



# Clinical manifestations of tooth eruption in the first year of life and related risk factors in three regions of Brazil: multicenter birth cohort study

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Received: 6 July 2022 / Accepted: 30 September 2022 / Published online: 14 October 2022  
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## Abstract

**Purpose** Estimate the incidence of teething symptoms and investigate risk factors at three centers in different regions of Brazil.

**Methods** A prospective cohort study enrolled children at birth in the cities of Manaus (northern region), Porto Alegre (southern region) and Salvador (northeast region). Sociodemographic and anthropometric variables were collected at baseline and 6 months. At 12 months, data were collected on the child's health through structured interviews and dental examinations, including the primary outcome: occurrence of signs and symptoms of tooth eruption reported by parents. Statistical analysis involved Poisson regression with robust variance, with calculation of relative risks (RR).

**Results** The incidence of teething symptoms was 82.4% (238/289). The multivariate analysis revealed a higher occurrence of the outcome in the city of Salvador (RR = 1.39; 95% CI 1.23–1.58), when mother's education was more than 11 years (RR = 1.31; 95% CI 1.04–1.65), when a larger number of individuals resided in the home (RR = 1.15; 95% CI 1.02–1.29), when a smoker resided in the home (RR = 1.16; 95% CI 1.03–1.31) and when the child presented flu or cold in the first year of life (RR = 1.23; 95% CI 1.09–1.38). The most reported symptoms were fever (50.5%), irritability (42.6%), itching (40.8%) and diarrhea (35.3%). Most parents (82%) took some action to alleviate symptoms, including unprescribed systemic medication, such as analgesic, anti-inflammatory and anti-diarrheic agents.

**Conclusion** Reports of teething symptoms were associated with the city investigated, socioeconomic factors of the families and characteristics of the child's health. A high rate of administering unprescribed medication was also found.

**Keywords** Tooth eruption · Signs and symptoms · Tooth · Deciduous · Pediatric dentistry

## Introduction

Although tooth eruption is a physiological process, epidemiological studies in different communities throughout the world describe 60–90% rates of general or local signs and symptoms of teething reported by parents, caregivers and health care providers (Wake et al. 2000; Peretz et al. 2003; Feldens et al. 2010; Kiran et al. 2011; Ramos-Jorge et al. 2011; Memarpour et al. 2015; Massignan et al. 2016). The manifestations most attributed to teething are irritability, pain, fever, diarrhea, increased salivation, a reduction in appetite and sleep disturbance (Macknin et al. 2000; Peretz et al. 2003; Feldens et al. 2010; Memarpour et al. 2015; Lopes-Silva et al. 2021).

Two types of studies are generally conducted to capture the occurrence of signs and symptoms of teething. The first type involves the recording of signs and symptoms that

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occurred during tooth eruption in the previous months or years (Peretz et al. 2003; Feldens et al. 2010; Lam et al. 2016; Kiran et al. 2011). Such studies generally have an adequate sample size, which confers precision to the estimates and enables the detection of risk factors. However, the outcome is based on the perceptions of parents or caregivers, which can be influenced by cultural aspects of the community and are subject to recall bias (Feldens et al. 2010; Lam et al. 2016). The other method is the day-to-day follow-up of the eruption of different tooth groups by a team of caregivers at a school or health center who record signs and symptoms that occur simultaneously, such as the daily reading of temperature (Wake et al. 2000; Macknin et al. 2000; Ramos-Jorge et al. 2011; Memarpour et al. 2015). Although the exposure and outcome variables are collected with greater validity, such studies generally have a small sample size, which reduces the precision of the estimates, and the sample is composed of either highly selected or institutionalized children (Wake et al. 2000; Macknin et al. 2000; Ramos-Jorge et al. 2011; Memarpour et al. 2015).

The scarcity of evidence on clinical manifestations associated with tooth eruption impedes more uniform, adequate management on the part of health care providers. As a consequence, parents may medicate their children without first consulting a physician. Such actions may involve the application of a topical anesthetic or the administration of systemic medications, incurring the risks of self-medication (Feldens et al. 2010; Getaneh et al. 2018; Teixeira et al. 2019; FDA 2022). Moreover, inadequately attributing symptoms to teething could delay the diagnosis of conditions that occur simultaneously, which can place the child's health at risk. The clarification of these issues requires longitudinal studies with an adequate sample size and the controlling of variables related to the child's health to provide parents and health teams with more comprehensive information (Feldens et al. 2010; Lam et al. 2016).

Therefore, the aim of the present birth cohort study was to estimate the incidence of parent-reported signs and symptoms of teething in the first year of life, and investigate demographic, socioeconomic, behavioral and health-related risk factors in three cities located in different regions of Brazil. Local and systemic actions taken on the part of parents to deal with the symptoms were also described.

## Methods

### Study design and sample

The present prospective cohort study is part of a randomized clinical trial that investigated the effectiveness of dietary and nutritional counseling to mothers who had recently given birth to prevent the early introduction of sugar and

ultra-processed foods in the first year of life of their newborn children. Mother–child pairs ( $n = 516$ ) were recruited at the birth of the child at public hospitals in three state capitals of Brazil (Manaus, Salvador and Porto Alegre). These cities are, respectively, located in the northern, northeastern and southern regions of the country, and their populations have distinct sociodemographic characteristics: Manaus: 2.25 million inhabitants, infant mortality rate 12.8, Human development index (HDI): 0.737; Salvador: 2.90 million inhabitants, infant mortality rate 14.8, HDI: 0.759; Porto Alegre: 1.41 million inhabitants, infant mortality rate 7.8, HDI: 0.805.

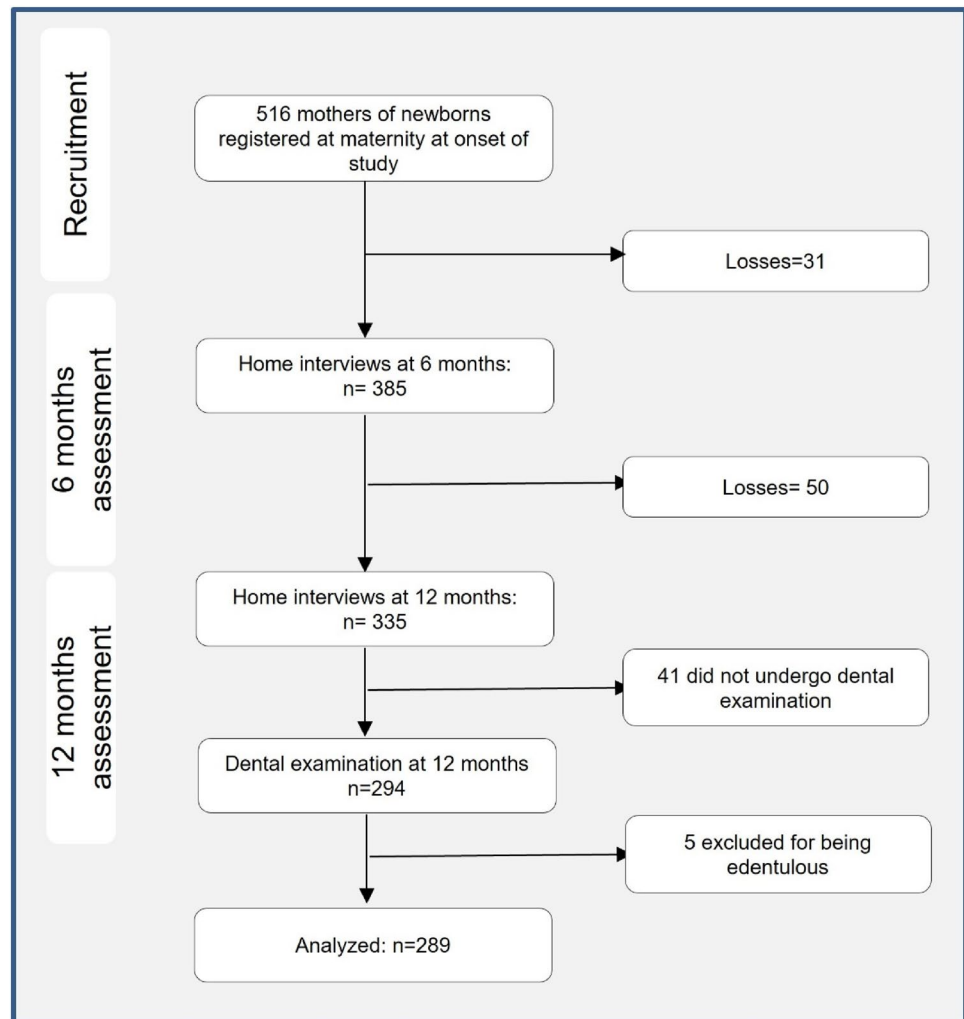
The sample size was calculated considering the estimate of a reduction in the prevalence of children who consume sugar in the first year of life in a previous study (60% consumption in the control group and 30% in the intervention group) (Vitolo et al. 2014), a 95% power and 5% significance level, which determined a minimum sample of 342 children. A design factor of 1.2 was applied due to the cluster sampling procedure and 20% was added to compensate for possible dropouts, leading to a sample of 504 children. The number of children retained at 12 months ( $n = 289$ ) determined the sample size of the present investigation. The post hoc calculation demonstrated that this study had a 99% power to detect a difference in the occurrence of clinical manifestations of tooth eruption in children between the cities of Salvador (95.3%;  $n = 102/107$ ) and Porto Alegre (74.6%;  $n = 88/118$ ). Figure 1 displays the flowchart of the cohort.

The inclusion criteria were mothers 18 years of age or older, negative for HIV and HTLV-1, single live birth and newborns with no clinical complications or other conditions that impeded breastfeeding. For the present study, children without teeth erupted by the dental examination at 12 months of age were excluded from the analysis.

### Data collection

An interview was held with the mother after the birth of the child, and data were collected from the child's records and mother's medical chart to obtain the following: mother's education (in complete years of study and categorized as < 8 years, 8–11 years or > 11 years), first pre-natal appointment (categorized as first trimester or later), mother's age (in complete years and categorized in terciles), family structure (nuclear [both father and mother live with child] or non-nuclear), number of residents in the home (categorized by the median), whether a grandparent participated in child care and whether any smokers resided in the home. The following data on the child's birth were collected: sex, birth weight (categorized as low or normal) and birth length (categorized as < or  $\geq 48$  cm).

At 6 months, interviews were held with the mothers at their homes and the following anthropometric data were

**Fig. 1** Flowchart of cohort

collected: body mass index (categorized as  $<$  or  $\geq +2$  standard deviations), duration of breastfeeding (categorized as  $<$  or  $\geq 6$  month), whether the child attended day-care and whether the child used a pacifier.

At 12 meses, interviews were held with the mothers at their homes and the following data related to the first year of life were collected: hospitalization, history of influenza or common cold diagnosed by a physician, use of anti-allergic agent, use of antibiotic in the first year of life, age at eruption of the first tooth (categorized as  $\leq$  or  $> 6$  meses) and occurrence of signs and symptoms of teething in the first year of life. In cases of an affirmative answer, the mothers were asked about the type of sign or symptom observed, whether any local or general measure was taken and what measure was taken. The outcome of the study was the occurrence of at least one sign or symptom of teething. The presence of erupted teeth at 12 months was collected during a dental clinical examination. All teeth erupted in the oral cavity were recorded.

## Data analysis

Statistical analysis was performed with the aid of SPSS version 20. The outcome (report of signs and symptoms of teething) was expressed as absolute and relative frequency in the overall sample and in the categories of the independent variables. Proportion differences between categories were evaluated using the Chi-squared test. Poisson regression with robust variance was then performed with the calculation of unadjusted and adjusted relative risk (RR) values and respective 95% confidence intervals (CI). A hierarchical model was used with the division of the independent variables into three blocks according to the data collection period: variables related to the family and child at birth, variables related to the child at six months and variables related to the child at 12 months. Adjustments were made for all variables in the same block and hierarchically superior blocks. The significance level was set a 5% ( $p < 0.05$ ). The post hoc analysis was performed with the chi-squared test

to investigate the occurrence of differences between cities regarding the frequency of the different signs and symptoms reported.

## Results

Among the initially recruited mother–child pairs, 385 (74.6%) were evaluated at 6 months and 335 (65.7%) were evaluated at 12 months. Forty-one children did not appear for the dental examination and five children were excluded for being edentulous. The predominant reasons for losses during the first year of life were having moved to another city and addresses not encountered. The sample analyzed ( $n=289$ ) was similar to the originally recruited sample with regards to the baseline variables (Table 1); the only statistically significant difference was mean age of the mothers, which was approximately 1 year older in the sample analyzed compared to the mothers lost to follow-up (27.8 versus 26.6 years of age at the birth of the child;  $p=0.049$ ). Mean (standard deviation) mothers education was 10.0 (2.6) years and most families had a nuclear structure (75.3%).

Table 2 shows that the occurrence of sign and symptoms was reported in 82.4% (238/289) of the children. The incidence was higher among children in Salvador (95.3%) compared to Porto Alegre and Manaus (74.6% and 75.0%, respectively;  $p < 0.001$ ). The unadjusted model revealed a lower occurrence of clinical manifestations of tooth eruption in children that had been hospitalized.

The multivariate analysis (Table 3) showed that the incidence of clinical manifestations of tooth eruption was 39% higher among children in Salvador compared to Porto Alegre. Mothers with more than 11 years of education and those with 8–11 years of education, respectively, reported the occurrence of clinical manifestations 31% and 23% more compared to those with less than 8 years of education. Reports of the occurrence of signs and symptoms of tooth eruption were more frequent in homes with more than four residents and those with a smoker. The occurrence of the

outcome was also 23% more frequent when the child had a history of influenza or the common cold in the first year of life. The variable ‘hospitalization’ lost its significance after the adjustment for confounding factors.

General symptoms of teething predominated over local systems (76.5% and 48.1%, respectively). The most reported general symptoms were fever (50.5%), irritability (42.6%) and diarrhea (35.3%), whereas the most prevalent local symptoms were itching (40.8%) and increased salivation (27.7%). With the exception of pain and difficulty sleeping, all symptoms differed among the centers evaluated and were more frequent in Salvador compared to the other two cities (Table 4).

Among the 238 parents who described clinical manifestations during tooth eruption, 195 (81.9%) reported taking some type of action to relieve the signs and symptoms; 145 (60.9%) took actions with a systemic effect and 132 (55.5%) took actions with a local effect (Fig. 2). The most prevalent actions were systemic analgesic, local analgesic ointment, the use of a teething ring and systemic anti-inflammatory agent. Other actions reported were the use of tea, anti-diarrheic medication, antihistamine and the offer of cold solid foods.

## Discussion

The present study investigated the occurrence of clinical manifestations of tooth eruption in the first year of life reported by parents and risk factors after adjustments for potential confounders. The most important result was the difference in the occurrence of symptoms depending upon the community evaluated and the greater incidence of the outcome in children with a history of influenza or the common cold in the first year of life. Moreover, the administration of medication without a prescription was a very frequent practice employed to mitigate clinical manifestations attributed to teething.

**Table 1** Characteristics of participants at baseline of cohort study and at 12 months of age

	Initial cohort		Sample analyzed	
	<i>n</i> (%)	Mean (SD)	<i>n</i> (%)	Mean (SD)
Maternal and family variables				
Mother’s age (years)		27.3 (6.7)		27.8 (6.8)
Mother’s education (years)		10.1 (2.5)		10.0 (2.6)
Nuclear family	386 (75.2)		216 (75.3)	
Smoker in home	145 (28.2)		81 (28.1)	
Child’s variables				
Male sex	258 (50.1)		151 (52.2)	
Birth weight (g)		3.357 (444)		3363 (452)
Birth length (cm)		48.7 (2.0)		48.8 (2.0)

**Table 2** Absolute and relative frequency of occurrence of clinical manifestations of tooth eruption in first year of life according to independent variables

Variables	n	(% )	Clinical manifestations of tooth eruption		p value
			n	(%)	
Overall sample	289	(100.0)	238	(82.4)	
Variables of family and child at birth					
City					<0.001
Porto Alegre	118	(40.8)	88	(74.6)	
Manaus	64	(22.2)	48	(75.0)	
Salvador	107	(37.0)	102	(95.3)	
Mother's education					0.254
< 8 years	45	(15.8)	33	(73.3)	
8–11 years	194	(68.1)	163	(84.0)	
> 11 years	46	(16.1)	38	(82.6)	
First pre-natal care					0.276
1st trimester	139	(48.1)	118	(84.9)	
≥ 2nd trimester	150	(51.9)	120	(80.0)	
Mother's age					0.947
< 24 years	96	(33.3)	79	(82.3)	
24–30 years	92	(32.0)	77	(83.7)	
> 30 years	100	(34.7)	82	(82.0)	
Family structure					0.349
Nuclear	216	(75.3)	175	(81.0)	
Non-nuclear	71	(24.7)	61	(85.9)	
Number of residents in home					0.391
≤ 4	160	(55.4)	129	(80.6)	
> 4	129	(44.6)	109	(84.5)	
Assistance from grandparent					0.089
Yes	183	(65.6)	156	(85.2)	
No	96	(34.4)	74	(77.1)	
Smoker in home					0.421
No	207	(71.9)	168	(81.2)	
Yes	81	(28.1)	69	(85.2)	
Child's sex					0.611
Male	151	(52.2)	126	(83.4)	
Female	138	(47.8)	112	(81.2)	
Birth weight					0.714
< 2500 g	27	(9.4)	23	(85.2)	
≥ 2500 g	261	(90.6)	215	(82.4)	
Birth length					0.971
< 48 cm	74	(25.7)	61	(82.4)	
≥ 48 cm	214	(74.3)	176	(82.2)	
Child's variables at 6 months					
BMI for age					0.186
< + 2 standard deviations	240	(88.6)	201	83.8	
≥ + 2 standard deviations	31	(11.4)	23	74.2	
Duration of breastfeeding					0.350
< 6 months	52	(18.3)	45	(86.5)	
≥ 6 months	232	(81.7)	188	(81.0)	
Daycare at 6 months					0.294
Yes	33	(12.2)	29	(87.9)	
No	238	(87.8)	191	(80.3)	
Pacifier use at 6 months					0.567

**Table 2** (continued)

Variables	<i>n</i>	( <i>%</i> )	Clinical manifestations of tooth eruption		<i>p</i> value
			<i>n</i>	( <i>%</i> )	
No	161	(59.2)	129	(80.1)	
Yes	111	(40.8)	92	(82.9)	
Child's variables at 12 months					
Hospitalization in 1st year of life					
No	229	(85.4)	192	(83.8)	0.029
Yes	39	(14.6)	27	(69.2)	
Flu/cold in 1st year of life					
No	180	(66.4)	142	(78.9)	0.175
Yes	91	(33.6)	78	(85.7)	
Use of anti-allergic in 1st year of life					
No	217	(79.2)	173	(79.7)	0.168
Yes	57	(20.8)	50	(87.7)	
Use of antibiotic in 1st year of life					
No	201	(73.4)	167	(83.1)	0.231
Yes	73	(26.6)	56	(76.7)	
Age at eruption of 1st tooth					
≤ 6 months	153	(52.9)	126	(82.4)	1.000
> 6 months	136	(47.1)	112	(82.4)	

The major challenge in studies on this issue is the differentiation of clinical manifestations that result from tooth eruption and signs and symptoms that have other causes. Previous studies report a considerable variation in the occurrence of this outcome, which is generally explained by the different methods employed (Feldens et al. 2010; Lam et al. 2016; Massignan et al. 2016; Nemezio et al. 2017). In the present investigation, however, the incidence of practically all general and local symptoms was higher in one of the cities (Salvador), although the same data collection instrument was administered by interviewees who had had the same training. Particularly, two general symptoms that could have other causes—diarrhea and a lack of appetite—differed strongly among the regions evaluated. Although genetic characteristics related to ethnicity cannot be discarded as an explanation for such differences (Lam et al. 2016), this finding lends strength to the notion that the beliefs of a community can at least partially exert an influence on the report of signs and symptoms of teething. Previous studies have reported that the most universal belief related to tooth eruption is its association with diarrhea (Coreil et al. 1995; Wake et al. 2000).

Along the same line, a recurrent explanation among clinicians and researchers is the concomitance of health conditions and prevalent development events in the first year of life and the period in which the teeth are erupting (Wake et al. 2000; Macknin et al. 2000; Hulland et al. 2000). In the present study, the incidence of signs and symptoms of teething reported by parents was higher among children who had

episodes of flu and colds diagnosed by a physician. Fever, a lack of appetite, difficulty sleeping and increased irritability are characteristic symptoms of colds, and it is possible that these episodes coincided with the period of tooth eruption in the first year of life (Macknin et al. 2000; Wake et al. 2000). Thus, other conditions may cause the symptoms reported by parents. This finding underscores the need to follow up the evolution of symptoms initially attributed to teething through a professional evaluation as well as adequate treatment and care in cases of bacterial or viral infections. Situations that require a diagnosis and immediate treatment, such as diarrhea, meningitis, and upper respiratory infection, have been reported for children in whom the parents' complaint was symptoms due to teething (Swan 1979; King et al. 1992; Wake et al. 2000).

On the other hand, one cannot discard the fact that tooth eruption produces local symptoms that were highly prevalent in this and previous studies, such as itching, and general symptoms, such as irritability and difficulty sleeping (Macknin et al. 2000; Feldens et al. 2010; Ramos-Jorge et al. 2011; Teixeira et al. 2019). Demonstrating a relationship of causality between tooth eruption and clinical manifestations would require the daily follow-up of a very large number of children, which is unviable from the methodological standpoint. Thus, a discerning assessment of the reports of parents and guardians seems to be the best basis on which to guide the diagnosis and clinical conduct.

The higher incidence of clinical manifestations of tooth eruption in children whose mothers had more education

**Table 3** Unadjusted and adjusted relative risk (RR) of occurrence of clinical manifestations of tooth eruption in first year of life according to independent variables

Variables	Unadjusted analysis			Adjusted analysis		
	RR	(95% CI)	<i>p</i>	RR	(95% CI)	<i>p</i>
Variables of family and child at birth						
City			<0.001			
Porto Alegre	1.00			1.00		
Manaus	1.01	(0.84–1.20)		0.94	(0.78–1.14)	0.544
Salvador	1.28	(1.14–1.43)		1.39	(1.23–1.58)	<0.001
Mother's education			0.360			
< 8 years	1.00					
8–11 years	1.15	(0.95–1.38)		1.23	(1.02–1.50)	0.033
> 11 years	1.13	(0.90–1.40)		1.31	(1.04–1.65)	0.021
First pre-natal care			0.274			
1st trimester	1.06	(0.95–1.18)		1.08	(0.97–1.19)	0.156
≥2nd trimester	1.00			1.00		
Mother's age			0.946			
< 24 years	1.00	(0.88–1.14)		1.05	(0.91–1.22)	0.473
24–30 years	1.02	(0.90–1.16)		1.05	(0.92–1.20)	0.501
> 30 years	1.00			1.00		
Family structure			0.314			
Nuclear	1.00			1.00		
Non-nuclear	1.06	(0.95–1.19)		0.88	(0.77–1.01)	0.072
Number of residents in home			0.386			
≤ 4	1.00			1.00		
> 4	1.05	(0.94–1.16)		1.15	(1.02–1.29)	0.018
Assistance from grandparent			0.113			
Yes	1.11	(0.98–1.25)		1.07	(0.94–1.22)	0.291
No	1.00					
Smoker in home			0.397			
No	1.00			1.00		
Yes	1.05	(0.94–1.17)		1.16	(1.03–1.31)	0.018
Child's sex			0.612			
Male	1.00			1.00		
Female	0.97	(0.87–1.08)		0.94	(0.84–1.04)	0.226
Birth weight			0.694			
< 2500 g	1.03	(0.87–1.22)		0.93	(0.76–1.14)	0.474
≥ 2500 g	1.00			1.00		
Birth length			0.971			
< 48 cm	1.00	(0.89–1.13)		0.97	(0.84–1.11)	0.610
≥ 48 cm	1.00			1.00		
Child's variables at 6 months						
BMI for age			0.269			
< 2 standard deviations	1.00			1.00		
≥ 2 standard deviations	0.89	(0.71–1.10)		0.90	(0.72–1.12)	0.335
Duration of breastfeeding			0.299			
< 6 meses	1.00			1.00		
≥ 6 meses	0.94	(0.83–1.03)		0.91	(0.77–1.06)	0.218
Daycare at 6 months			0.209			
Yes	1.10	(0.95–12.6)		1.05	(0.90–1.24)	0.518
No	1.00			1.00		
Use of pacifier at 6 months			0.562			
No	0.97	(0.86–1.08)		1.05	(0.93–1.18)	0.416



**Table 3** (continued)

Variables	Unadjusted analysis			Adjusted analysis		
	RR	(95% CI)	<i>p</i>	RR	(95% CI)	<i>p</i>
Yes	1.00			1.00		
Child's variables at 12 months						
Hospitalization			0.083			
No	1.00			1.00		
Yes	0.83	(0.66–1.03)		0.96	(0.78–1.19)	0.743
Had flu/cold			0.150			
No	1.00			1.00		
Yes	1.09	(0.97–1.22)		1.23	(1.09–1.38)	0.001
Use of anti-allergic			0.113			
No	1.00			1.00		
Yes	1.10	(0.98–1.24)		0.95	(0.83–1.08)	0.409
Use of antibiotic			0.267			
No	1.00			1.00		
Yes	1.08	(0.94–1.25)		1.11	(0.98–1.26)	0.112
Age at eruption of 1st tooth			1.00			
≤ 6 months	1.00	(0.90–1.11)		0.95	(0.84–1.08)	0.954
> 6 months	1.00			1.00		

**Table 4** Occurrence of general and local symptoms of tooth eruption and type of symptom reported by parents according to city (*n* = 289)

Type of symptom	All		Porto Alegre		Salvador		Manaus		<i>p</i> value
	With symptom		With symptom		With symptom		With symptom		
	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	
General or local symptom	238	82.4	88	74.6	102	95.3	48	75.0	<0.001
General symptom	221	76.5	81	68.6	94	87.9	46	71.9	0.002
Fever	146	50.5	57	48.3	66	61.7	23	35.9	0.004
Irritability	123	42.6	37	31.4	60	56.1	26	40.6	0.001
Diarrhea	102	35.3	27	22.9	56	52.3	19	29.7	<0.001
Lack of appetite	45	15.6	3	2.5	37	34.6	5	7.8	<0.001
Skin rash	23	8.0	1	0.8	22	20.6	0	0.0	<0.001
Pain	21	7.3	5	4.2	10	9.3	6	9.4	0.257
Difficulty sleeping	15	5.2	3	2.5	10	9.3	2	3.1	0.050
Local symptom	139	48.1	29	24.6	96	89.7	14	21.9	<0.001
Itching	118	40.8	21	17.8	88	82.2	9	14.1	<0.001
Increased salivation	80	27.7	9	7.6	67	62.6	4	6.3	<0.001
Inflamed gums	18	6.2	2	1.7	12	11.2	4	6.3	0.013

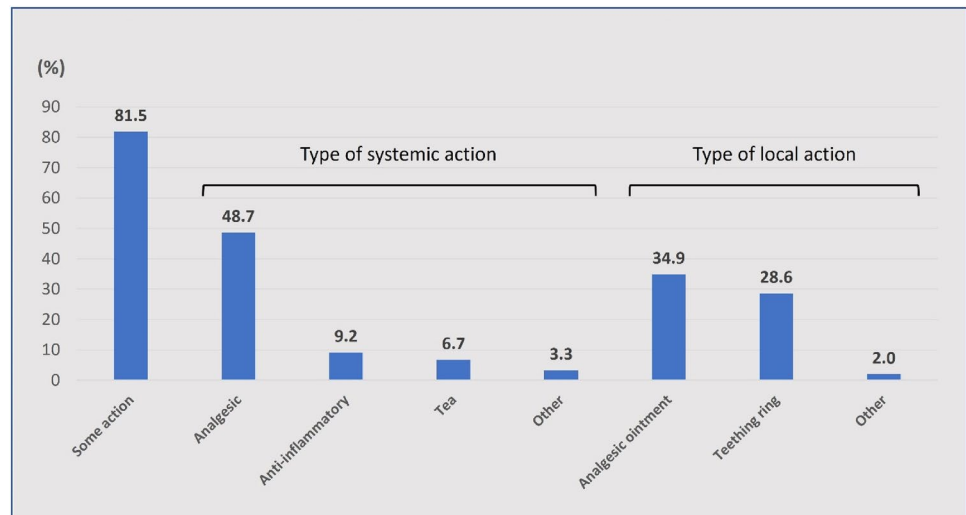
may be at least partially explained by psychosocial characteristics. Mothers with a higher socioeconomic status are generally more attentive to signs, symptoms, the risk of developing a health problem, and its potential consequences (Harris et al. 2017). It is therefore plausible that this perception extends to symptoms in the period of tooth eruption. Reports of clinical manifestations of tooth eruption and fever in families with a better socioeconomic status have been described in previous studies conducted in Brazil and Singapore, respectively (Feldens et al. 2010; Lam et al. 2016). However, other studies have

not investigated this issue, which precludes a comparison of the results.

The number of residents in the home was also associated with the outcome. It is possible that a greater number of individuals residing with the child increases the level of supervision, the perception of symptoms and the occurrence of discussions on facts and routines in the child's daily life, including the manifestation of increased salivation, irritability and biting on objects to relieve itching. However, there is no simple explanation for the association with the presence of a smoker in the home. Only one previous study



**Fig. 2** Systemic and local measures taken by parents who reported signs and symptoms of tooth eruption ( $n=238$ )



reported a greater frequency of symptoms of teething in families exposed to passive smoking and when the mother was a smoker (Lam et al. 2016). Other studies have reported that the presence of smokers in families is associated with oral health variables, such as the early introduction of sugar in the child's life, dental caries and other adverse events (problems with speaking and motor skills) (Bernabé et al. 2017; WHO 2013; Tanaka et al. 2015; Feldens et al. 2021). Among the mechanisms of this association, exposure to passive smoke has been suggested to affect acetylcholine receptors in the fetal brain and alter patterns of cell proliferation and differentiation as well as interfere with the supply of oxygen to the fetus, which is linked to increased sensitivity to pain and a lower capacity of the child to remain calm in situations of stress (Law et al. 2003). Moreover, smoking may be a marker of greater anxiety or stress and less resilience (Bernabé et al. 2017; Tanaka et al. 2015; Feldens et al. 2021). It is, therefore, possible that such characteristics may at least partially explain the greater report of clinical manifestations of tooth eruption in homes with a smoker.

The vast majority of parents took some action to alleviate the symptoms. While some actions do not have the potential to cause harm to the child and can contribute to the remission of some symptoms, such as massaging the gums and offering cold foods (Memarpour et al. 2015; AAP 2019), others constitute a form of self-medication, such as the administration of analgesic, anti-inflammatory and anti-diarrheic agents (Wake et al. 1999; Plutzer et al. 2012). This finding is worrisome, as tooth eruption is a phenomenon that takes weeks and is repeated with each tooth group in the early years of life. The administration of medications without a medical prescription can be prolonged, placing the child's health at risk and increasing the cost to the family. Although rare, oral drug products containing benzocaine in children younger than 2 years

can cause methemoglobinemia, a condition in which the amount of oxygen carried through the blood is greatly reduced and can result in death (FDA 2022). Moreover, mistakenly attributing symptoms to teething or disregarding symptoms, especially fever and diarrhea, can delay the diagnosis of conditions that occur concomitantly and can threaten the child's life.

Among the clinical implications of the present study, health care providers should pay particular attention to parental complaints of signs and symptoms attributed to tooth eruption. While it is plausible that some clinical manifestations result from the tooth eruption process, parental reports may reflect the beliefs of the family or community, the degree of child supervision or even coinciding health conditions. The proper diagnosis on a case-by-case basis is the presupposition for a clinical approach that balances the management of specific cases, avoiding the risks of self-medication while also not disregarding symptoms that may result from other general health problems.

This study has limitations that should be considered. The number of losses to follow-up in the first year of life may have affected the results in an unknown direction. However, the proportion of losses is similar to that found in the first year of life in other cohort studies and the likelihood of selection bias is low, as demonstrated by the similar characteristics between the sample analyzed and the dropouts. As this study accompanied the first year of life of the children, it was not possible to investigate the effect of the eruption of the molars and canines. However, the incidence of signs and symptoms of eruption is greater in the first year of life during the eruption of the incisors (Peretz et al. 2003). The possibility of recall bias is not likely to have affected the results, considering the short time between symptoms and data collection.

## Conclusion

The occurrence of clinical manifestations of tooth eruption varied among the communities evaluated and was more frequent in children with a history of influenza or the common cold in the first year of life, children whose mothers had a higher level of education and those in families with a larger number of residents in the home. This study also found a highly frequent administration of unprescribed medications to alleviate clinical manifestations attributed to teething. Taken together, these data can contribute to the diagnosis, counseling and clinical management offered by health care providers with regards to complaints reported by parents.

**Acknowledgements** The work was supported by the National Council for Scientific and Technological Development (CNPq) (No. 408125/2017-9).

## Declarations

**Conflict of interest** The authors have no relevant financial or non-financial interests to disclose.

**Ethics approval** The study received approval from the Human Research Ethics Committee of Universidade Federal de Ciências da Saúde de Porto Alegre (No. 88214918.3.0000.5345). All parents signed a statement of informed consent after receiving clarifications regarding the intervention and all phases of the data collection process. This study was performed in line with the principles of the Declaration of Helsinki.

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