

Teething Symptoms in the First Year of Life and Associated Factors: A Cohort Study

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Objective: To investigate the occurrence and management of teething symptoms during the first year of life and associated factors. **Study design:** 500 children were recruited at birth. Research assessments including structured interviews, anthropometric measurements and dental examination were carried out after birth, at 6 months and at one-year of age. The primary outcome of this study was defined as the occurrence of one or more teething symptoms within the first year of life, as reported by the mother. **Results:** Teething symptoms were reported in 73% of the children analyzed (273/375). The symptoms most frequently reported were irritability (40.5%), fever (38.9%), diarrhoea (36.0%) and itching (33.6%). Dentists had little influence on the management of symptoms and self-medication to relieve them was a common practice. The risk of reporting teething symptoms was higher for children from nuclear families ($p=0.040$) and for children from families with higher income ($p=0.040$). **Conclusions:** Teething symptoms were highly reported in this population. Pediatric dentists should be accessible and provide adequate orientation when symptoms can be managed at home or immediate referral to health services when more serious diseases are suspected.

Keywords: tooth eruption, teething, tooth, deciduous; primary, signs and symptoms.

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INTRODUCTION

Tooth eruption represents a natural physiological process by which a tooth moves from its site of development to its final functional position in the oral cavity.¹ However, general and oral symptoms have been related to teething in early childhood.²⁻⁵ Much of the data about possible manifestations of tooth eruption have been obtained from studies with significant methodological limitations such as small sample size, cross-sectional design and samples of institutionalized children.^{4, 6-7} Furthermore, many studies rely on parents' information of symptoms that occur a long time prior to being reported, which indicates that information bias has probably occurred.⁴

Symptoms attributed to tooth eruption are often responsi-

ble for the referral of toddlers to medical or dental professionals or prompt parents to administer medications to children on their own initiative.⁷⁻⁹ However, parents are confronted by a lack of consensus on the subject among health professionals.⁹⁻¹⁰ In truth, it remains unclear whether these disturbances are caused by the eruption, are just related to it or whether they simply coincide with tooth eruption. A lack of evidence makes diagnosis problematic and may prevent professionals from effectively managing some common developmental issues of infancy and could lead to late diagnosis of important illnesses.¹¹

Prospective studies investigating the distribution of the different symptoms observed by parents during the first year of their children's lives and associated factors can contribute to an understanding of these phenomena. This knowledge can help in differentiating between true symptoms of teething and the unfounded beliefs of each population, thereby contributing to adoption of the best management.

The aim of this prospective cohort study was to estimate the occurrence of teething symptoms perceived by parents during the first year of life and its association with anthropometric, socioeconomic and general health variables. Additionally, the parents' management of teething symptoms was also investigated.

MATERIAL AND METHODS

Subjects and Study Design

This cohort study is nested in a randomized trial which

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investigated the effectiveness of nutritional advice about breastfeeding and healthy weaning based on WHO recommendations in the city of São Leopoldo, south Brazil (12). The children were recruited in the maternity clinic of the town's only publicly-funded hospital, which mainly serves the low-income population.

A sample of 350 one-year-old-children in the larger study was estimated to detect the effect of the intervention during the first year. Then, allowing for confounding and losses of 25% during the follow up, 500 children were recruited at the outset of the trial (at birth). In order to estimate whether this sample size would be sufficient to estimate the occurrence of teething symptoms reported by mothers, the following parameters were adopted: 95% confidence level, 80% power, 3% margin of error with an outcome frequency of 87% (2). The resulting minimum sample size was 326 children.

All mothers who gave birth to an apparently normal, single, full term (≥ 37 weeks) and normal birth-weight ($\geq 2,500$ g) baby and who did not have an impediment to breastfeeding (HIV/AIDS) were invited to participate in the larger study, until the desired sample size was reached; 90% of those invited agreed to participate after being informed of the research procedures.

Data collection

Data collection consisted of face-to-face structured interviews with mothers and anthropometric measurements and dental examination of their children. At birth, demographic, socioeconomic and anthropometric variables were investigated: sex, weight and length, mother's education (number of years of schooling) and *per capita* income. Birth weight and length were dichotomized as the lowest decile and the 9 other deciles. The monthly wages of all economically active members of the family were summed and divided by the number of people living in the house. The *per capita* income (in local currency) was divided by the Brazilian Minimum Wage (BMW: about US \$100.00) and then stratified in three categories (< 0.5 BMW; 0.5 to 1.0 BMW; > 1.0 BMW).

At six months, family structure (nuclear: child living with mother and father; non-nuclear: child not living with both parents) and exclusive breastfeeding duration were assessed during home visits. Exclusive breastfeeding was defined as when the child was only fed breastmilk, without water or any other liquid or solid food.

At 12 months, mothers were asked at their homes about the occurrence of the following health conditions during the previous 6 months: symptoms of respiratory morbidity (cough, runny nose, stuffy nose or breathlessness), any kind of infection (especially intestinal or urinary tract infections) and hospital admission. Then, mothers were asked about the occurrence of any symptom during eruption of teeth. All symptoms reported by the parents were recorded. The primary outcome of this study—occurrence of teething symptoms—was defined as when a mother had reported one or more symptoms. Additionally, parents who reported teething symptoms were asked if they had taken any action. If the answer was affirmative, they were asked who had prescribed

the action. The questionnaires were previously tested in a pilot study of 16 mothers of children aged 12 months attending primary care services, and modified accordingly.

Between 12 and 16 months, dental examinations were conducted at a Municipal Health Centre by a paediatric dentist (C.A.F.) to assess dental caries and traumatic dental injuries. Results concerning those outcomes have been published previously.¹³⁻¹⁴ For the present study, the number of erupted teeth was registered because this variable may confound the association between the other independent variables and teething symptoms. The teeth were inspected under natural light, with the help of a mouth mirror and with the child lying on a stretcher. A tooth was considered erupted if any part of the dental crown appeared on the mucosa.

Statistical Analysis

The statistical analysis was performed using SPSS 16.0. Since this study is nested in a randomized trial of the effectiveness of a nutritional program on other outcomes, frequencies of reporting teething symptoms at one year had to be compared between groups (intervention versus control) to confirm the assumed hypothesis that the intervention had no effect on the frequency of this outcome. Confirmation of this hypothesis allowed children from the intervention group to be analyzed together, increasing the study's power. In a first step, the distribution of symptoms was evaluated by descriptive methods. Second, relative frequencies of the primary outcome according to the independent variables were obtained. Unadjusted and adjusted relative risks of the outcome were estimated with Poisson regression with robust variance. Initially, relative risks and 95% confidence intervals (95% CI) were estimated separately for each variable. Then, a series of multivariable models were constructed, starting with all available independent variables and confounders for the outcomes using backward elimination when the Wald *p*-value was higher than 0.05. The variable "number of erupted teeth" was retained in the models irrespective of the statistical significance. Interactions were evaluated by Wald tests in the final model.

Ethical Aspects

This study was approved by the Ethics Committee at the Universidade Federal do Rio Grande do Sul. The parents gave written informed consent for the various research procedures. Children with dental problems requiring any professional intervention were referred for treatment at the Paediatric Dental Clinic of the Lutheran University of Brazil. At one-year assessment all children had nutritional evaluation (anthropometric measurements, blood hemoglobin count) and development examinations. Children with anemia, overweight, or developmental problems were referred to their primary care pediatricians for further assessment and treatment.

RESULTS

Of the 500 children initially recruited, 397 underwent the 6-month research assessment; and, at the one-year assessment,

outcome data were collected and oral examinations carried out on 378 of them. The reasons for losses to follow up were: address not found (n=31), refusal (n=22), family moved to another city (n=43), infant given for adoption (n=1), genetic illness in the child (n=2), child death (n=2), severe illness of the mother (n=1), maternal death (n=1) and non-attendance at the dental examination (n=19). Three children were excluded from the analysis this study: two were pre-eruptive and the data on another child regarding manifestations of dental eruption were incomplete. Of the 375 children analyzed, 220 were boys (58.5%) and 156 girls (41.5%); their ages ranged from 12.0 to 16.0 months, with 86% of them being examined at 12 to 14 months of age; the number of teeth varied from 1 to 16 per child (mean=7.55; SD=3.17).

Teething symptoms were reported in 72.8% (273/375) of the children (Table 1). More than one third of the parents (136/375) reported both general and oral symptoms. Exclusively general symptoms were reported in 119/375 (31.7%) of the children, while exclusively oral symptoms were reported in 18/375 (4.8%) of them. The symptoms most frequently reported were irritability (40.5%), fever (38.9%), diarrhoea (36.0%), gingival itching (33.6%) and

Table 1. Distribution of teething symptoms during the first year of life among the whole sample (N=375).

| Type of symptom | With symptoms | |
|---------------------------------|---------------|--------|
| | n | (%) |
| General or local symptom | 273 | (72.8) |
| General symptoms | 255 | (68.0) |
| Irritability | 152 | (40.5) |
| Fever | 146 | (38.9) |
| Diarrhoea | 135 | (36.0) |
| Sleep disturbance | 38 | (10.1) |
| Less appetite | 35 | (9.3) |
| Local symptoms | 154 | (41.1) |
| Gingival itching | 126 | (33.6) |
| Drooling/dribbling | 96 | (25.6) |
| Pain | 36 | (9.6) |
| Gingival inflammation | 24 | (6.4) |

drooling/dribbling (25.6%). Sleep disturbance, pain, reduced appetite and gingival inflammation were also reported.

A total of 57% (157/273) of the parents took some type of action in order to relieve the symptoms they described; 25.1% (n=69) applied a topical analgesic of some sort,

Table 2. Poisson regression: Unadjusted Relative Risk (RR) and 95% confidence intervals (95% CI) for the association between independent variables and teething symptoms.

| Variables | N | With teething symptoms n (%) | RR | (95% CI) | p value |
|---|-----|---------------------------------|------|-------------|---------|
| Sex | | | | | |
| Male | 220 | 161 (73.2) | 1.01 | (0.89–1.15) | 0.844 |
| Female | 155 | 112 (72.3) | 1 | | |
| Weight at birth | | | | | |
| < 2,800 g | 40 | 27 (67.5) | 0.92 | (0.73–1.15) | 0.462 |
| ≥ 2,800 g | 335 | 246 (73.4) | 1 | | |
| Length at birth | | | | | |
| < 47 cm | 43 | 31 (72.1) | 0.99 | (0.81–1.20) | 0.913 |
| ≥ 47 cm | 332 | 242 (72.9) | 1 | | |
| Mother's level of education | | | | | |
| < 4 years | 36 | 24 (66.7) | 1 | | |
| 4 – 8 years | 233 | 170 (73.0) | 1.09 | (0.86–1.40) | 0.468 |
| > 8 years | 103 | 77 (74.8) | 1.12 | (0.87–1.45) | 0.382 |
| Per capita income (BMW*) | | | | | |
| < 0.5 | 120 | 83 (69.2) | 1 | | |
| 0.5 - 1 | 169 | 123 (72.8) | 1.05 | (0.90–1.22) | 0.505 |
| > 1 | 73 | 60 (82.2) | 1.19 | (1.01–1.39) | 0.035 |
| Family structure | | | | | |
| Nuclear | 266 | 203 (76.3) | 1.20 | (1.02–1.41) | 0.024 |
| Non-nuclear | 104 | 66 (63.5) | 1 | | |
| Exclusive breastfeeding duration | | | | | |
| < 4 months | 234 | 168 (71.8) | 0.95 | (0.84–1.08) | 0.469 |
| ≥ 4 months | 118 | 89 (75.4) | 1 | | |
| Hospital admission (previous 6 months) | | | | | |
| Yes | 20 | 15 (75.0) | 1.03 | (0.80–1.34) | 0.801 |
| No | 353 | 256 (72.5) | 1 | | |
| Any kind of infection (previous 6 months) | | | | | |
| Yes | 96 | 70 (72.9) | 1.04 | (0.90–1.20) | 0.628 |
| No | 246 | 173 (70.3) | 1 | | |
| Respiratory symptoms (previous 6 months) | | | | | |
| Yes | 131 | 102 (77.9) | 1.11 | (0.99–1.26) | 0.084 |
| No | 242 | 169 (69.8) | 1 | | |
| Number of teeth (at one year) | | | | | |
| < 5 | 64 | 44 (68.8) | 1 | | |
| 5 - 8 | 201 | 148 (73.6) | 1.07 | (0.89–1.29) | 0.467 |
| > 8 | 110 | 81 (73.6) | 1.07 | (0.88–1.31) | 0.500 |

* BMW=Brazilian Minimum Wage

23.6% (n=65) administered a systemic analgesic or antipyretic, 7.6% (n=21) gave the child a teething ring, 6.9% (n=19) gave tea and 4% (n=11) gave the child home-made oral rehydration solution. The actions taken were self-prescribed by 43.3% (68/157) of the mothers, indicated by a health professional in 41.4% (65/157) of cases (pediatricians: n=56; dentists: n=9) and 15.3% (24/157) of mothers were following lay advice.

There was no difference between intervention and control groups in terms of the proportion of mothers reporting teething symptoms (112/157: 71.3% versus 161/218: 73.9%), demonstrating that the intervention had no effect on the likelihood of symptoms (chi-square test: $p=0.589$).

The results of the univariate Poisson regression analysis are shown in Table 2. Significant associations were observed between the occurrence of teething symptoms in the first year of life and per capita income and family structure. The univariate analysis did not detect any association between the primary outcome and sex, number of erupted teeth, maternal level of education, exclusive breastfeeding, birth weight and length, symptoms of respiratory morbidity, any kind of infection or hospitalization.

Table 3 presents the final multivariable model. The risk of reporting teething symptoms was higher when per capita income was ≥ 1 BMW compared to < 0.5 BMW (RR 1.18; 95% CI 1.01-1.39) and for children from nuclear compared to non-nuclear families (RR 1.18; 95% CI 1.01-1.38). None of the other independent variables remained in the multivariable model after backward elimination and no statistically significant interactions were found between variables.

Table 3. Association of per capita income and family structure with teething symptoms at one year of age. Final model after adjusting for confounding.

| Variables | RR† | IC (95%) | p value |
|--------------------------|------|-------------|---------|
| Per capita income (BMW*) | | | |
| < 0.5 | 1 | | |
| 0.5 - 1 | 1.06 | (0.91-1.23) | 0.477 |
| > 1 | 1.18 | (1.01-1.39) | 0.040 |
| Family structure | | | |
| Nuclear | 1.18 | (1.01-1.38) | 0.040 |
| Non-nuclear | 1 | | |

* BMW=Brazilian Minimum Wage

† Relative Risk: adjusted for the other variable in the model and number of teeth at one year of age

DISCUSSION

Teething symptoms described by the children's mothers varied from simple manifestations that could be dealt with at home, such as gingival itching and drooling/dribbling to symptoms which could require medical attention, such as loss of appetite, fever and diarrhoea. All of these symptoms have been described as being related to tooth eruption in other populations.^{2,4,15-19} Although the children in this sample did manifest important diseases during their first year of life, including hospital admissions and two deaths,¹³ their parents

did not relate any of these conditions to teething. These findings are different to what has been observed with other populations, where more severe symptoms, such as convulsions, vomiting, abnormal urine, respiratory tract infections or cutaneous eruptions were all described by parents as being related to tooth eruption.^{15,20-21} Differences in the sampling process (representative sample versus institutionalized sample) and differences in beliefs between populations are possible explanations for this finding.

The high proportion of mothers who took action on their own initiative or on the basis of lay advice is a significant cause for concern in a range of symptoms or insults to children's health. Notwithstanding the fact that populations in developing countries have greater difficulty in accessing professional care, the findings of this study are possibly a reflection of a feeling on the part of the mothers that these symptoms do not need specialized attention, which could have serious repercussions in certain isolated situations.⁵ This would appear to be an important gap in the guidance given to expectant mothers and mothers of children in their first year of life in similar populations. The small proportion of mothers who took action on the basis of a dentist's recommendations indicates how little influence these professionals have on cases of teething symptoms. Further researches are needed to investigate to what extent these results are determined by cultural characteristics of this population or by difficulties in accessing dental care for young children.

The action taken by professionals faced with reports of teething symptoms should take account of the type/severity of the symptom reported. It is possible that an "oscillating" pattern of eruption may be accompanied by certain other alterations such as gingival erythema, thumb sucking, drooling/dribbling and loss of appetite on the days preceding or succeeding break-through of teeth into the oral cavity.^{4,7} Although hypotheses have already been offered as to how tooth eruption might cause general symptoms,²²⁻²³ there is still no consensus on the plausibility of the occurrence of symptoms such as fever and diarrhoea.^{4,7,17} Symptoms such as temporary lack of appetite and minor increases in temperature are day-to-day conditions in infancy and can be dealt with by parents during the first few days, irrespective of whether their appearance is concurrent with teething. However, it is not plausible for them to last for more than 5 to 7 days, which would indicate a need for medical attention. In contrast, symptoms such as vomiting or convulsions could indicate more serious health problems and are indications for immediate medical consultation to investigate the child's general health. In truth, there are no symptoms or signs that are so pathognomonic of teething that they would allow for parents to be reassured without further management.²⁴ Conditions such as respiratory tract infections, herpetic encephalitis and bacterial meningitis have been diagnosed in children who sought medical attention for teething symptoms,²⁵⁻²⁶ indicating a clear need for professional monitoring.

Anthropometric variables and details of feeding practices

appear to have an effect on the time of tooth eruption.²⁷ Nevertheless, even though they may be associated with diseases during the first year of life, and even with infant mortality, no association was detected in this study between the outcome and birth weight and length or with exclusive breastfeeding. Furthermore, teething symptoms were not associated with any of the medical conditions assessed (infections, respiratory symptoms or hospital admissions), suggesting that they did not have any confounding effect on the outcome.

Similar teething symptoms have been reported among parents from different socioeconomic strata, suggesting that socioeconomic status does not have an influence on beliefs with relation to eruption symptoms.⁸ The association observed in this study between the outcome and per capita income and family structure may be more a reflection of high socioeconomic status families taking greater care of their children than of them having increased susceptibility to the symptoms. It is possible that these mothers are more health responsive, more likely to maintain good practices and more likely to have positive health attitudes,²⁸ including paying more attention to symptoms that appear during the first year of life.

Some aspects of the methodology of this investigation merit comment. At the beginning of the study the researchers collected extensive identification data in order to minimize losses. Nevertheless, a significant number of families moved away within the first weeks after the child's birth without letting the research staffs know. This is a common problem in cohort studies, chiefly in populations with high mobility, and constitutes a limitation of the present study.

The possibility of information bias has to be considered, since the investigators had to rely on participants' memories. However, the period between the occurrence of teething symptoms and data collection was never longer than 6 months, thus limiting this bias. Furthermore, the effects of variables are more likely to be attenuated than increased by this phenomenon.²⁹ Most variables in this study were collected at families' homes, which possibly contributed towards the report of actual data by the mothers.

Several different studies have investigated teething symptoms in institutionalized children, which clearly indicate selection bias.⁷ The sample assessed in this study is representative and selection bias is not a limitation. Therefore, the results can be extrapolated to populations with similar levels of exposure, such as low socioeconomic status and poor access to professional healthcare.

Finally, this study has described a high occurrence of reported teething symptoms, demonstrating the importance of healthcare professionals being prepared to deal with the various different situations involved. This preparation consists primarily of acquiring the ability to differentiate between conditions that demand immediate professional attention and simple reports that could indeed be related to teething or other conditions that can be dealt with at home over the short term.^{4,7} Drooling/dribbling, gingival itching and sleep disturbance represent normal developmental

stages rather than pathologies⁴ and require either observation or simple, effective measures such as sleep and behaviour management programs.^{4,30} On the other hand, teething may be a scapegoat for many other events occurring between 6 and 24 months, including sudden rises in respiratory, middle ear, and diarrhoeal infections.²⁰ The erroneous belief that certain symptoms are due to teething may prevent prompt assessment and management of a range of illnesses, with serious consequences.^{4,5,7,11} Furthermore, professionals should contribute towards reducing self-medication, by which children are given oral and/or topical medication over periods of months to years,⁸ and which can involve both financial costs and health risks.

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