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Does fluoride rinsing have an effect on teeth status? Evaluation of preventive dental health activities for the youth of Woudenberg, The Netherlands

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Abstract: Surveys among primary school children of group 8 (mainly 12-year olds) in 1988/1989 and 1995/1996 revealed that the dental status in Woudenberg was worse than in other municipalities in the Eemland region. Therefore, several dental preventive activities were started in Woudenberg for children aged 0–12 years. This included fluoride rinsing and teeth brushing lessons at primary schools. So as to evaluate the effect of these school activities, a new survey was carried out in Woudenberg in 2004. The teeth status (DMF-S value, percentage sound teeth, percentage erosion) was investigated by examination. Information regarding dental hygiene behaviour and participation in teeth brushing lessons was obtained by questionnaire. Teeth status (measured by DMF-S value as well as percentage sound teeth) at rinsing schools in 2004 was significantly better than at the same schools in 1995/1996. Multivariate analyses revealed that fluoride rinsing for at least 3 years (besides educational level of parents) is the most determining factor for teeth status independent of other variables. Pupils who never rinsed with fluoride were almost four times more likely to have caries lesions than pupils who rinsed for at least 3 years. This study strongly indicates that long-term rinsing with fluoride has a positive effect on teeth status.

Key words: DMF-S value; fluoride rinsing; sound teeth; teeth status; youth

Introduction

In the Netherlands, municipal health services are, by legislation, responsible for collective preventive dental health activities for the youth. So as to get insight into the youth's teeth status and dental hygiene behaviour, the municipal health service (GGD) in the region Eemland (seven municipalities) carried out dental epidemiological surveys among primary school children of group 8 (mainly 12-year olds) in 1988/1989 and in 1995/1996 (1–3).

The results of the survey of 1995/1996 revealed that the dental status of children living in the village Woudenberg was obviously worse than of children living in other municipalities in the region Eemland. They were three times more likely to have caries lesions. Moreover, differences in teeth status between pupils from Woudenberg and the other municipalities had increased compared with the situation of 1988/1989.

Based on mentioned surveys, a dental preventive activity plan was developed for children aged 0–12 years in the region Eemland. Considering the teeth status of pupils in Woudenberg, extra activities were planned in this village in co-operation with concerned organizations.

New data regarding the teeth status of children in Woudenberg had to be collected to evaluate the effect of mentioned activities and to determine whether they were to be continued. For this reason, a new survey was carried out in Spring 2004 in Woudenberg. So as to compare the results with the previous surveys, only primary school pupils of group 8 were included. Activities at primary schools that will be evaluated in this article are fluoride rinsing and teeth brushing lessons given by the GGD's dental hygienist.

Study population and methodology

The current survey methodology was set up similarly to the survey of 1995/1996 for reasons of comparability. The study population comprised all pupils of group 8 (mainly 12-year olds) of all primary schools in the village Woudenberg (The Netherlands).

Dentists and school directors were informed before the start of the survey. School directors were approached by letter and were requested to participate in the survey. After the school's permission, parents received a letter sent by the school in which they were notified about the survey and their informed consent was obtained.

The dental hygienist and an assistant visited all schools. The dental hygienist was trained before the survey and examined teeth status with mirror, probe and hobby lamp, according to a protocol similar to that of the 1995/1996 survey. Pupils lied down on a table with a head and neck pillow (Funke). The DMF-S score was determined by examining every surface of a permanent element whether it was decayed by caries, missing or filled. Further, the number of sealed elements was registered as well as evidence of erosion of the elements. The assistant completed a brief questionnaire regarding the child's background, dental hygiene behaviour and participation in teeth brushing lessons. Data were directly imported into a laptop computer by the assistant.

All seven primary schools in Woudenberg participated in the survey. The total number of children in group 8 was 137 of which 125 participated. This is a high response rate (91%). Six children did not participate because they were ill and parents of six children did not give permission. One case had to be excluded from analyses (see data analysis).

The study population is described according to sex, age, ethnic origin and educational status of the parents in Table 1. The number of boys and girls is equal. Group 8 children are usually 11 and 12 years old. The vast majority of the children (97%) had a mother who was born in the Netherlands. Unfortunately 33% of the children did not know the educational status of either parent. In the future, parents should be requested (in the introduction letter) to inform their children about their educational status, as this is an important background information.

Data analysis

Data were anonymously processed and analysed. A data entering programme was made in EPI-INFO (Centers for Disease Control and Prevention, Atlanta, GA, USA). Data were analysed with the statistical package SPSS/PC+ (SPSS Inc., Chicago, IL, USA).

Table 1. **Background information about the study population**

	n	%
Sex		
Boy	62	50
Girl	62	50
Age		
11 years	51	41
12 years	67	54
13 years	6	5
Mothers' country of birth		
The Netherlands	120	97
Others	4	3
Parents' educational status		
Unknown	41	33
Low	18	15
Middle	36	29
High	29	23

Results of teeth status are reported as percentage sound teeth and mean DMF-S score. So as to judge the magnitude of the differences between groups, variance analyses (for DMF-S scores) and chi-squared tests (for percentage sound teeth) were used. Multivariate (logistic) regression analyses were carried out to find out which variables were the best predictors of teeth status. $P < 0.05$ was considered as significant.

One child had an extraordinary high DMF-S value of 14 whereas the values of other children of the same school did not exceed 5. This case was excluded from analyses. DMF-S values were more equally divided at other schools.

The results of this study must be interpreted carefully as the study population was quite small from a statistical point of view. Further, there was very little variation in answers to particular questions (teeth brushing before sleeping, dental check-ups). Therefore, these variables could not be used to demonstrate relationships.

Preventive measures in Woudenberg

Preventive measures focussed on the target group (the pupils) and intermediary target groups. Intermediary target groups, an indirect channel of information/communication, were acquainted with the results of the previous survey so as to use this new information in their contacts with pupils (and parents). Approached intermediary target groups were:

- dentists in Woudenberg;
- the regional department of the Dutch Society for Dentistry;
- GGD Medical doctors and nurses who carry out preventive health check-ups in primary schools (in group 2: 5- and 6-year-old pupils);
- primary school teachers (who give lessons in dental health, organize parents meetings);
- parents;
- medical doctors and nurses working in child health clinics.

Further, preventive measures focussed on the target group itself were offered to primary schools by the GGD. These were:

- a fluoride rinsing programme: weekly rinsing with 0.2% fluoride (7 ml) at schools in groups 3-8 (age 6–12 years);
- teeth brushing lessons at schools in groups 4–8 (age 7–12 years);
- an educational package focussing on oral health could be borrowed.

Fluoride rinsing programme

At the time of the 1995–1996 survey, fluoride rinsing was not in use at any primary school in Woudenberg. Given the results of the mentioned survey, a fluoride rinsing programme was offered to all schools. At the time of the 2004 survey, two schools had been carrying out the programme for 6 years and one school for 4 years. The other four schools were not interested in the rinsing programme.

Table 2. **Rinsing behaviour at rinsing and non-rinsing schools in 2004**

Schools	*n*	Never	Up to 3 years	3 years or more
Rinsing	48	15%	25%	60%
Non-rinsing	77	75%	22%	3%

Fluoride rinsing should be continued for a longer period to achieve a permanent effect. Most studies used a period of 3 years but this is still considered to be fairly short (4). For practical reasons the current study also used a cut-off point of 3 years in the regression analysis. Overall, about half of the children never rinsed with fluoride, a quarter rinsed for <3 years and a quarter continued for >3 years. Table 2 shows the percentage pupils that never rinsed with fluoride and the percentage pupils that rinsed up to 3 years and 3 years or more by groups of schools. There are hardly any pupils who rinsed long at schools that did not participate in the programme ($n = 2$). Possibly these children rinsed at home on prescription of an orthodontist (while using a dental brace) and some of them probably attended another school in the past where rinsing was common. At the participating schools, however, the percentage of pupils who rinsed for at least 3 years is 60%.

Results

None of the schools were rinsing at the time of the 1995/1996 survey. Results were presented with split up by the rinsing division of 2004 to demonstrate possible differences between the groups of schools before the intervention.

Table 3. **Mean DMF-S values in 1995/1996 and 2004 by rinsing and non-rinsing schools**

	1995/1996		2004	
Schools	*n*	DMF-S	*n*	DMF-S
Rinsing	45	2.5[c]	48	0.5[b,c,d]
Non-rinsing	80	2.9	76	2.0[d]
Total	125	2.8[a]	124	1.4[a,b]

Mean values with the same superscript alphabet are significantly different from each other.

Teeth status

The DMF-S value of every pupil was determined as an indicator of teeth status. Table 3 shows mean DMF-S values in 1995/1996 and 2004 split up by rinsing and non-rinsing schools. The mean DMF-S value in Woudenberg was 1.4 in 2004. This indicates that the pupils had on average 1.4 decayed or filled tooth surface or missing element because of caries in mature teeth. This is a statistically significant improvement compared with the situation of 1995/1996, when the DMF-S value was 2.8. The mean DMF-S value in Woudenberg in 2004 is comparable with the mean DMF-S value (1.3) in the region Eemland in 1995/1996.

Table 3 also shows that the mean DMF-S value of the rinsing schools in 2004 is significantly lower than the overall mean in 2004. There was no such difference in 1995/1996. The mean DMF-S value of the rinsing schools in 2004 is also significantly lower than the DMF-S value of the same group of schools in 1995/1996. There is no significant improvement in mean DMF-S value of non-rinsing schools. Further, the DMF-S value of rinsing schools is significantly better than of non-rinsing schools in 2004, whereas there was no difference between the same groups of schools in 1995/1996.

The percentage sound teeth is another indicator of teeth status. Table 4 shows the percentage sound teeth in 1995/1996 and 2004 by rinsing and non-rinsing schools. The overall percentage sound teeth in Woudenberg has increased from 36% in 1995/1996 to 53% in 2004 (almost statistically significant). However, the overall mean is still lower than the region mean (63%) in 1995/1996 and the national mean (62%) at the end of the same decade (5).

Table 4 shows that the percentage sound teeth in 2004 was significantly higher for children of rinsing schools compared with children of non-rinsing schools. There was no such difference between the school groups in 1995/1996. The percentage sound teeth of children of rinsing schools in 2004 is also significantly higher than in 1995/1996, whereas there is no such difference between non-rinsing schools. This means that pupils on rinsing schools in 2004 also had a better teeth status measured by the percentage sound teeth than those on the same schools in 1995/1996.

As teeth erosion is a growing problem in dentistry, it was registered for the first time in the 2004 survey. The most serious form with loss of dentine was not seen. Table 5 shows the prevalence of teeth erosion with loss of enamel. The average prevalence was 13%. Enamel erosion was hardly seen at rinsing schools, whereas the prevalence was 20% at non-rinsing schools. The prevalence of erosion at rinsing schools was significantly lower than at non-rinsing schools and than the overall mean. In The Hague, enamel erosion was seen in 23% of the 12-year-old pupils of Dutch origin (6). This figure is quite high and comparable with that of three of the four non-rinsing schools (22–25%).

Dental hygiene

The following paragraphs discuss dental hygiene behaviour and professional care. These data were collected by interviewing the children briefly after the dental inspection. Possibly pupils gave socially desirable answers to the questions regarding dental hygiene, which may have influenced the results. However, this factor also played a role in the previous survey. We assume the pupils of 1995/1996 were comparable with the pupils of 2004 regarding giving socially desirable answers.

Table 4. **Percentage sound teeth in 1995/1996 and 2004 by rinsing and non-rinsing schools**

	1995/1996		2004	
Schools	*n*	%	*n*	%
Rinsing	45	40[b]	48	73[a,b]
Non-rinsing	80	34	76	41[a]
Total	125	36	124	53

Mean values with the same superscript alphabet are significantly different from each other.

Table 5. **Prevalence of teeth erosion in 2004 by rinsing and non-rinsing schools (%)**

Schools	*n*	%
Rinsing	48	2[a,b]
Non-rinsing	76	20[b]
Total	124	13[a]

Mean values with the same superscript alphabet are significantly different from each other.

Table 6. **Percentage pupils brushing twice a day or more in 1995/ 1996 and 2004 by rinsing and non-rinsing schools**

	1995/1996		2004	
Schools	*n*	%	*n*	%
Rinsing	45	62	48	79
Non-rinsing	80	66	76	84
Total	125	65[a]	124	82[a]

Mean values with the same superscript alphabet are significantly different from each other.

Teeth brushing frequency

The pupils were asked how many times a day they usually brush their teeth. Eighteen per cent brushed once a day, 68% twice a day and 14% three times a day. Answer categories were collapsed into two categories: twice a day or more (desired behaviour) and once a day or less. Table 6 shows the percentage pupils with desired brushing behaviour in 1995/1996 and 2004 by rinsing and non-rinsing schools. The percentage pupils with desired brushing behaviour is higher in 2004, but there are no significant differences between rinsing and non-rinsing schools.

Brushing teeth before sleeping

The vast majority (95%) said they 'always' brush their teeth before sleeping. Four per cent answered 'sometimes' and <1% ($n = 1$) said 'never'. Results of the 1995/1996 survey revealed that 'always brushing before sleeping' was one of the most determining factors for teeth status (2). Table 7 shows the percentage pupils who always brush their teeth before sleeping in 1995/1996 and 2004 by rinsing and non-rinsing schools. There are no significant differences.

Fluoride application

Independent from the fluoride rinsing programme at schools, children may receive fluoride treatments at regular dental check-ups. The pupils were asked how often they received a fluoride application from the dentist. Few pupils were not able to answer this question. Ten per cent said to receive this at each check-up, 33% said 'sometimes' and 55% 'never'. This was collapsed into two categories : 'ever' and 'never'. Table 8 shows the percentage pupils who 'ever' received a fluoride application from the dentist in 1995/1996 and 2004 by rinsing and non-rinsing schools. Although there are no significant differences, the percentage for rinsing schools was lower in 2004 than in 1995/1996 and the opposite is true for non-rinsing schools. This trend was expected as it can be assumed that dentists do not provide fluoride applications to children who weekly rinse with fluoride.

Table 7. **Percentage pupils always brushing before sleeping in 1995/1996 and 2004 by rinsing and non-rinsing schools**

	1995/1996		2004	
Schools	*n*	%	*n*	%
Rinsing	44	91	48	94
Non-rinsing	80	90	76	96
Total	124	90	124	95

Table 8. **Percentage pupils who ever received a fluoride application from the dentist in 1995/1996 and 2004 by rinsing and non-rinsing schools**

	1995/1996		2004	
Schools	*n*	%	*n*	%
Rinsing	48	51	48	40
Non-rinsing	75	34	74	46
Total	123	40	122	43

Table 9. **Percentage pupils with one or more sealants in 1995/1996 and 2004 by rinsing and non-rinsing schools**

	1995/1996		2004	
Schools	*n*	%	*n*	%
Rinsing	45	27[b]	48	81[b]
Non-rinsing	59	36[c]	76	82[c]
Total	104	32[a]	124	82[a]

Mean values with the same superscript alphabet are significantly different from each other.

Sealants

The registration of sealants only started halfway the survey of 1995/1996, once it was noticed that the prevalence was relatively high. Therefore, there are no data for 1995/1996 of one non-rinsing school (21 pupils). The average number of sealants per child was 3.8 in 2004. A total of 82% of the pupils had one or more sealants. Table 9 shows the percentage of pupils with one or more sealants in 1995/1996 and 2004 by rinsing and non-rinsing schools. The percentage of pupils with sealants increased significantly in both groups of schools; however, there are no significant differences within data of the same survey. A possible explanation is that sealing has become a more usual preventive measure. It could also have been a local effect, as dentists in Woudenberg may have changed their policy upon the results of the survey of 1995/1996.

Evaluation and discussion of the effect of preventive measures at schools

The above made clear that teeth status improved significantly at schools that participated in the rinsing programme. Multivariate analyses were carried out to identify the net effect of variables while controlling for other variables. This revealed that fluoride rinsing for at least 3 years (besides the educational level of parents) is the most determining factor for teeth status

(measured by DMF-S value as well as percentage sound teeth) independent of other variables. It was proved that pupils who never rinsed with fluoride, were almost four times more likely to have caries lesions than pupils who rinsed for at least 3 years.

Other pupils participated in the survey of 1995/1996 than in the survey of 2004. Is the finding that teeth status of pupils at rinsing schools is better than at non-rinsing schools because of the fact that teeth status of pupils at rinsing schools was already better before the rinsing programme started? This is not likely as teeth status (measured by DMF-S value as well as percentage sound teeth) in 2004 is only significantly better than in 1995/1996 at rinsing schools.

It can also be hypothesized that participation in the rinsing programme created an intensified attention for oral health, resulting in a positive change of attitude and dental hygiene behaviour of children and parents. A difference in change of children's behaviour between rinsing and non-rinsing schools could not be demonstrated in the current study.

The findings in Woudenberg regarding the effect of fluoride rinsing on teeth status agree with the results of other research. Children at dental risk in the Dutch city of Rotterdam participated in a cohort study regarding the effect of 5 years of fluoride rinsing at schools. Compared with the control group, pupils in the rinsing group had a significantly lower increase of caries (4). A cross-sectional study in the Dutch province of Drenthe revealed that pupils who did not rinse with fluoride, were twice as likely to have two or more cavities or fillings (7). The results strongly indicate that fluoride rinsing for at least 3 years has had an extra positive effect on teeth status of pupils in Woudenberg.

Unlike fluoride rinsing, the current study does not reveal an effect of teeth brushing lessons on teeth status. The improvement in teeth brushing frequency as well as teeth status (percentage sound teeth) per school cannot be related to teeth brushing lessons per school. Indeed a relation was demonstrated, independent of the other variables, between participation in teeth brushing lessons and a low DMF-S value.

It is not very likely that a single, short-term intervention like a teeth brushing lesson will have an obvious effect. However, in combination with the other preventive measures, teeth brushing lessons probably contributed to the general improvement in teeth status and dental hygiene behaviour in Woudenberg. An inevitable bias of this study is that it cannot be investigated whether the intensified attention for oral health as such contributed to the improvement in teeth status.

Conclusion

This study proved that group 8 pupils at rinsing schools had a better teeth status (both measured by DMF-S value as well as percentage sound teeth) in 2004 than pupils of the same age at the same schools in 1995/1996. Teeth status of pupils at non-rinsing schools in 2004 was not significantly different from teeth status of pupils of the same age at the same schools in 1995/1996. After controlling for other variables, fluoride rinsing for at least 3 years, receiving teeth brushing lessons and educational level of parents proved to be the most determining factors for teeth status (measured by DMF-S value as well as percentage sound teeth). Although the study was not designed to determine the effect of fluoride rinsing and teeth brushing lessons, the results strongly indicate that long-term rinsing with fluoride has an extra positive effect on teeth status. Besides, teeth brushing lessons combined with the other preventive measures seem to have had a positive effect on teeth status.

In this study, enamel erosion was registered for the first time. The prevalence of enamel erosion was quite high at non-rinsing schools. This finding means that the problem of erosion in Woudenberg deserves serious consideration. The finding that the prevalence of erosion at rinsing schools was significantly lower than at non-rinsing schools and lower than the overall mean, supports the conclusion that long-term rinsing with fluoride has a positive effect on teeth status. This is explained by the fact that fluoride strengthens enamel which consequently less easily dissolves in an acid environment (8). These results plead for fluoride rinsing and educational activities (such as teeth brushing lessons) as preventive measures among children at dental risk.

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