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ORIGINAL ARTICLE

Risk factors for caries incidence in a cohort of Flemish preschool children

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Abstract The main objective of this study was to identify the risk factors for the incidence of visible caries experience in a cohort of preschool children living in Flanders. Data were collected from 1,057 children; validated questionnaires on oral health-related behaviour were completed by parents at birth (2003–2004), at age 3 (2007) and 5 years (2009). At ages 3 and 5, the children were examined by trained dentists. Logistic regression analyses were performed with the following as outcome variables: visible caries experience at age 3 and increment in visible caries experience between ages 3 and 5. At ages 3 and 5, enamel and/or dentinal caries experience was observed in 22% and 41% of the cohort, respectively. The multivariable logistic regression analyses revealed that the presence of visible plaque accumulation on at least one primary tooth was a significant risk factor for visible caries experience at age 3 and for an increment in caries experience between ages 3 and 5. Children with previous caries experience at age 3 had significantly higher odds for new caries lesions at age 5. Presence of visible plaque and previous caries experience are confirmed as significant risk factors for visible caries experience in preschool children. Interventions aimed at caries prevention should focus on very young children and on the control of plaque accumulation. The presence of visible plaque accumulation as a screening tool to identify young children at risk for future caries experience shows high potential.

Keywords Caries experience · Caries incidence · Oral health · Preschool children · Risk factors · Dental plaque

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Introduction

The prevalence (and incidence) of dental caries in preschool children can be very high, as was illustrated in several studies [1–5]. According to a recent review on dental caries experience in young children, prevalence data for 5-year-olds varied between 29% in Denmark, 39% in Norway, 40% in England and Wales, 43% in Greece and 55% in Scotland [6]. These data illustrate that still a considerable proportion of young children suffer from dental caries and its consequences. Hence, prospective studies are needed which will not only yield caries incidence data but will also give a better insight into the complex multifactorial aetiology of dental caries because in prospective studies risk factors can be identified.

In 2004, Harris et al. published a systematic review on risk factors and indicators that could be significantly associated with the prevalence or incidence of dental caries in the deciduous teeth of children up to the age of 6 [7]. They identified a total of 106 factors, which could be grouped into demographic factors (e.g. parental education, birth order), dietary factors (e.g. frequent exposure to sugar-containing snacks and drinks, nighttime meals and drinks), factors related to breast and/or bottle feeding (e.g. duration of bottle feeding, frequency of breast feeding), factors related to oral hygiene habits (e.g. brushing frequency, accumulation of visible plaque), factors related to oral bacteria flora (e.g. presence of *Streptococci mutans*, presence of *Lactobacilli*) and "other factors" (e.g. parental oral health behaviour, age at first dental examination). The authors confirm that longitudinal studies are essential in order to identify risk factors, as by definition, a risk factor must clearly establish that the exposure has occurred before the outcome, or before the conditions are established that make the outcome likely.

In Belgium, data on the oral health of preschool children are scarce since, among other reasons, there is no systematic collection of oral health data. According to the most recent publication, visible caries experience (at the d_3 level) was observed in 7% of 3-year-olds and 31% of 5-year-olds, randomly selected in 2003 in four geographical areas in Flanders (northern part of Belgium) [8]. So far, no prospective studies on caries incidence in preschool children have been performed in Flanders. In the present study, the following research question was addressed: What are the risk factors for visible caries experience at age 3 and for an increment in caries experience between the examinations at ages 3 and 5?

Material and methods

Cohort

The cohort presented here consisted of 1,057 children, selected shortly after birth in two regions in Flanders, Tielt-Winge and Berlaar. These children served as controls in the 'Smile for Life–Tandje de Voorste' project, an oral health promotion programme that was implemented in 2003 in two regions in Flanders (Waregem and Tielt) within the frame of the well-baby clinics organised by Kind & Gezin ("Child & Family"). The well-baby clinics offer preventive health care and educational guidance to parents of young children from birth until the age of 2.5 years. Although attendance of the well-baby clinics is not compulsory, the participation level in 2003 and 2004 (the years of recruitment for the study) was 97% for the home visits and ranged between 84% and 86% for attendance at consultation offices.

As in each region about 1,000 children had been born in 2002 and the preceding years, it was decided to recruit for the present study during a period of 6 months in order to obtain a cohort of at least 500 consecutively born children in each region. From the start of the study (October 2003) onwards, the nurses of Child & Family kept track of all newborn children in the four above-mentioned regions. During the first home visit, the parents were orally and in writing informed about the project and invited to participate, to sign an informed consent and to complete a questionnaire. A baby was not adopted in the cohort if parental language skills were insufficient to complete the questionnaire, if the child had one of the predefined congenital and/or acquired general health problems which might have an oral impact (e.g. Down's syndrome, congenital cleft in lip and/or palate), if the parents did not attend the well-baby clinics or if they moved out of the region shortly after birth. In addition, in case of twins, only one child (the one whose name was alphabetically ranked first) was adopted in the study cohort.

It was scheduled to examine the children's oral health and to ask parents for information regarding oral health behaviour through questionnaires at the ages of 3 and 5 years. For this purpose, kindergartens were the most appropriate setting. In Flanders, children can attend kindergarten from 2.5 years on. Although compulsory education in Belgium only starts at the age of 6 (first year of primary school), over 99% of 3-year-olds and 98% of 5-year-olds living in Flanders attended kindergarten in the school year 2002–2003 (source: Ministry of the Flemish Community, Education Department). Hence, in order to retrieve as many toddlers as possible at ages 3 and 5, parents were asked during the last consultations at the well-baby clinic which kindergarten their child would attend.

Questionnaires

Parents completed questionnaires which yielded data on sociodemographic variables, children's and parental oral health behaviours at birth (2003–2004) and when the child was 3 (2007) and 5 (2009). The questionnaires were accompanied by a letter explaining the purpose of the study; at ages 3 and 5, the letter included a request for permission to have the child examined by a dentist. Questionnaires were tested and validated during a pilot study executed in another region. The inquired variables that were used in the logistic regression analyses are summarized in Table 1.

The socioeconomic status of the child was evaluated based on the reported educational level of the mother and father; these data were collected at birth. Distinction was made between parents who did not continue educational training after primary and/or secondary school ("Primary or secondary school") and parents who received higher education at the level of college, non-university or university ("Higher education or University").

If one of the parents or other caretakers of the child smoked on a regular basis in a place where the child was raised, the family smoking status was recorded as "yes"; if they quit smoking or reported that they had never smoked, the child was assigned to the "no" category. The question

Table 1 Results of univariable regression analyses for visible caries experience at age 3 and for an increment in caries experience between the examinations at ages 3 and 5, yielding unadjusted odds ratios (OR) and 95% confidence intervals (CI)

Variables	At age 3 (N=624)		At age 5 with d_1mft=0 at age 3 (N=404)		At age 5 with d_1mft>0 at age 3 (N=117)	
	OR	95% CI	OR	95% CI	OR	95% CI
Sociodemographic variables						
Region (Berlaar vs. Tielt-Winge)	1.25	0.85–1.82	1.20	0.79–1.81	1.03	0.48–2.23
Gender (boys vs. girls)[a]	1.05	0.72–1.53	1.03	0.68–1.57	0.61	0.28–1.32
Age[a]	**3.47**	**1.31–9.16**	1.95	0.70–5.40	0.80	0.10–6.48
Ranking of the child (1st vs. 2nd and following)[a]	**1.48**	**1.01–2.18**	0.92	0.61–1.40	0.87	0.40–1.92
Pregnancy duration in weeks (≤37 weeks vs. >37 weeks)	0.99	0.58–1.67	1.22	0.70–2.13	0.96	0.33–2.77
Family situation at ages 3 and 5 (both parents vs. other)	0.87	0.40–1.91	1.17	0.55–2.46	0.29	0.03–2.41
Watching television at ages 3 and 5 (≤1 h/day vs. >1 h/day)[a]	1.34	0.90–1.99	**1.89**	**1.23–2.91**	0.81	0.36–1.84
Family smoking status at birth (no vs. yes)[a]	**1.65**	**1.04–2.62**	0.94	0.54–1.65	1.12	0.43–2.90
Family smoking status at ages 3 and 5 (no vs. yes)[a]	0.99	0.58–1.69	1.20	0.70–2.04	1.56	0.47–5.20
Parental information						
Parental age at birth	1.01	0.96–1.05	0.97	0.93–1.03	0.99	0.89–1.09
Educational level of mother[a] (low vs. high)	1.08	0.73–1.59	1.10	0.71–1.69	**2.37**	**1.02–5.52**
Educational level of father (low vs. high)	1.15	0.79–1.68	0.92	0.60–1.39	**2.23**	**1.01–4.91**
Parental dental visit at birth (≤1 year vs. >1 year)	0.66	0.42–1.03	0.67	0.41–1.10	1.27	0.56–2.91
Parental dental visit at ages 3 and 5 (≤1 year vs. >1 year)	1.04	0.64–1.70	1.35	0.77–2.37	0.93	0.31–2.78
Parental brushing frequency at birth (≥2×/day vs. <2×/day)[a]	**1.67**	**1.10–2.55**	1.19	0.73–1.92	1.91	0.83–4.39
Parental brushing frequency at ages 3 and 5 (≥2×/day vs. <2×/day)[a]	1.41	0.94–2.11	1.38	0.89–2.16	1.19	0.52–2.73
Interdental cleaning aids at birth (yes vs. no)[a]	1.03	0.69–1.56	1.00	0.64–1.57	0.89	0.38–2.07
Interdental cleaning aids at ages 3 and 5 (yes vs. no)[a]	0.94	0.61–1.46	**1.88**	**1.13–3.13**	0.68	0.28–1.65
Children's oral hygiene habits						
Age at start tooth brushing (≤1 year vs. >1 year)	1.03	0.68–1.55	1.29	0.81–2.06	1.25	0.55–2.85
Help with brushing at age 3 (daily vs. <1/day)[a]	1.25	0.81–1.92	**2.31**	**1.46–3.67**	1.49	0.63–3.54
Help with brushing at age 5 (daily vs. <1/day)[a]	NA	NA	1.06	0.69–1.63	1.06	0.47–2.35
Brushing frequency at age 3 (daily vs. <1/day)	1.27	0.70–2.32	1.35	0.66–2.73	1.84	0.46–7.38
Brushing frequency at age (daily vs. <1/day)	NA	NA	1.28	0.46–3.54	4.52	0.55–37.51
Plaque accumulation at ages 3 and 5 (no vs. yes)[a]	**2.11**	**1.44–3.09**	**1.86**	**1.21–2.87**	**3.18**	**1.44–7.03**
Children's dietary habits						
Baby feeding at birth (baby formula vs. breastfeeding)[a]	1.19	0.79–1.78	1.16	0.74–1.81	**2.75**	**1.14–6.62**
Baby feeding at birth (combination vs. breastfeeding)[a]	0.87	0.46–1.64	0.83	0.41–1.67	0.96	0.29–3.16
Sugar-containing products on pacifier at birth (yes vs. no)	1.39	0.67–2.89	1.55	0.62–3.84	3.90	0.46–32.84
Pacifier cleaned in parents' mouth (yes vs. no)	1.15	0.75–1.77	1.10	0.70–1.75	0.90	0.39–2.06
Fluoride supplements at birth (yes vs. no)	1.02	0.52–1.99	0.73	0.37–1.47	1.10	0.31–3.97
Nursing bottle at ages 3 and 5 (yes vs. no)	1.43	0.93–2.21	1.11	0.48–2.56	0.85	0.12–5.95
Pacifier at ages 3 and 5 (yes vs. no)	1.25	0.83–1.89	0.46	0.17–1.26	1.45	0.20–10.65
In between meals sugar-containing snacks at ages 3 and 5 (<1/day vs. ≥1/day)[a]	1.07	0.66–1.71	1.23	0.68–2.24	0.49	0.11–2.19
In between meals sugar-containing drinks at ages 3 and 5 (<1/day vs. ≥1/day)[a]	1.22	0.80–1.85	1.42	0.91–2.20	1.01	0.44–2.31
Drinks at night at ages 3 and 5 (<1/day vs. ≥1/day)[a]	1.51	0.69–3.28	1.13	0.35–3.60	0.75	0.12–4.84
Snacks at night at ages 3 and 5 (<1/day vs. ≥1/day)[a]	1.24	0.62–2.49	1.12	0.57–2.22	1.65	0.47–5.85
Fruit juice consumption at age 5 (<1/day vs. ≥1/day)[a]	NA	NA	1.06	0.68–1.65	1.28	0.56–2.90
Soda consumption at age 5 (<1/day vs. ≥1/day)[a]	NA	NA	1.15	0.70–1.89	1.05	0.43–2.56

Significant results are presented in bold. Results are derived from a multiple imputation analysis with five imputations

OR odds ratio, *CI* confidence interval, *NA* not appropriate, *low educational level* primary and secondary school, *high educational level* college or university

[a] Variables that were adopted in the multivariable logistic models

on exposure to environmental smoke was adopted in the questionnaire at all three occasions (birth, age 3 and 5).

Clinical examination

The oral health examinations were carried out at age 3 and 5 years in the kindergarten of the participating children, with the children sitting on an ordinary chair. Parents were not informed about the exact date of the oral examination in order to prevent extra brushing.

Teeth were examined using a mirror with a built-in light source (Mirrorlite™ by Defend® from Medident, Belgium), and a WHO/CPITN type-E screening probe was available for the examiners in case they wanted to clean debris from a pit or fissure or they wanted to confirm the absence of a cavity. If felt necessary, teeth were cleaned and/or dried with cotton rolls before caries experience was recorded. Caries experience was scored according to the guidelines published by the British Association for the Study of Community Dentistry [9]. Caries experience was expressed using the dmft index (decayed, missing due to caries and filled teeth) [10]; for each child, a dmft score (sum of decayed, filled or missing due to caries deciduous teeth) was calculated. As was suggested by the participants of the Bethesda workshop on early childhood caries, both non-cavitated (d_1) and cavitated caries lesions (d-component of WHO index) were recorded [11]. Dental caries lesions at the d_1 level were scored according to the criteria described by Fyffe et al. [12].Theoretically, teeth should be dried before caries experience is recorded at the d_1 level. Unfortunately, the field conditions (i.e. a classroom in kindergarten) made it impossible to comply with this instruction. No radiographs were taken as the screenings were not part of routine oral health examinations. The absence/presence of dental plaque was assessed on the buccal surfaces of teeth 52, 55, 72 and 75 in accordance with Carvalho et al. [13].

Examinations were performed by six (2007) and five (2009) trained dentist examiners; all examiners participating in 2009 had been involved in 2007. Before each examination period, all examiners received a specific training for this purpose and participated in a calibration session during which in 2007 21 3-year-olds and in 2009 32 5-year-olds were examined. Afterwards, the examiners received individual feedback. The sensitivity and specificity in the scoring of caries experience were estimated for each examiner versus the benchmark scorer (last author) since recent publications recommended the use of sensitivity and specificity scores rather than kappa scores for reporting inter-examiner reproducibility in the presence of a gold standard [14]. At the d_1 level, sensitivity scores (at mouth level) ranged between 0.67 and 1.0 in 2007 and between 0.67 and 1.00 in 2009, and specificity scores ranged between 0.50 and 0.92 in 2007 and between 0.70 and 1.00 in 2009. At the d_3 level, sensitivity scores (at mouth level) ranged between 0.67 and 0.89 in 2007 and between 0.73 and 0.91 in 2009, specificity scores ranged between 0.83 and 1.00 in 2007 and between 0.95 and 1.00 in 2009.

Ethical approval

The study protocol received ethical approval from the Medical Ethics Committee of the Katholieke Universiteit Leuven, Belgium.

Statistical methodology

First univariable logistic regression analyses were performed with the following outcome variables: (1) visible caries experience at d_1 level at age 3 and (2) an increment in visible caries experience at d_1 level between the examinations at ages 3 and 5. Children's and parental characteristics reported at birth and ages 3 and 5 were used as explanatory variables; an overview of all evaluated variables is presented in Table 1.

In order to account for the missing explanatory variables, multiple imputations using five imputations were performed [15]. All characteristics and outcome variables were simultaneously used in the imputation model. The imputations were done in R version 2.11.1 by the aregImpute function (adaptive regression and multiple imputation) of the package Hmisc [16, 17].

In the next step, multivariable models were constructed, which allow an efficient way to control for several variables simultaneously. In order to select the variables for the multivariable logistic regression, an automatic backward selection strategy was applied to 1,000 bootstrap samples for each of the five imputed datasets. Following Heymans et al., several strategies were applied as a sensitivity analysis [18]. A p value to stay of 0.5, 0.175 and 0.05 with a selection level in the 5,000 samples of 90%, 80% and 70% was used, respectively. Variables that were selected in all three analyses were chosen to be included in the final multivariable logistic regression model. This strategy takes into account the uncertainty created by the missing data and the sample design. Pairwise interactions between the selected variables were investigated. The proportion of variance of the dependent variable explained by the selected covariates was expressed by the adjusted sum of squares measure (R^2) averaged over the five imputed data sets [19]. All statistical analyses were performed using SAS software version 9.2 [20].

Results

Cohort

Although it was scheduled to recruit children during 6 months, it took eventually 8 months in one region and

10 months in the other to collect respectively 547 and 510 children whose parents consented to participate. During that time span, 768 and 886 babies had been born in these regions. In the two regions, only 15 and 25 parents fulfilling the inclusion criteria refused collaboration in the study; the major reasons were lack of interest and lack of time.

A flow chart indicating the number of children who entered the study and their follow-up (retrieval, clinical examination) over the 5-year study period is presented in Fig. 1. Sixty-six percent (n=701) of the 1,057 originally selected children were retrieved at age 3 years and 73% (n=772) at age 5. The main reason for missing data at follow-up was failure to identify the kindergarten the child attended (n=439); more details on the reasons for dropout are summarized in Table 2. Oral examinations were performed in 624 3-year-olds (59%); 521 of them were also present at the oral examination when they were 5.

Responders versus nonresponders

In order to evaluate potential bias due to missing data, questionnaire data obtained at baseline (i.e. birth of the child) were compared for responders (i.e. clinical examination performed at age 3 c.q. 5) and nonresponders (i.e. no clinical examination at age 3 c.q. 5). Significantly more parents–responders reported a higher paternal educational level (i.e. higher education or university; p=0.030 at age 3 and p=0.004 at age 5) and the use of interdental cleaning aids (e.g. dental floss, proximal brushes; p=0.003 at age 3 and p<0.001 at age 5), while significantly more parents–nonresponders reported the current use of a nursing bottle by their child (p=0.023 at age 3 and p=0.015 at age 5). In addition, significantly more children who were examined at age 5 had mothers with a higher educational level compared to their peers who were not retrieved for clinical examination (p=0.018).

Caries experience

At age 3, enamel and/or dentinal caries experience (i.e. $d_1$mft>0) was observed in 139 (22%) children; at age 5, in 213 (41%) children. Caries experience at the d_3 level (i.e. $d_3$mft>0) was observed in 31 (5%) children examined at age 3 and in 134 (26%) children at age 5. In 26 (84%) and 73 (54%) children with overt caries experience (d_3), no restorations were observed at ages 3 and 5, respectively. In none of the 3-year-olds and 11 5-year-olds teeth had been extracted due to caries experience.

At both ages, the distribution of caries experience scores was skewed: 75% of all 335 teeth affected at the d_1 level at age 3 were observed in 70 (11%) children and 76% of all 660 teeth affected at the d_1 level at age 5 were scored in 100 (19%) children. In view of these very skewed dmft scores (at d_1 as well at d_3 level), it was opted not to present the means and standard deviations of the dmft scores as these are only good indicators of the central location and the spread of the data when these data are normally or at least symmetrically distributed, which was not the case.

Univariable analysis

Unadjusted odds ratios (and 95% confidence intervals) were calculated for variables explaining (1) caries experience (d_1 level) at age 3, (2) caries experience (d_1 level) at age 5 for children without visible caries experience at age 3 and (3) new caries experience (d_1 level) developed between examinations at ages 3 and 5 for children with visible caries experience at age 3 (Table 1). It was apparent that 3-year-olds who were older, not firstborn and exposed to second-hand tobacco smoke had significantly higher odds for having caries experience at the d_1 level. Likewise, 5-year-olds who had not been diagnosed with visible caries experience at age 3, who were older and who watched

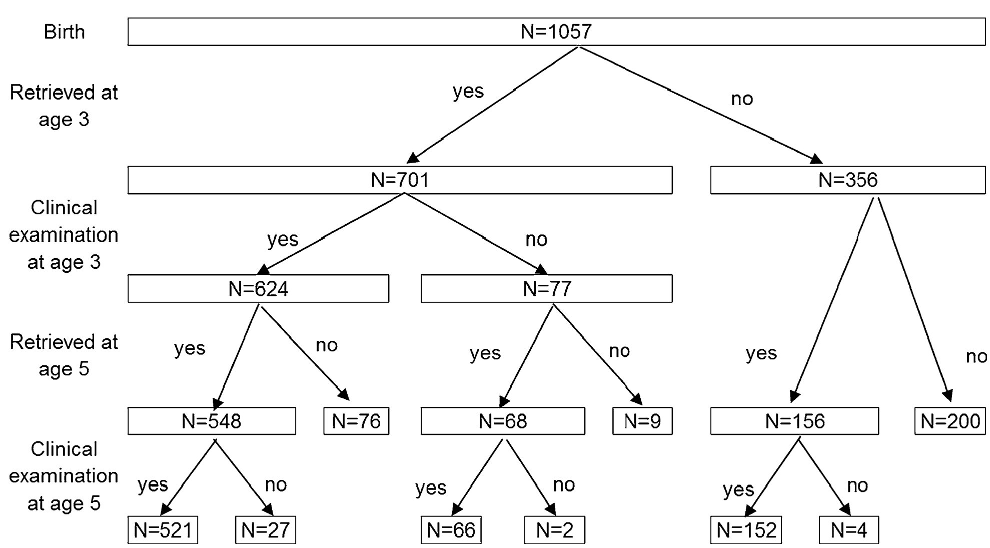

Fig. 1 Number of children who entered the study and their follow-up (retrieval, clinical examination) over the 5-year study period

Table 2 Reasons for dropout at ages 3 and 5

	Age 3	Age 5
Child was absent on the day of examination	31	28
Child moved out of the study region	28	7
Kindergarten was not adopted in study schedule	1	44
Kindergarten was not known to researchers	241	198
Parents refused collaboration to the study	12	7
Kindergarten refused collaboration to the study	43	1
Total	356	285

more than 1 h of television a day had significant higher odds for having visible caries experience at age 5.

Children whose parents reported at birth not brushing twice a day had significantly higher odds for presenting with visible caries experience at age 3. Children without visible caries experience at age 3 and whose parents did not use interdental cleaning aids at regular intervals had significantly higher odds for having visible caries experience at age 5. In the peer group who had already experienced caries by age 3, a lower educational level of both mother and father was significantly associated with new visible caries experience at the d_1 level at age 5.

It was apparent that in all three groups, children who presented with dental plaque on at least one of the index teeth had significantly higher odds for having visible caries experience at the d_1 level. Children whose parents reported they received help with brushing at age 3 were less likely to present with visible caries experience at age 5. No significant difference was observed between children with and without visible caries experience with respect to the age at which tooth brushing was started and the brushing frequency (as reported by the parents).

The only dietary habit that was significantly associated with an increment in caries experience between 3 and 5 was baby formula in infancy for children who had already experienced visible caries at age 3.

Multivariable logistic regression analyses

The final multivariable logistic regression analyses revealed that 3- as well as 5-year-olds who presented with visible plaque accumulation on at least one primary tooth had two times the odds for having visible caries experience at the d_1 level compared to children who were plaque free (Table 3). In addition, children with previous caries experience (at the d_1 level) at age 3 had significantly higher odds for new caries lesions at age 5 than their peers who presented without visible caries experience at age 3. In none of the multivariable logistic regression analyses statistically significant interactions between variables were observed.

Discussion

Caries experience at the d_1 and d_3 levels was diagnosed in respectively 22% and 5% of 3-year-olds and 41% and 26% of 5-year-olds. It is tempting to conclude that these results are acceptable; yet one should realize that even lesions at the d_1 level, which indeed do not need any restorative treatment yet, are indicators that the affected child presents the risk factors for early caries experience and presumably for further caries development and hence needs appropriate preventive care.

The univariable logistic regression analyses revealed that several sociodemographic, dietary and oral hygiene habits were significantly related to the development of visible caries experience at age 3 and to the development of new caries lesions between ages 3 and 5. However, if the evaluated parameters were simultaneously adopted in multivariable models, there was only one variable that remained significant after backward selection and this in both groups considered: the presence of visible plaque accumulation. Previous reports have already indicated that the impact of visible plaque accumulation on caries development cannot be overestimated [8, 21–23]. Presumably, the presence of visible plaque accumulation can be considered a proxy for many different

Table 3 Multivariable regression analyses for visible caries experience (at d_1 level) at age 3 and for an increment in caries experience between the examinations at ages 3 and 5

Characteristic	Comparison	OR	95% CI
Caries experience at age 3 (n=624)[a]			
Plaque accumulation at age 3	Yes vs. no	2.11	1.44–3.09
Increment in caries experience between 3 and 5 (n=521)[b]			
Caries experience (at d_1) at age 3	Yes vs. no	2.79	1.82–4.29
Plaque accumulation at age 5	Yes vs. no	2.20	1.50–3.23

Results are derived from a multiple imputation analysis with five imputations

[a] Variables included in the analysis explained 2% of the variance

[b] Variables included in the analysis explained 7% of the variance

aspects: oral hygiene practices (frequency, efficiency, received help), enamel surface characteristics (roughness, texture), biofilm characteristics (microbiological composition) and dietary characteristics (sucrose content, stickiness). Further research in this field is indicated. But already now, it should be highlighted that a screening for the presence of visible plaque is a powerful tool for the detection of children at risk for caries development, and this before (irreversible) damage has taken place.

In previous reports, it was concluded that children with early caries development were at higher risk for further caries development [24, 25]. This finding was confirmed in the present study. Hence, if the burden of caries and the high polarization of the disease are to be tackled, the efforts should be focused on very young children and their parents.

Finally, some of the limitations of the present study should be considered. Data on oral health-related habits and socio-demographic background were reported by the parents, and it was not possible to verify these data. As is well known, people, when responding to questionnaires, sometimes answer more according to a prevailing social norm than to the factual situation as they want to adhere to what is socially desirable [26]. Hence, some children may have been assigned to the wrong group. Misclassification of 'exposure' usually results in differences between groups being faded, and hence, the true risk from the exposure may be underestimated.

Since teeth were not dried, caries experience may have been underscored, and the differential diagnosis with enamel hypoplasia may have been hampered. In addition, since the dental examinations were not performed in combination with routine dental checkups or treatment appointments, no radiographic documentation was available. Exposing the children to roentgen rays only for scientific purposes was considered unethical. Consequently, it was not possible to assess hidden occlusal caries or dentin lesions on approximal surfaces, which may have led to underscoring of caries experience.

One of the major problems in prospective studies is dropout. As in the present study cohort selection was performed within the frame of well-baby clinics and follow-up within the frame of kindergartens, it was extremely difficult to retrieve all children as both are completely separately organised in Belgium. In addition, for reasons of privacy protection, it is in Belgium not possible to obtain the coordinates of the school a child is attending. Significantly more parents–responders reported a higher paternal or maternal educational level compared to their peers who were not retrieved. This may have had an impact on the results in this way that caries prevalence data may have been underestimated in this study since children from lower socioeconomic background were more likely to dropout.

Data presented in this report were collected in two distinct geographical areas in Flanders and as a result cannot be regarded as representative for children of that age living in Flanders. Yet, care was taken to collect within each region a cohort of at least 500 consecutively born children in order to represent the population as well as possible. But as data were obtained through questionnaires completed by the parents, one of the participation criteria for the present study was that at least one parent had sufficient language skills in Dutch, the language spoken in the northern part of Belgium. As a consequence, some immigrant children will have been excluded from the study, and hence, the sample may not truly be representative for the population of 3- and 5-year-olds living in those regions.

In conclusion, the present study indicated that the presence of visible plaque accumulation on at least one primary tooth was a significant risk factor for visible caries experience at age 3 and for an increment in caries experience between the examinations at ages 3 and 5. Furthermore, children with caries experience at age 3 had significantly higher odds for new caries lesions at age 5 than their peers who presented without visible caries experience at age 3. Interventions aimed at caries prevention should therefore focus on very young children and on the control of dental plaque accumulation. The presence of visible plaque accumulation as a screening tool for identifying young children at risk for future caries experience shows high potential.

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Conflict of interest The authors declare that they have no conflict of interest.

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