

ORIGINAL ARTICLE

Caries prevalence in Danish pre-school children delivered vaginally and by caesarean section

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Abstract

Objective. The mode of delivery may significantly influence the diversity and composition of the oral microflora and facilitate early acquisition of *mutans streptococci*. The aim was to compare caries prevalence and experience in 3-year-old children delivered vaginally and by caesarean section (C-section). **Materials and methods.** The study had an observational cohort protocol based on extracted information from governmental databases and nationwide registers concerning birth, social and educational levels and dental status. Children born at the Copenhagen University Hospital in 2005 were eligible and the final study group with complete information consisted of 594 children, 443 delivered vaginally and 151 by C-section. **Results.** The total caries prevalence was 8% and no significant difference was displayed between the groups. When only the children with caries (dmfs > 0) were compared, those delivered by C-section had a higher mean value in comparison with those delivered vaginally (dmfs 6.8 vs 3.2), but the difference was not statistically significant. There was a significant relationship between caries prevalence and low family income in the total study group (OR = 5.8, $p < 0.05$). **Conclusions.** Within the limitations of this observational cohort study, caries prevalence in 3-year-old children was not related to the mode of delivery. However, the tendency of more severe caries in the C-section group justifies further studies, preferably with a prospective design.

Key Words: caesarean section, caries, pre-school children

Introduction

Children below 3 years of age are at risk of developing early childhood caries (ECC) because of unique risk factors such as erupting teeth, feeding mode (breast or bottle) and a continuous development of the oral microflora and immune system [1]. ECC is a multi-factorial-based disease and a considerable number of risk factors have been identified [2] with early colonization of *mutans streptococci* as possibly being the most important [3]. In this context, the mode of delivery has been highlighted since it has been shown to significantly influence the diversity and composition of the gut microflora [4] and our research group has recently presented similar findings concerning the oral biofilm [5]. Infants delivered vaginally displayed a significantly higher prevalence of health-promoting streptococci and lactobacilli compared to those delivered by caesarean section (C-section). It has

previously been suggested that C-section children harbour *S. mutans* earlier than vaginally-delivered children [6]. Whether or not this has an influence on the development of dental caries later in life is, however, not clear. In a case-control study, which investigated the relationship between baby-bottle-tooth-decay and delivery mode, Peretz and Kafka [7] observed that children delivered by C-section were over-represented among those with ECC.

In Denmark, the caries prevalence among young children is low compared with other European countries. In 2009, the caries prevalence in 3-year-olds was 4.3% [8], however, considerable inequalities exist. In vulnerable groups, e.g. certain ethnic minorities, the caries prevalence is significantly higher [9]. The complex nature of ECC is difficult to target with caries-preventive measures [10,11] and it is of outmost importance to further study and understand the risk factors involved in the aetiology of the disease. The

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aim of the present project was therefore to investigate if the mode of delivery had an influence on the caries experience in pre-school children. The null hypothesis was that the caries experience would not differ between children delivered vaginally and those delivered by C-section.

Materials and methods

Study design

This study employed an observational cohort design and was carried out in the municipality of Copenhagen, Denmark. All data were collected from different governmental databases and nationwide registers that allowed extraction of information regarding oral health, mode of delivery and socio-economic status. The study protocol was approved by the Danish Data Protection Agency.

Study population

The eligible study population included all 3-year-old children born at the Copenhagen University Hospital in 2005 ($n = 2476$) and who still lived in Copenhagen in 2008. After merging birth data, social data and data from dental records the final study population comprised 606 cases. Due to a lack of dental registrations in the Public Dental Health Service, only 54% of all 3-year-olds were registered, furthermore, relocation between municipalities resulted in a relative low number of cases. Twelve cases were excluded because of typing errors and the final study group with complete information consisted of 594 children, 443 delivered vaginally and 151 delivered by C-section.

Data sources

All Danes have a personal security number which facilitated the analysis between the different databases. Data concerning mode of delivery and caries experience were obtained from the Danish National Board of Health, which receives the information continuously from hospitals and dental clinics. The socio-economic data were collected from Statistics Denmark.

Caries scoring

The Public Dental Health Service offer free dental care for all children and adolescents aged 0–18 years and, according to directives from the health authorities, registration on oral health data by 5, 7, 12 and 15 years is mandatory. In Copenhagen, however, The Public Dental Health Service has extended the registration to all age groups, which enabled us to select oral health information from the 3-year-olds. Standardized criteria for clinical registration provide information on decayed, missing and filled surfaces (dmfs)

[12]. In the present study caries was recorded at the cavity level.

Socioeconomic data

The socioeconomic data, educational level of the mother and family income per year, were classified as low, medium and high. The income intervals were as follows: ≤ 399.999 Danish Kroner (DKr), 400.000–699.999 DKr and ≥ 700.000 DKr. The cut-offs values were set in order to get an equal amount of cases in each class and to permit the identification of differences between different socio-economic groups.

Statistical procedures

All data were processed with the Statistical Programme for the Social Sciences (SPSS, version 18.0; Chicago, IL). Differences in caries prevalence between the mode of delivery groups were subjected to ANOVA. Mode of delivery, dmfs and educational- and income levels were analysed with logistic regression. A p -value of 0.05 or less was considered statistically significant.

Results

There were no significant differences between the mode of delivery groups in relation to mother's level of education and family income, as shown in Table I. The caries data are presented in Table II. The total caries prevalence was 8%. Forty-eight children were registered with dmfs > 0 and the mean caries experience was dmfs = 0.31. No significant differences were displayed between the delivery mode groups in relation to caries. However, when only children with dmfs > 0 were compared, those delivered by C-section had a higher caries experience (mean dmfs = 6.8, SD = 10.9) than vaginally-delivered children (mean dmfs = 3.2, SD = 4.1). However, the difference was not statistically significant ($p = 0.110$).

Table I. Socioeconomic characteristics in relation to mode of delivery in the two study groups. Values in the table are expressed as a percentage.

	Vaginal delivery ($n = 443$)	C-section ($n = 151$)
<i>Educational level of the mother</i>		
Low, >7 years	39%	40%
Medium, 12 years	30%	38%
High, >12 years	31%	22%
<i>Family income per year</i>		
Low	39%	27%
Medium	35%	40%
High	26%	33%

Table II. Caries prevalence in the two study groups.

	Vaginal delivery (<i>n</i> = 443)	C-section (<i>n</i> = 151)	<i>p</i>
Caries prevalence proportion	8.8% (<i>n</i> = 39)	6.0% (<i>n</i> = 9)	NS
All children, mean dmfs (SD)	0.2 (1.4)	0.4 (3.0)	NS
dmfs > 0, mean dmfs (SD)	3.2 (4.1)	6.8 (11.0)	NS

NS = no statistically significant differences (ANOVA).

Controlling for mother's educational level and family income per year it was found that children born by mothers with low educational level had a 2.4-times greater risk of having caries ($p = 0.069$), while children in low income families had a 5.8-times greater risk of having caries ($p = 0.002$) (Table III).

Discussion

This observational cohort study analysed the relationship between mode of delivery and caries prevalence in 3-year-old children born and raised in Copenhagen. Accessible public registrars in Denmark provide a unique possibility of merging data from the health-care system and other statistical databases using the civil registration number of each individual as a key variable. However, a complete set of data was available from much fewer children than expected and, in combination with the relatively low caries prevalence, the study turned out with a certain lack of power. A retrospective power calculation with ($\alpha = 0.05$ and $\beta = 0.8$) indicated that at least 118 cases with dental caries, corresponding to a prevalence of 5% in the total birth cohort, were needed in order to detect a

40% difference between the two modes of delivery. Consequently, the study was too small to allow any safe conclusions and the null hypothesis could not be rejected. Nevertheless, the present findings may be looked upon as tendencies that merit further attention. Also, the nature of register research has certain limitations. There were no possibilities to contact the participants with regards to possible confounders such as oral hygiene, diet, usage of antibiotics and general health, problems that easily could be managed in a prospective design.

The dental status was only registered in about half of the 3-year-old children, even though all children at all age-groups were supposed to be included. Possible explanations for this could be cooperation and patient behaviour management problems and parents staying away from the appointments. Thus, a selection bias could not be excluded. The examiners were trained and experienced dentists, used to handle the registration forms daily and the methodology have been used in several epidemiological studies in Denmark [13,14]. Besides, detailed guidelines for registration and well-described criteria and standards are dictated by the National Board of Health. The current findings were only slightly higher than previous nation-wide observations [8]. Thus, the present study cohort was considered to be fairly representative for the entire pre-school population in the municipality of Copenhagen. Statistics Denmark provides data for all official statistics and they are produced in compliance with the European Statistics Code of Practice. Thus, this source was considered to be reliable and of high quality.

With the limitations of the sample size, the following tendencies were observed: the children delivered by C-section were not at greater risk of developing dental caries, but those with caries had 2-times higher caries experience than the vaginally-delivered children with caries. It should be stressed that only one child in the C-section group exhibited a very high caries score. The finding of Peretz and Kafka [7], who showed that baby-bottle-tooth-decay was significantly related to mode of delivery, was therefore not confirmed. Moreover, opposite findings were presented in a recent study which showed that vaginal birth was a significant risk predictor for caries, especially in non-Hispanic African Americans [15]. The possible explanation was that C-section children may receive more attention and care resulting in decreased caries risk. The great influence of family income on caries development was in agreement with current knowledge and similar observations are repeatedly reported from Denmark and elsewhere [16–20]. The null hypothesis could not be rejected, however, from a clinical point of view, it still seems to be important to collect information on the mode of delivery in the anamnesis and include it among the factors to consider in the risk assessment of the individual.

In conclusion, this observational cohort study showed a tendency towards a higher caries experience

Table III. Logistic regression model of odds ratio for caries experience.

Variable	<i>n</i>	<i>p</i>	OR (95% CI)
Mode of delivery			
C-section	151	0.54	0.77 (0.3–1.8)
Vaginal	443	—	—
Education level of the mother			
Low	230	0.07	2.41 (0.9–6.2)
Medium	184	0.94	1.04 (0.3–3.2)
High	166	—	—
Family income			
Low	202	0.00	5.84 (1.9–18.2)
Medium	202	0.02	3.41 (1.2–9.5)
High	157	—	—

OR (95% CI) = odds ratio with 95% confidence interval.

among 3-year-old children delivered by C-section, but the difference compared with children delivered vaginally was not statistically different due to an evident lack of power. Thus, the research question would need further attention in prospective trials.

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