z-scores)	54.7	45.3	1.0	
Inadequate (≤2 Z-scores)	66.7	33.3	0.5 (0.3–8.8)	
P			1.000[e]	
Number of teeth at 12 months				
≤5	56.7	43.3	1.0	1.0
>5	53.2	46.8	1.2 (0.7–1.8)	1.3 (0.8–2.1)
P			0.638	0.314
Ever hospitalized				[d]
No	53.0	47.0	1.0	
Yes	57.3	42.7	0.8 (0.5–1.4)	
P			0.556	
Frequent medicine consumption between 1 and 6 years				[d]
No	62.9	37.1	1.0	
Yes	53.7	46.3	0.7 (0.3–1.4)	
P			0.401	
Breastfeeding				[d]
≥9 months	49.2	50.8	1.0	
4–8.9 months	65.7	34.3	0.5 (0.2–1.0)	
1–3.9 months	53.1	46.9	0.8 (0.5–1.6)	
<1 month	53.2	46.8	0.9 (0.4–1.8)	
P			0.242	
Bottle-feeding at night				[d]
No	59.1	40.9	1.0	
Yes	53.8	46.2	1.2 (0.7–2.4)	
P			0.632	

[a]Unadjusted crude univariate analysis.
[b]Adjusted for children's life course variables.
[c]Chi-squared test.
[d]Variable not included in the multiple logistic regression analysis ($P > 0.2$ when chi-squared text was performed).
[e]Fisher exact test.

and biological damage (37, 38). Several epidemiological studies reported delay in both tooth eruption (39–41) and delay in the peak time for caries in malnourished children (16). Therefore, the time of eruption or the number of erupted teeth must be controlled for in epidemiological studies to avoid bias. And, comparisons between countries with different levels of malnutrition should be viewed with caution.

Birth weight, a critical measure involved in the life course approach, was not associated with high dental caries. Moreover, interaction between birth weight and long-term malnutrition was tested and was not associated with severity dental caries. It shows that the only biological explanation linked to dental caries in very early life is the role of stunting, as explained before stressing the postnatal effects. The importance of these results for all

Table 4. Associations between oral behaviours, children's care and high level of dental caries (dmft ≥ 4). Pelotas, Brazil, 1999 (n = 359)

Variables	dmft ≤ 1%	dmft ≥ 4%	OR (95% CI)[a]	OR (95% CI)[b]
Day care centre attendance at 6 months				[d]
Yes	74.9	23.1	1.0	
No	54.0	46.0	3.4 (0.9–13.9)	
P^c			0.180	
Day care centre attendance at 12 months				[d]
Yes	78.6	21.4	1.0	
No	53.6	46.4	3.0 (0.8–10.6)	
P			0.120	
Day care centre attendance at sixth years of children life				
Yes	74.2	25.8	1.0	1.0
No	49.6	50.4	2.9 (1.5–5.3)	2.5 (1.3–4.8)
P			0.001	0.006
Access to the dentist at sixth years of children life				[e]
Yes	54.8	45.2	1.0	
No	54.5	45.5	1.0 (0.6–1.7)	
P			1.000	
Times/day brush teeth				
≥3	64.6	35.4	1.0	1.0
1–2	47.2	52.8	2.0 (1.3–3.3)	1.8 (1.1–2.9)
Less than once a day	28.6	71.4	4.2 (1.5–11.2)	4.2 (1.5–11.6)
P			0.001	0.008
Does someone help the child toothbrush at 6 years				[e]
Yes	54.8	54.2	1.0	
No	54.3	45.7	1.0 (0.6–1.6)	
P			1.000	
Use of dental floss at 6 years				[d]
Yes	71.4	28.6	1.0	
No	53.0	47.0	2.2 (0.9–5.1)	
P			0.097	
When did the child begin brushing teeth				[d]
At the time of eruption of the first teeth	63.6	36.4	1.0	
After 1 year	50.3	49.7	1.7 (1.0–2.9)	
P			0.044	
Educational oral health attendance at school at 6 years				[e]
Yes	58.8	41.2	1.0	
No	52.0	48.0	1.3 (0.8–2.1)	
P			0.301	
Sweet consumption at 6 years				
Almost never/less than once a day	67.0	33.0	1.0	1.0
Every day at least once	48.1	51.9	2.2 (1.3–3.6)	2.4 (1.4–4.1)
P			0.003	0.004
Use of chewing gum at 6 years				[e]
No	55.7	44.3	1.0	
Yes	51.6	48.4	1.2 (0.7–2.0)	
P			0.656	
What does the child drink regularly				[e]
Water	56.7	43.3	1.0	
Other	50.0	50.0	1.3 (0.8–2.2)	
P			0.369	

[a]Unadjusted crude univariate analysis.
[b]Adjusted for children's care and oral behavioural variables.
[c]Chi-squared test.
[d]Variable excluded of the multiple logistic regression analysis after lost statistic significance when it was controlled by other oral behaviours and children's care variables (P < 0.2).
[e]Variable not included in the multiple logistic regression analysis (P > 0.2 when chi-squared text was performed).

populations depends both of the prevalence of dental caries and malnutrition. According to UNICEF (42), approximately one in three children under 5 years suffers from protein-energy malnutrition in developing countries. Our findings have serious implications in such countries because a

Table 5. Hierarchical final model. Multiple logistic regression analysis of the relationship between children's life course variables and high level of dental caries (dmft ≥ 4)

Variable	OR (95% CI)[a]	$P^{a,b}$	OR (95% CI)[c]	P^{c}
Socioeconomic level[d]				
Social class at child's birth		0.001		0.078
Employers/professionals	1.0		1.0	
Self-employed	14.4 (2.2–94.1)		8.7 (1.3–58.9)	
Employees/unemployed	13.5 (2.2–82.9)		7.7 (1.2–49.6)	
Father educational level at children birth		<0.001		0.031
>8 years	1.0		1.0	
≤8 years	3.1 (1.7–5.4)		2.2 (1.2–4.1)	
Demographic and children's life course variables[e]				
Sex		0.615		0.932
Male	1.0		1.0	
Female	0.9 (0.5–1.4)		1.0 (0.6–1.7)	
Number of teeth at 12 months		0.638		0.111
<5	1.0		1.0	
≥5	1.2 (0.7–1.8)		1.5 (0.9–2.5)	
Height by age at 12 months		0.009		0.020
Adequate (>2 Z-scores)	1.0		1.0	
Inadequate (≤2 Z-scores)	4.1 (1.4–12.3)		3.6 (1.1–11.1)	
Oral behaviours and children's care[f]				
Day care centre attendance at sixth years of children life		0.001		0.017
Yes	1.0		1.0	
No	2.9 (1.5–5.3)		2.3 (1.2–4.7)	
Sweet consumption at 6 years		0.003		0.017
Almost never/less than once a day	1.0		1.0	
Every day at least once	2.2 (1.3–3.6)		2.3 (1.3–3.9)	
Times/day brush teeth		0.001		0.050
≥3	1.0		1.0	
1–2	2.0 (1.3–3.3)		1.6 (0.9–2.8)	
Less than once a day	4.2 (1.5–11.2)		3.1 (1.1–9.0)	

[a]Unadjusted crude univariate analysis.
[b]Chi-squared test; Hosmer and Lemeshow test ($P = 0.9058$).
[c]Adjusted for all variables in the same level.
[d]Adjusted by socioeconomic variables.
[e]Adjusted by demographic, children's life course and socioeconomic variables.
[f]Adjusted by oral behaviours and children's care, children's life course and socioeconomic variables.

moderate risk applied to a high proportion of the exposed population would produce more cases of disease than a high exposure relating to a small proportion of the population (43).

The role of day care centres was important for the children's dental health. This link needs further research. It was unclear whether it was because early oral health education and prevention was carried out or because the preschool atmosphere was conducive for the acquisition of oral health habits. The second hypothesis may be more realistic because the role of educational oral heath attendance at school was analysed and did not show an association with a high level of dental caries. According to a Brazilian UNICEF report (44) children whose parents are poor but who attended day care centres had more opportunities in adult life. For example, poor Brazilian children who attended preschool for 2 years increased their purchasing power by 18% when adult.

The last and more proximate risk factor for caries, which was investigated, was sugar intake. The Brazilian sugar consumption (sugar and soft drinks) has increased in the last two decades to almost 15% of energy intake (45). Pelotas is known as 'the Capital of sweets in Brazil' and its economy is dependent on the manufacture of sweets, mostly based on Portuguese recipes. Unfortunately, we do not have sugar consumption records in the follow-up study.

Some comments on methodology are relevant. First, we decided on a dental caries cut-off point for high caries (dmft ≥ 4) for both theoretical and statistical reasons. The population in the highest tertile of frequency distribution are those who attended dental services with more treatment need (46, 47). On the other hand, a child with dmft equal to one may be considered as acceptable because dental caries is almost impossible to eradicate.

There are very few birth cohort studies that include oral health. All medical data were collected in our follow-up study avoiding common problems, such as recall bias, which occur in cross-sectional and case–control studies. Furthermore, the population studied was a random representative sample of births in Pelotas in 1993. On the other hand, the sample comes from a relatively wealthy part of Brazil. More studies, particularly in the poorer North and North East of Brazil are necessary to confirm our findings. Multicentre studies are needed to elucidate whether the same pattern occurs in other countries with different social conditions, different patterns of sugar consumption, and different levels of access to preventive measures. From the results of this study we can conclude that political changes, expressed as health and social policies, are more important to reduce dental caries than specific treatment and preventive measures used in dentistry. Based on the findings from this study, recommendations to general and health policy decision makers to improve oral health includes: 1) improvement in general socioeconomic indicators such as educational level; 2) a food and health policy to prevent malnutrition, and, especially related to dental public health, 3) to improve the pattern of oral cleanliness and the implementation of policies to reduce sugar consumption. Childhood is the most crucial time to break the poverty cycle (43). The current role of dentistry is mainly to mitigate pain and suffering. Strategies for oral health care should include intersectoral approaches to health promotion based upon a population strategy and a common risk factor approach.

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