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Title: Effect of passive smoking during pregnancy on tooth eruption in infants

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ABSTRACT

Background: The deciduous teeth are very important to the development of infants in terms of speaking, chewing and holding space for the permanent teeth. Smoking is very common in Thai people, especially males. Women and children are also affected by their behaviors. There are not many studies examining the association between passive smoking in pregnant women and the time of first tooth eruption.

Objective: To evaluate the association between passive smoking in pregnant women and time of first tooth eruption in infants.

Methods: Data from the Prospective Cohort Study of Thai Children (PCTC) was used to record the exposure of passive smoking in pregnant women. PCTC is a large birth cohort study which was conducted on more than 4,000 infants born from October 2000 to September 2002 and their parents or caregivers in five different regions in Thailand. Dental records of children were followed by questionnaires from three months of age until the time of first tooth eruption. Cox proportional regression analysis were applied using Stata SE 12.0.

Results: The median age of first tooth eruption was 8 months. 59.11% participants are passive smokers during pregnancy. Infants of passive smoking mothers faced a hazard of not having erupted tooth 6% greater than non-passive smoking mothers (adjusted HR = 0.94, 95% confidence interval 0.86 to 1.02), but this association was not significant.

Conclusion: Passive smoking in Thai pregnant women had an effect on the time of the first tooth eruption in infants.

Keywords: Deciduous teeth, eruption, passive smoking, Thai pregnant women, infants

INTRODUCTION

Delayed first tooth eruption (DTE) can cause many problems in the dental development of infants because deciduous teeth not only help to hold space in the jaws for the permanent teeth and align them into correct position (1), but also permit infants to chew and speak properly. There are many factors which may influence the time of tooth eruption including genetics, gender, ethnicity, social economic status, nutrition (1-5), and neonatal factors (1, 6). However, role of passive smoking (PS) on DTE has not yet been broadly established.

Many studies have reported the negative effect of smoking during pregnancy on children (7-10), particularly on the time of first tooth eruption (11, 12). Smoking is very common in Thai people, especially among males. Women and children are also affected by their behaviors. This leads to a high prevalence (29.8%) of passive smoking exposure among Thai women (13).

Being aware of such risk factors, we could help improve the dental development of infants. However, little was known about this association in Thai population. Hence, we conducted this study to examine the association between PS during pregnancy period and the time of first tooth eruption in Thai infants.

MATERIALS AND METHODS

Study design

This paper is a part of the Prospective Cohort Study of Thai Children (PCTC). The PCTC is a large birth cohort study which was conducted by Dr. Chanpen Choprapawon and colleagues on more than 4,000 infants born from October 2000 to September 2002 and their parents or caregivers in five different regions in Thailand (14, 15). Participants were recruited from one selected district in each of four regions (including the North (Nan province), Northeast (Khon Kaen province), Central (Kanchanaburi), and South (Songkla province) of Thailand) and the capital Bangkok. These samples had to meet the criteria including being accessible year-round, 800 to 900 newborns on average each year, all residents intend to live in the study area for at least 5 years, and having a long-term commitment with the project by a hospital director (and associates). The babies who were born between October 15, 2000 and September 14, 2002 were recruited in the study.

All participants signed the written informed consent after obtaining verbal permission. PCTC project was approved by the National Ethics Committee of the Ministry of Public Health of Thailand. This study was approved by the Khon Kaen University Ethics Committee for Human Research.

Independent variables and outcomes

Data were collected not only from mothers, fathers, other family members and children, but also from secondary data regarding community and demographic variables. Many methods of data collection were used in PCTC study including in-person interview using questionnaire, diary records, medical records, and extraction from existing data.

This study focused on the passive smoking (PS) status of pregnant women during pregnancy and the time of first tooth eruption in infants. The PS status was defined by a binary variable (yes/no). The number of cigarettes was also recorded.

Main binary outcome was the time to eruption of the first tooth which was extracted from the questionnaires at 6 months and 12 months.

Potential bias

Other demographic variables were also taken into account for controlling potential bias including mother's education level, income, maternal age, alcohol consumption, child's gender, birth weight (BW), gestational age (GA), and study site. Deletion method was applied to handle for unavoidable missing values.

Statistical analysis

Description analysis was utilized to describe the baseline characteristics of infants and their families. Cox proportional regression was used to estimate the hazard ratio (HR) of time to eruption between the PS mothers and the non-PS ones. We applied the backward stepwise procedure to achieve the best fitted model. All data were analyzed using Stata SE statistical software version 12.0 (Stata Corp, College Station, TX). A p-value of less than 0.05 was set as a statistically significant level for all tests.

RESULTS

A total of 4,116 participants from five different areas were included in this study (figure 1).

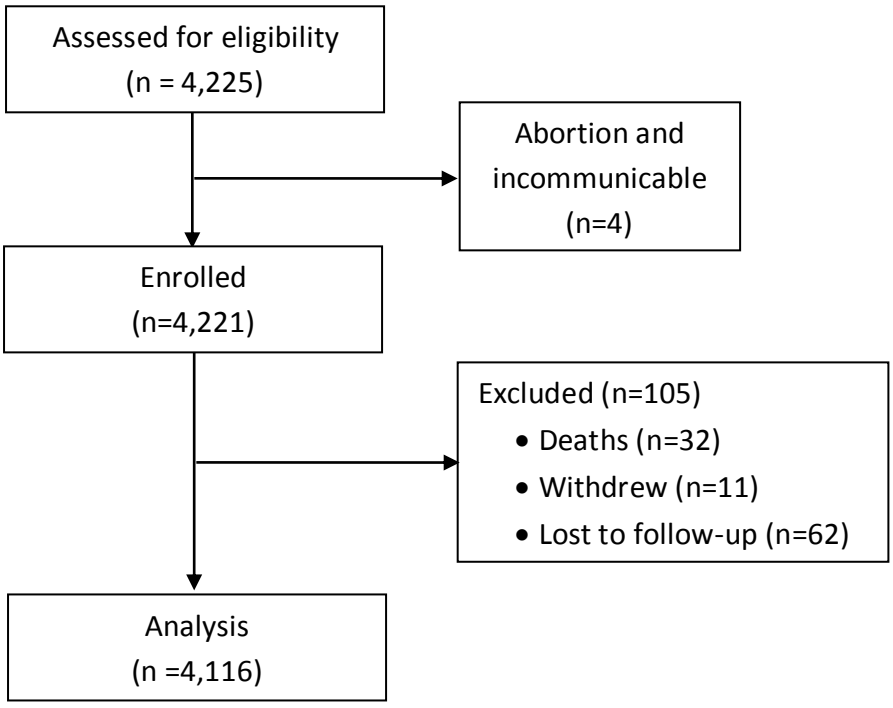

Figure 1. The inclusion flow chart

Demographic Characteristics

Among 4,116 infants, approximately 50% were girls. 94.7% of infants followed the study at 6 months and 12 months. The med age of mothers was 27.0 ± 6.2 years old. Other demographic characteristics are shown in table 1.

Table 1. Demographic characteristics presented as percentage unless specified otherwise

Characteristics	Total (n)	Sites (%)*				
		North (n=759)	Northeast (n=1,061)	Central (n=853)	South (n=772)	Bangkok (n=671)
Mothers						
Age (years)						
14 – 24	1,546	41.9	36.3	52.8	34.3	19.1
25 – 48	2,570	58.1	63.7	47.2	65.7	80.9
Mean ± SD	27.0 ± 6.2	26.3 ± 6.1	27.5 ± 6.5	24.9 ± 5.5	27.4 ± 6.3	29.3 ± 5.9
Min – Max	14 – 48	14 – 48	14 – 46	14 – 43	14 – 47	15 – 46
Highest education						
Illiterate	211	3.95	5.56	1.06	14.51	0.15
Primary school	1,925	60.74	59.75	59.91	28.11	15.20
High school	1,151	25.16	26.01	29.66	28.63	31.30
Vocational training	339	5.40	4.05	4.57	11.01	19.52
University and higher	399	3.29	3.49	2.58	15.03	29.66
Others	10	0.13	0.19	0.35	0.39	0.15
Alcohol drinking						
No	3,670	88.14	90.95	90.86	91.32	82.86
Yes	152	2.90	1.13	3.52	2.33	10.43
Infants						
Gender						
Boys	2,025	46.90	51.56	48.42	48.58	49.78
Girls	2,040	52.31	47.50	51.11	49.35	49.56
Birth weight						
Normal BW	3,601	91.83	80.21	87.81	85.75	95.68
Low BW	515	8.17	19.79	12.19	14.25	4.32
Gestational age						
Term birth	3,558	89.99	82.47	79.25	90.41	93.29
Preterm birth	558	10.01	17.53	20.75	9.59	6.71

** Numbers do not always match the totals because of missing values*

Passive smoking in mothers among five study sites

The average prevalence of PS in pregnant women among five study sites was 59.11% (Table 2). Northeast area has the highest prevalence of PS during pregnancy (68.24%), while the lowest prevalence of PS belonged to South region.

Table 2. Percentage of PS in pregnant women among five study sites

Site	Number of PS	Percentage of PS
North	431	56.79
Northeast	724	68.24
Central	549	64.36
South	388	50.26
Bangkok	341	50.82
Total	2,433	59.11

Time to erupt the first tooth

Thai infants had the median time of first tooth eruption of 8 months, as shown in figure 2.

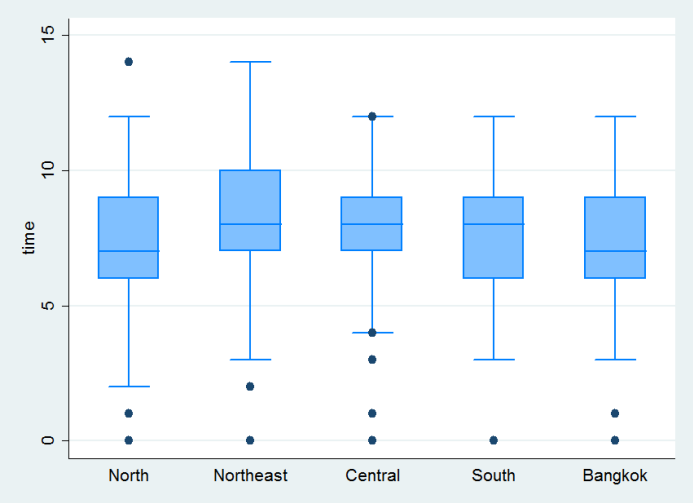

Figure 2. Median time of first tooth eruption among five study sites

Factors associated with time to eruption

Cox proportional regression analysis provided the effect of each characteristic on the outcome. Table 3 shows the crude hazard ratios of having the first tooth eruption in infants.

Table 3. Crude HR of having the first tooth eruption for each explanatory factor, stratifying by study site

Factors	n	Person-months	Incident rate/100	Crude HR	95%CI	P-value
Passive smoking						0.090
No	785	6,007	13.1	1.00	Reference	
Yes	2,312	18,364	12.6	0.93	0.86 to 1.01	
Maternal age (1-year increase)	N/A	N/A	N/A	1.00	0.99 to 1.00	0.916
Highest education of mothers						0.356
Illiterate	194	1,470	13.2	1.00	Reference	
Primary	1,835	14,681	12.5	0.86	0.74 to 1.00	0.053
High	1,094	8,628	12.7	0.87	0.75 to 1.02	0.09
College	323	2,483	13.0	0.92	0.77 to 1.11	0.372
University and higher	382	2,893	13.2	0.94	0.78 to 1.12	0.483
Others	10	76	13.2	1.04	0.55 to 1.97	0.895
Alcohol drinking during pregnancy						0.893
No	3,495	27,541	12.7	1.00	Reference	
Yes	149	1,119	13.3	1.01	0.86 to 1.20	
Child's gender						<0.001
Female	1,917	15,354	12.5	1.00	Reference	
Male	1,949	15,092	12.9	1.14	1.07 to 1.22	
Birth weight						<0.001
Normal BW	3,445	26,887	12.8	1.00	Reference	
Low BW	469	3,917	12.0	0.83	0.75 to 0.92	
Gestational age						0.023
Term birth	3,405	26,640	12.8	1.00	Reference	
Preterm birth	509	4,164	12.2	0.90	0.82 to 0.99	

After adjusting for child's gender, BW, GA, maternal age, and alcohol drinking during pregnancy, infants of passive smoking mothers faced a hazard of not erupted tooth 6% greater than non-passive smoking mothers (adjusted HR = 0.94, 95% confidence interval 0.86 to 1.02), but this association was not significant (Table 4). Girls have earlier time of tooth eruption than boys. Results show that low BW is also a risk of not having tooth eruption.

Table 4. Adjusted HR of having first tooth eruption for each explanatory factor

Factors	Crude HR	Adjusted HR (95% CI)	P-value
Passive smoking			0.120
No	1.00	1.00	
Yes	0.93	0.94 (0.86 to 1.02)	
Child's gender			<0.001
Female	1.00	1.00	
Male	1.14	1.16 (1.08 to 1.25)	
Birth weight			0.002
Normal BW	1.00	1.00	
Low BW	0.83	0.84 (0.75 to 0.94)	

The hazard rate curve showed the difference in the probability of having erupted tooth between PS group and non-PS group (Figure 3).

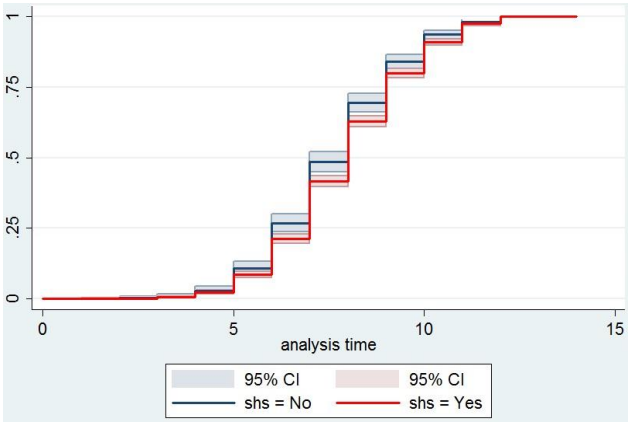

Figure 3. Difference in the probability of having erupted tooth between PS and non-PS group

DISCUSSIONS

This study evaluated the association between PS during pregnancy and the time of first tooth eruption. We found that the time of first tooth eruption was delayed in PS women comparing to non-PS women, although this association was not significant. This can be explained by the mechanism where smoking can increase the amount of calcium that goes out of the body by uterine, resulting hypocalcemia (16). Once hypocalcemia occurs, it may have an effect on dental calcification. It occurs when the infant body cannot accumulate calcium and phosphate or does not absorb enough during the last three months of pregnancy (17-19). Our findings are consistent with other previous studies when suggesting a positive association between PS and delayed formation of child's teeth. PS could be much more serious than primary smoking in mothers during pregnancy (20).

We also found the non-significant association between social economic status of parents including income and education level and the development with tooth eruption. This finding is similar with the study of Adler et al. (2, 4). Low income and not well-educated parents might have not provided sufficient nutrition to their infants, especially calcium deficiency, affecting to the formation of tooth enamel in both primary and permanent teeth (21, 22).

Maternal age is also related to the time of eruption of the first tooth, especially the young mothers. They may lack of physical maturity. Moreover, they themselves are developing, so the development of the infants may be competing with them (23).

Low BW and preterm birth were also related to the time of tooth eruption, as mentioned in many previous studies (2, 24, 25). Study of Negar (1) and Fadavi (26) suggested that infants with higher BW had earlier time of deciduous tooth eruption, whereas study of Lawoyin et al. (27) proved the opposite relationship between BW and time of first tooth eruption. Infants with preterm birth and low BW may lack of vitamin D absorption resulting in reduction of calcium and phosphate intake. This could lead to insufficient nutrients among those infants, thus they are lack of dental calcification necessary for the formation of their first dentition.

There was a difference between girls and boys regarding the time of first tooth eruption. A previous study in Uganda also showed a similar result that girls have shorter time of tooth eruption than boys about half year (28). While recent study of Kutesa (2) has found an earlier time (0.8 year) in girls comparing to boys. This gender-relationship has still not known much yet until now, however, some authors assumed that this differences was due to the differences in sexual maturity (2) or embryologic timing (23).

Strengths of the study

This study is a strongest observational design which can investigate multiple risk factors for delayed first tooth eruption. Besides, this study used data from PCTC project which is a very large birth cohort study in Thai population, therefore this sample can be a national representative. Another strength of this study is the minimal loss to follow-up.

Limitations of the study

Although having several strengths described above, this study also had some limitations that might distort the findings. Firstly, to overcome information bias in the main PCTC study, we trained and calibrated the interviewers. Another type of bias that may occur in this study is potential confounding factors. We have made our efforts to control for several possible confounders which were listed in table 1 by adjusting in data analysis process.

Causal inferences are still suspect in this recent study as this is a part of PCTC, a cohort study design. Also, this study does not allow us to see the change of association over time.

Missing values are also concerned as one of the limitations of this study. By comparing the missing group to the completed group, we found that they are similar with regard to all significant predictors (data not shown). Therefore, the assumption of “missing at random” can be made reasonably.

Conclusions and recommendations

In summary, our findings suggested that passive smoking in Thai pregnant women had an effect on the time of the first tooth eruption in infants. This may lead to many problems in the dental and nutritional development of infants. Further studies on this topic in other population should be conducted in the future to achieve much more evidences in order to help the policy-makers eliminate this burden.

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Conflict of interests

None declared.

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