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The effectiveness of a 6-year oral health education programme for primary schoolchildren

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Abstract – *Objectives:* The aim of this study was to evaluate the effect of a 6-year oral health education programme in primary schoolchildren. *Methods:* This programme was part of the Signal-Tandmobiel® project, a longitudinal collaborative project combining the registration of oral health data and oral health promotion. The intervention group comprised 3291 children with a mean age of 7.1 years (SD 0.43) at the start of the programme. Every year these children were examined clinically and a questionnaire, to be filled in by the parents, was administered to assess oral health behaviour. These children received an oral health education programme which consisted of a yearly 1-h instruction. Data collected using the same questionnaire and clinical examination in 676 12-year-old children were included as control group. The samples were obtained using stratified cluster sampling. The effect of the interventional programme was assessed by measuring differences in caries prevalence and incidence, levels of dental care and reported oral health behaviour. *Results:* Mean DMFT/S values, although higher in the control group, were not significantly different. The reported frequency of brushing was the same in both groups. Significant differences in favour of the intervention group were found in the number of between-meal snacks ($P < 0.001$) and the proper use of topical fluorides ($P < 0.05$). Children in the control group showed a significantly lower proportion of filled teeth than those in the intervention group ($P < 0.01$), with a care index of 73% versus 80%. *Conclusion:* In conclusion, the implemented minimal school-based oral health education programme did not result in a significant reduction of the caries prevalence measured. The programme has been effective in improving reported dietary habits and the proper use of topical fluorides and resulted in a higher care index.

Key words: effectiveness; evaluation; oral health education; primary schoolchildren

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As in most western industrialized countries, the prevalence of dental caries in children has declined significantly over the past decades in Belgium (1, 2). Simultaneously this trend resulted in a polarization of caries prevalence with 75% of caries in 27% of the children (3). This polarization is very strongly related to deprivation (4, 5). Nowadays many governments commit themselves to promote (oral) health, based upon the principles and strategies advocated in the Ottawa Charter (6). This policy combines three types of measures: (i) modern health education, dealing with knowledge and feelings, as well as with individual and social skills; (ii) health protection, which includes the development of environmental measures capable of facilitating healthier behaviours and lifestyle (i.e. making healthier and easier choices); and (iii) reorganization of health systems to ensure relevant and high-quality services to the population. To enable and support healthy behaviour, a range of external factors, an array of healthy products, such as fluoridated toothpaste, and the presence of social pressures are emphasized. They continuously affect an individual patient's oral health and oral health behaviour. Social norms tend to support good oral hygiene and to a lesser degree dietary

habits. This means that health promotion studies must focus not only on health and health-related behaviours, but also on the relationship between health and health behaviours and the environment (7).

One of the environmental settings is the school. Schools can contribute to the achievement of public health goals in conjunction with their educational commitments (8). With respect to health promotion at school, recent studies revealed that it indeed makes some difference towards health and health-related behaviour of the children (9). The fact that the whole school system has to be considered has led to the development of the 'Healthy School Concept' (10) and more recently to the 'Health Promoting School Concept' in Europe (11, 12). In this context, and taking into account the increasing pressure on health resources, it remains to be seen whether some aspects of oral health promotion, including oral health education, can add value in promoting oral health and reducing inequalities in oral health. In this case, it could be worth implementing on a population base.

Despite the poor methodologies and inadequate study designs of many effectiveness studies, reviews published in the last decennium concluded that oral health education can result in short-term gains in knowledge, improvements in oral health behaviours and oral health status. The latter took place only when additional health-promoting measures involving widespread multiple fluoride exposure were included (13, 14). More recently, Kay and Locker (15, 16) showed that dental health education interventions have a small positive, but temporary effect on plaque accumulation, no discernable effect on caries increment, short-lived effects on attitude and a consistent positive effect on knowledge levels.

The aim of this study was to evaluate the additional effect of a school-based oral health education programme in primary schoolchildren over a 6-year period in a low-caries prevalence region. The study aimed to evaluate both the clinical outcome effects and the intermediate behavioural effects. The hypothesis of no difference between the intervention and the control group was tested.

Material and methods

The present report is a 6-year longitudinal analysis of the Signal-Tandmobiel® data. Data were obtained from Flanders, the northern federal state of Belgium with 5 900 000 inhabitants. A cohort of schoolchildren, representative of children born in 1989 in Flanders, was selected and has been followed up for a period of 6 years (1996–2001). At the start of the project, the children were 7 years of age. Two groups were sampled, one intervention group (A group – initially 4468 children) and a longitudinal control group (B group – initially 800 children).

The samples were drawn using a technique of stratified cluster sampling without replacement. The selection units were the schools. For this, the target population was divided into 15 different strata, combining the three different types of educational system, namely private schools (mainly Catholic schools), public schools and municipal schools, within the five geographical areas (provinces). Schools were selected with a probability proportional to their size, i.e. the number of children in the first year of primary school. The children participated in oral health examinations on school premises in a mobile dental clinic by 16 examiners calibrated to the agreed criteria (17). Calibration exercises were conducted in groups of 12 age-matched children with a variety of pathology, including untreated caries, recurrent caries and fillings, nevertheless making sure that some caries-free children were included. To evaluate the levels of reliability, master sheets were used and scores compared using paired *t*-tests. To obtain more detailed information on caries scores, Cohen's kappa coefficient was calculated, as this score corrects by a chance–expected agreement. The examination methods were calibrated prior to the start of the study and further on a yearly basis. Examiners having a kappa score below 0.60 were recalibrated until the necessary quality of data acquisition was obtained or were otherwise excluded from further participation. Finally, from a larger group of candidate-examiners, 16 dentists were selected at the start of the study. The obtained level of agreement between the examiners and the benchmark examiner over the different years remained good to excellent (κ ranged between 0.64 and 0.91) (18). The dental examinations were conducted following standardized and widely accepted criteria, as recommended by the WHO report on oral health surveys (19). The diagnostic criteria for caries prevalence were those of the British Association for the Study of Community Dentistry (20). No radiographs were taken and decay was recorded at the level of cavitation,

using a mouth mirror and a WHO/CPITN-type E (Community Periodontal Index of Treatment Needs) probe.

Plaque accumulation and gingival health status were assessed on the buccal surfaces of Ramfjord teeth (16 (55), 21 (61), 24 (64), 36 (75), 44 (84), 41 (81)); if present, permanent teeth were preferred. The presence of plaque on the buccal surfaces of reference teeth was scored using the Index of Silness and Löe (21). The presence of plaque on the occlusal surfaces of first permanent molars was assessed using a simplified version of the index described by Carvalho et al. (22):

Code 0: no visible plaque (Carvalho et al.: code 0)
Code 1: detectable plaque restricted to fossae and grooves (Carvalho et al.: codes 1 and 2)
Code 2: surface partially or totally covered with heavy plaque accumulation (Carvalho et al.: code 3)

The Sulcus Bleeding Index (SBI) described by Mühlemann and Son (23) was used to assess the level of gingivitis.

The detailed set-up of the Signal-Tandmobiel® project has been presented elsewhere (24).

Sample

In the present study, from the initial selection, 4351 children in the intervention group (A group) and 800 children in the control group (B group) were examined at baseline and had a complete clinical data set. From this cohort 3291 and 676 children, respectively, reached the final examination (year 6/age 12). The mean age of the children was 7.1 years (SD 0.43) at baseline and 11.6 years (0.37) at the final examination. In the intervention group each child participated annually in oral health examinations. In the control group, clinical examinations took place at the beginning and at the end of the 6-year period.

For all children, both from the intervention and control group, informed consent was obtained and information to the parents and the School Health Care Centres about the oral health status and treatment need of the children was provided by means of an advice and referral letter. The study was approved by the Ethics Committee of the Catholic University Leuven.

Questionnaires

Information on oral health habits, dental attendance, history of dental trauma and toothache related to the children was obtained from the parents of the children using a structured questionnaire. In the intervention group, this questionnaire was repeated on a yearly basis with small adaptations each year. The parents of the children from the control group received a questionnaire, identical to the one used in the intervention group, but only at the beginning and at the end of the 6-year period. The questionnaire was validated during a pretest phase.

The questionnaires were completed in the week prior to the examination at school. Questions on oral health-related topics used in the present analyses included:

- Oral hygiene habits, with brushing frequency, use of fluoridated toothpaste and regular use of dental floss. The last topic was questioned only in the final year;
- Dental attendance pattern;
- Dietary habits, with the number of between-meal snacks;
- History of toothache (only in the final year).

The identification of the child and the sociogeographical background were provided by the school Health Care Centre.

Educational programme

Only within the intervention group the oral health education programme was delivered. This included a 1-h oral health education session for children and teachers once a year, preceding the individual oral health examination. Oral health education involved instructions on oral hygiene, use of fluorides, dietary habits and dental attendance, the basic concepts of oral health promotion. Attention was paid to the use of a correct age-matched educational technique. The importance of topical fluorides as a protective agent was emphasized, advising toothpaste as the preferred carrier three times a day. Diet counselling focussed on the danger of frequent intake between meals of sugar-rich food and beverages. For health educational and counselling purposes, material was designed and adapted to each specific age group.

Evaluation model

To evaluate the effectiveness of the intervention, an outcome evaluation model was designed using the variables of the clinical examination and the questionnaire (25). This model outlines a range of health outcomes and intermediate health outcomes. Change in DMF levels, plaque indices, SBI and restorative index (F/DF) are used as primary outcome measures. Frequency of brushing, number of between-meal snacks, the use of topical fluorides, the use of dental floss, dental attendance and the

Table 1. Changes in frequency distribution and mean values (SEM) of oral health and oral health behaviour variables according to intervention and control groups and to cohort groups at baseline and at the end of the investigation period

	Survey year					
	1			6		
	Intervention ($n = 4351$)	Control ($n = 800$)	P-value	Intervention ($n = 3291$)	Control ($n = 676$)	P-value
DMFT	**0.17 (0.008)**	**0.24 (0.02)**	**<0.001**	0.92 (0.02)	1.0 (0.06)	0.49
DMFS	**0.22 (0.01)**	**0.36 (0.04)**	**<0.001**	1.46 (0.04)	1.59 (0.10)	0.31
dmft	2.24 (0.04)	2.38 (0.09)	0.31			
dmfs	5.02 (0.10)	5.61 (0.11)	0.22			
Restorative index – permanent teeth	0.35 (0.02)	0.39 (0.04)	0.58	**0.80 (0.01)**	**0.73 (0.02)**	**<0.01**
Restorative index – deciduous teeth	**0.43 (0.01)**	**0.37 (0.01)**	**<0.05**			
Plaque index – buccal	**0.49 (0.007)**	**0.61 (0.02)**	**<0.001**	**0.35 (0.008)**	**0.40 (0.02)**	**0.02**
Plaque index – occlusal	0.36 (0.007)	0.39 (0.01)	0.9	0.06 (0.003)	0.06 (0.007)	0.3
SBI	**0.21 (0.006)**	**0.27 (0.01)**	**<0.001**	**0.21 (0.003)**	**0.29 (0.02)**	**<0.001**
More than two between-meal snacks (%)	31.3	31.1	0.89	**29.9**	**36.9**	**<0.001**
Frequency of brushing (not every day) (%)	15	14.6	0.72	8.4	7.0	0.27
Use of fluoridated toothpaste (%)	90	89	0.43	**88**	**86**	**<0.05**
Last visit to the dentist (>6 months ago) (%)	47.9	45.0	0.18	67.0	66.6	0.11
Regular use of floss (%)				6	7	0.71
Toothache (never) (%)				**78.1**	**51.0**	**<0.001**

Significant variables are printed in bold.

history of toothache are used as intermediate health outcomes. These secondary measures may provide insight into the potential effects the intervention may have on quality of life and on risk factors directly correlated to the primary outcome of interest.

Data analysis

The chi-square test was used for testing differences in proportions of the ordinal reported oral health behaviour variables between the intervention and the control group both at baseline and at year 6. The child was used as the unit of analysis. The non-parametric Mann–Whitney *U*-test was used to compare DMF scores and their derivatives. To control for the influence of environmental factors on significantly different variables simple and ordinal logistic regression with random school effects were used. In this analysis, the responses of interest were the significant oral health and oral health behaviour variables. The regressors included in the regression analysis were the study group, i.e. whether or not the oral health education programme had been received, gender, the stratification variables province and educational system, the socioeconomic status of the school and the level of urbanization of the school. Tests resulting in P-values <0.05 were considered significant. Statistical analyses were performed using SPSS 10.0 and SAS, version 8.2 procedure NLMIXED.

The equivalence of experimental and control groups at baseline was ascertained by Chi-square test analysis and the nonparametric Mann–Whitney *U*-test. Despite randomization the experimental and control group differed in baseline DMF (permanent dentition), buccal plaque scores, gingival health and restorative level in the deciduous dentition. There was no statistically significant difference in baseline dmf (deciduous dentition), restorative level in the permanent dentition, amount of occlusal plaque and reported oral health behaviour (Table 1).

Results

Effect on health outcomes

The extent of caries, expressed by the DMFT/S scores, between experimental and control group did not differ significantly at the end of the follow-up period. In 2001, the mean DMFT score was 0.92 for children in the intervention group and 1.00 for those in the control group. A mean DMFS score of 1.46 in the intervention and 1.59 in the control group was found (Table 1). After 6 years of interventional programme, the prevalence of caries in the permanent dentition of the intervention group was 40.7% (95% CI: 38.9–42.3%), in the control group it was 41.3% (95% CI: 37.5–44.9%). The difference of 0.61% was not significant ($P = 0.76$). The cumulative incidence (number of new children with caries during the investigation period from the total population at risk) for the 6-year investigation

period in the study group was 0.36, whereas in the control group it was 0.35 ($P = 0.78$). By the end of the study, comparison of the index of restoration (F/DF) between both cohorts showed a statistically significant difference ($P < 0.01$) with a higher restorative level in the intervention group (80% versus 73% on surface level).

Almost no discernable effect was observed on plaque accumulation. The analysis showed that extra dental health education did only result in a small significant reduction in buccal plaque accumulation with a mean intervention effect of −0.05 (95% CI −0.007 to −0.09; $P = 0.02$). This difference, however, was already observed at baseline. The apparent significant improvement in gingival health, expressed by the SBI, was already present at baseline.

For the total sample, intervention and control group (Table 2) a significant improvement in plaque scores and restorative index for the permanent dentition was found during the investigation period ($P < 0.0001$).

Effect on intermediate health outcome variables – healthy lifestyles

At the end of the investigation period, there was a statistically significant difference between intervention and control group in some of the caries risk-related behavioural factors studied (Table 1). The parents of the children in the intervention group reported more favourable oral health habits concerning the number of between-meal snacks; 36.9% in the control group reported to have more than two between-meal snacks per day versus 29.9% in the intervention group ($P < 0.001$). A similar, but less pronounced pattern was evident concerning the use of fluoridated toothpaste ($P < 0.05$). No significant difference among the two groups was found concerning the habit of flossing, the frequency of brushing and the frequency of dental visits. Regarding the reported history of toothache, 78.1% in the intervention group reported they had never had a toothache compared with 51% in the control group ($P < 0.001$).

For the total sample (Table 2) a significant improvement of reported oral health habits was found during the investigation period. The reported frequencies of between-meal snacks were significantly lowered ($P < 0.0001$). Dental self-care, represented by brushing frequencies, was significantly improved ($P < 0.0001$). The reported last dental visits were more recent ($P < 0.0001$).

Logistic regression

To control simultaneously for other potential environmental confounders logistic regression models were used. The responses of interest were the previous found significant variables 'restorative index of permanent surfaces' and 'between-meal snacks'. The latter was a binary response defined as 1 if a child took at least two between-meal snacks per day, and 0 otherwise. Concerning the 'restorative index of permanent surfaces', a discrete outcome for the ith child was defined as

$$y_i = \begin{cases} 0 & \text{if the restorative index for the } i\text{th child was 0} \\ 1 & \text{if the restorative index for the } i\text{th child was between 1 and 99} \\ 2 & \text{if the restorative index for the } i\text{th child was 100.} \end{cases}$$

A simple logistic regression with random school effects to the binary number of between-meal response, and an ordinal logistic regression model with a random school intercept to the ordinal restorative index response was applied. The latter model has the form:

Table 2. Changes in frequency distribution and mean values (SEM) of oral health and oral health behaviour variables according to year of investigation (baseline and final examination) for all children, intervention and control group

	Year of investigation		
	Year 1 ($n = 5151$)	Year 6 ($n = 3967$)	P-value
Restorative index – permanent teeth	0.36 (0.02)	0.77 (0.01)	<0.0001
Plaque index – buccal	0.50 (0.008)	0.36 (0.008)	<0.0001
Plaque index – occlusal	0.36 (0.006)	0.06 (0.003)	<0.0001
SBI	0.21 (0.005)	0.22 (0.007)	<0.05
More than two between-meal snacks (%)	31.3	30.6	<0.001
Frequency of brushing (not every day) (%)	15	8.2	<0.0001
Use of fluoridated toothpaste (%)	90	87	<0.0001
Last visit to the dentist (>6 months) (%)	47.3	66.9	<0.0001

$$\log\left(\frac{\pi_{ik1}+\cdots+\pi_{ikr}}{\pi_{ik,r+1}+\cdots+\pi_{ik3}}\right)=\lambda_r+\mathbf{x}_i'\boldsymbol{\beta}+u_k'$$
$$r=\ 1,\ 2;\ i=1,\ \ldots,\ 3291;\ k=1,\ \ldots,\ 197$$

where $\mathbf{x}_i$ is a d-dimensional vector of covariates pertaining to the ith child and $\boldsymbol{\beta}$ is the corresponding vector of regression coefficients (fixed effects). It is assumed here that the effect of covariates is the same for all logits (proportional odds assumption). π_{ikr} is the probability of child i in school k being classified in category r of the ordinal restorative index response. Further the random effect u_k pertains to the kth school and we assume that u_k is normally distributed $N(0, \sigma^2)$. λ_1 and λ_2 are the two ordered category cut-offs satisfying $\lambda_1 > \lambda_2$. Models were controlled for group, gender, educational system (municipal as the reference), provinces (West-Flanders as the reference), schools' socioeconomic status (low status as the reference), and urbanization (countryside as the reference).

First, models were considered with the intervention as the only covariate for each of the two responses. This showed a significant difference between the intervention and the control group for both restorative index and meals intake with an odds ratio of 1.50 (CI: 1.06–2.11; $P = 0.02$) for having a higher restorative index and 1.33 (CI: 1.07–1.66; $P < 0.01$) for having less between-meal snacks when one belongs to the intervention group. Secondly, two models were fitted with all the covariates and their interaction terms. There was no significant interaction effect among the studied factors for the two models. Therefore only models without interaction terms were considered including the covariates stepwise. Table 3 presents the results of fitting an ordinal logistic model with random school effects to the ordinal restorative index. After controlling for gender, educational system and geographical effect, there was a moderate intervention effect on the restorative index ($P < 0.05$). This effect disappeared when urbanization was included in the model.

The chance of 100% restorative level was 1.40 times greater for children who did receive the educational programme. Other significant factors in this model included educational system, with a decreasing odds for attending a community school, and province with borderline significance ($P = 0.05$).

There was a strong intervention effect on the binary 'number of between-meal response' as

Table 3. Odds ratios (OR) from a multiple logistic regression analysis with random school effect and the ordinal restorative index as dependent variable*

	Restorative index					
	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Intervention						
No	1			1		
Yes	1.40	1.00–1.95	0.05	1.35	0.97–1.89	0.07
Gender						
Boy	1			1		
Girl	0.92	0.74–1.15	0.48	0.93	0.74–1.15	0.49
Educational system						
Municipal	1			1		
Free	0.95	0.69–1.30	0.73	1.01	0.71–1.35	0.91
Community	0.59	0.38–0.92	0.02	0.61	0.40–0.95	0.03
Overall educational system effect			0.04			0.04
Province						
West-Flanders (westernmost province)	1			1		
East-Flanders	0.97	0.64–1.47	0.87	0.96	0.63–1.45	0.84
Antwerp	1.47	0.98–2.21	0.06	1.47	0.98–2.21	0.06
Fl. Brabant	0.89	0.58–1.38	0.61	0.87	0.56–1.33	0.51
Limburg (easternmost province)	1.37	0.89–2.13	0.16	1.34	0.87–2.09	0.18
Overall provinces' effect			0.05			0.04
Urbanization						
Countryside				1		
Metropolitan				0.68	0.44–1.05	0.08
Conurbation				0.81	0.57–1.17	0.26
City				0.86	0.61–1.20	0.36
Overall urbanization effect						0.28

*0, restorative index equals 0%; 1, restorative index between 1 and 99%; 2, restorative index equals 100%.

Table 4. Odds ratios (OR) from a multiple logistic regression analysis with random school effect and the binary 'number of between-meal snacks' as dependent variable*

	Number of between-meals outcome					
	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Intervention						
No	1			1		
Yes	0.75	0.61–0.93	<0.01	0.77	0.62–0.94	0.01
Gender						
Boy	1			1		
Girl	0.95	0.82–1.11	0.53	0.96	0.83–1.12	0.60
Educational system						
Municipal	1			1		
Free	1.01	0.82–1.23	0.73	1.00	0.82–1.22	0.99
Community	1.06	0.79–1.41	0.70	1.06	0.80–1.41	0.68
Overall educational system effect			0.91			0.89
Province						
West-Flanders (westernmost province)	1			1		
East-Flanders	1.15	0.89–1.49	0.27	1.13	0.88–1.45	0.34
Antwerp	1.17	1.09–1.50	0.02	1.13	0.89–1.44	0.31
Fl. Brabant	1.13	0.85–1.49	0.40	1.11	0.84–1.46	0.45
Limburg (easternmost province)	1.36	1.03–1.80	0.03	1.31	0.99–1.73	0.05
Overall provinces' effect			0.30			0.44
Urbanization						
Countryside				1		
Metropolitan				1.11	0.87–1.43	0.40
Conurbation				1.04	0.84–1.29	0.71
City				0.87	0.71–1.07	0.19
Overall urbanization effect						0.34

*0, less than two between-meal snacks; 1, two between-meal snacks.

shown in Table 4 ($P < 0.01$). This effect remained significant even after including all environmental factors in the model.

Discussion

Population-based efforts and initiatives during the last decades as mentioned in the introduction offered opportunities for, and required commitments to, the provision of safe and health enhancing social and physical environment in an important part of our country. A lot of schools recognized the importance of the availability of nutritious food and drinks within their school canteens and vending machines. They supported and organized a lot of continuing initiatives at achieving healthy lifestyles, including oral health. The 'Health Promoting School' concept seeks to provide a multifaceted approach to school health (9). Together with the widescale use of fluoridated toothpastes, this range of supportive environments brought the general level of caries prevalence to a historical low in Flanders. Since the last epidemiological survey in 12-year olds in Flanders reported in 1996 (2, 26) the DMFT decreased from 1.93 to the actual 1.0 found in this study.

One of the additional findings of the present investigation is that, over the last 6 years, in the studied cohort of children, both study and control group, a significant improvement of restorative level for the permanent dentition was observed together with a significant decrease of plaque accumulation when comparing the final results with the baseline results. The important decrease in occlusal plaque accumulation is most likely connected with the further eruption stage of the first permanent molars. Both cohorts, the intervention and control group, showed improved reported oral health behaviour with consumption of lesser between-meal snacks, increased brushing frequency and more frequent dental attendance.

In agreement with the most recent literature (16) it was found that additional oral health education on top of the existing oral health promotion climate did not result in measurable improvements in dental health. Differences between intervention and control group in mean DMF and SBI were not statistically significant and/or already present at baseline. It seems to be difficult to achieve

further caries reduction in a population with an already low caries activity.

Logistic regression analyses applied to the dichotomized caries versus no caries response were not reported in the actual tables. They provided nonsignificant odds ratios by the intervention after 6 years of follow-up. Children who did receive the intervention programme had a small, but not significant, decrease in risk of dental caries. Significant factors included in this model were the geographical variable province with a high risk of dental caries in the most eastern part of the country and the urbanization level of the school with a higher risk of dental caries in the countryside versus the city or metropolis. This was in agreement with previously reported intermediate results after 4 years of follow-up (27).

Twelve-year-old children in Flanders have a mean restorative index in the permanent dentition of 0.77. This overall number of filled teeth is high compared with recent figures from the UK. The England and Wales mean care index (actually measured as FT/DMFT) was 0.48 in 2000/2001 coordinated surveys (28). What is apparent as well from the present results is that there was a significant difference between intervention and control group in the amount of restorative care which had been provided. This increased restorative level does not, however, extend to the number of experienced extractions. The proportion of children who had experienced extractions was the same in the intervention and the control group (1.3% versus 1.6%; $P = 0.42$).

The children in the intervention group demonstrated a 12.5% lower plaque index on the buccal surfaces of the studied teeth when compared with the control group; i.e. although less pronounced, in agreement with the literature (15), but the fact that differences at baseline were already observed qualify this statement.

The overall substantial increase of brushing frequency for the whole study cohort (both intervention and control group), as mentioned above and shown in Table 2, seems to have an important influence on the present results when comparing intervention and control group. Probably this overall increase, irrespective of the intervention, can partly explain the lack of effect of the intervention on toothbrushing frequency. Anyway, previous investigation in the same study group showed the frequency of brushing to be an important risk indicator for caries in the primary dentition of 7-year olds in Flanders (3) and the value of this indicator for caries development in the permanent dentition was confirmed in a longitudinal follow-up study (27).

Studies examining dietary changes are hard to compare. Objective and comparable outcome measures are lacking. There is no evidence in the literature for any dietary change as a result of an oral health educational programme. However, in the present study a significant reduction was observed (7%; $P < 0.001$) in the proportion of children where parents reported a consumption of more than two between-meal snacks.

Finally an interesting finding was that reported toothache was significantly correlated to the presence of the intervention programme. Children in the control group were more likely to have suffered from toothache. The reason why this factor, and even some other factors, are significantly correlated with the intervention is sometimes difficult to interpret if only quantitative measures are used. The relevance of measuring parental responses when the targets are the children is not always self-evident. The complexity and assumption underpinning the interaction between children's behaviour and parental experience and feeling is difficult to explore. Perhaps the only way to search out these peculiarities in the findings is to use some form of qualitative evaluation. That is why, in the final year of the present health education programme, rounds of talks and additional questionnaires were used with the children themselves. The outcome of these measurements will be the subject of further research.

In the evaluation of the results one should also consider the intervention to be not only the classroom health education programme. The fact that the 'Tandmobiel' visited the school, that a questionnaire was completed and that referral letters were used, makes the intervention a package of events. While the principal component of the intervention remains the classroom activities, it is this package of events which forms the intervention as a whole resulting in an effect more than merely the effect of the oral health education session.

The proportion of children lost to follow-up by the end of the study period was large in both the intervention and the control group, 24% and 16%, respectively, but not such that the validity of the study results would be irrevocably affected. The losses to follow-up were mainly caused by the absence because of illness or moving, children who had to stay down in class, closure or merging of

schools and to a minor degree, to refusals. To check the influence of drop-out, the distribution of the children with and without a follow-up was compared with regard to the variables gender, baseline dmf and the stratification variables province and educational system. For most of these variables, no significant difference was observed. Of the stratification variables only for the variable 'educational system' a significant difference was found. In the final study group, more children belonged to the free educational system at the expense of the public schools ($P < 0.001$). There were more girls in the final study group than in the group of children who were lost to follow-up (49% versus 45%; $P < 0.05$).

It can be questioned whether the present oral health promotion programme was cost-effective. To answer this question it is important to keep in mind that the extra cost of the oral health promotion programme was small, whereas this programme was part of a larger data registration-oriented follow-up visit. In this context and in view of the obtained outcome effects concerning the restorative level and oral health behaviour changes, the extra oral health promotional contribution was justified and can be supported in the future. In addition, the consideration that the oral health profession has a responsibility to inform people about oral diseases and their prevention may support this position.

Further research to explore the usefulness of comparable programmes in reducing oral health inequalities should be undertaken.

In conclusion, the implemented yearly based extra oral health promotional programme did not result in a significant reduction of caries prevalence. The effectiveness on plaque level and gingival health was inconclusive. However, the favourable reported behavioural changes and the increased restoration level together with the educational responsibility of the profession justify the efforts and costs of this programme.

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