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ORIGINAL ARTICLE

Attitudes and behavioural factors relating to toothbrushing and the use of fluoride toothpaste among caries-active Swedish adolescents – a questionnaire study

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ABSTRACT

Objective: The aim of this study was to identify attitudes and behaviour relating to fluoride toothpaste and toothbrushing habits among caries-active Swedish adolescents.

Materials and methods: This cross-sectional study is based on an earlier clinical, two-year toothpaste intervention study. At the last appointment, 206 adolescents (of 211) answered a questionnaire comprising nine semi-closed questions.

Results: The majority (93%) brushed their teeth every day, while 7% did so only occasionally. Most participants (77%) brushed twice a day, while 12% brushed just once a day. About half of those brushing just once a day forgot to brush in the evening. Similarly, more than half of the adolescents (53%) used 1 cm of toothpaste or less on their toothbrush. Moreover, 49% brushed for less than 2 min, 41% brushed for 2 min and 10% for more than 2 min. The majority (73%) rinsed with water after toothbrushing. A difference between boys and girls was also observed; 87% of the girls brushed twice a day, whereas only 67% of the boys did so and boys more frequently forgot in the evening.

Conclusions: Attitudes and behaviour relating to fluoride toothpaste and toothbrushing habits among caries-active Swedish adolescents are still inadequate after two years of toothpaste intervention. There are several areas where improvements can be made, such as frequency of brushing, brushing time, amount of toothpaste and post-brushing procedures. The majority (81%) included 'fresh breath' as a reason for performing oral hygiene and this aspect can be used by dental staff in health promotion.

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Introduction

Dental caries is the most common oral disease worldwide and remains a problem for society and individuals. Around 60–90% of schoolchildren and the vast majority of adults are affected in most industrialised countries. Oral disease is the fourth most expensive disease to treat and 5–10% of national public-health resources are spent on dental care, according to the World Oral Health Report [1]. In Sweden, almost 80% of 15-year-olds have signs of caries [2].

There is strong scientific evidence that the daily use of fluoridated (F) toothpaste is associated with the dramatic decrease in dental caries prevalence seen in the last six decades [3–5]. The efficacy is mainly due to the ability of toothpaste to increase intraoral F at levels high enough to shift the balance from enamel demineralisation to remineralisation [6]. On the other hand, two independent studies [7,8] concluded that 25% of 14-year-old adolescents do not use toothpaste regularly. Honkala et al. [9] found that, between 1994 and 2010, the prevalence of recommended toothbrushing behaviour (more than once a day) increased in all countries, except for Scandinavia. In Sweden, Denmark and Norway, a minor decrease was observed, albeit from an already high level. Furthermore, Julihn et al. [10] found that irregular toothbrushing in the evening was strongly associated with a high caries prevalence in 19-year-olds.

In general, F toothpaste is recommended for brushing twice a day, i.e. in the morning, after breakfast, and in the evening, just before bedtime. The most significant factors are the toothbrushing frequency and the concentration of F in the toothpaste [3,11]. Several other 'behavioural factors' influence the efficacy of F toothpaste, such as the brushing time, the amount of toothpaste applied to the brush and subsequent water rinsing or post-brushing behaviour [12,13].

A long brushing time increases the amount of F delivered to the oral cavity and Zero et al. [12] showed that 1.5 g of toothpaste on the brush, compared with 0.5 g, more than doubled the F concentration in saliva after brushing, as well as increasing the enamel F uptake. In addition, caries activity is reported to be significantly correlated to brushing time [14]. Using only a small amount of water after brushing has been reported to prolong the retention time of F in saliva and strengthen the anti-caries benefit of F toothpaste [15,16]. Other studies have not found any relationship between the F concentration in saliva, caries incidence and post-brushing behaviour [17,18]. However, an expert group has recently

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evaluated scientific reports and concluded that too much rinsing with water after brushing can reduce the benefits of F toothpaste [19].

The F concentration in the toothpaste itself is a determining factor in its caries-reducing effectiveness. Several reviews show that the toothpaste should contain at least 1000 ppm F, preferably 1500 ppm F, for both schoolchildren and adults [13,20]. Several RCT studies of F concentrations in toothpastes have reported a positive dose response, where toothpaste containing 1000–1500 ppm F produced a 23% caries reduction, while 2500 ppm F produced a 36% reduction [5]. Toothpastes with higher concentrations of F (>2500 ppm) have been shown to be significantly effective in reversing root caries in adults [21]. A previous study by Nordström and Birkhed [22] found that, when using 5000 ppm F toothpaste, adolescents with a high caries risk had a 40% lower caries progression than those using standard toothpaste (1450 ppm F). No adverse effects of F toothpaste and rinses in adults have been reported and the use of F toothpaste is considered to be both safe and effective in preventing tooth decay [5,23,24].

The aim of the present investigation was to identify attitudes and behaviour relating to F toothpaste and toothbrushing habits among caries-active Swedish adolescents after two years of toothpaste intervention.

Materials and methods

This cross-sectional study is based on an earlier intervention study. A total of 279 healthy volunteers (146 boys and 133 girls) participated in a two-year clinical evaluation of high-F toothpaste (5000 ppm F) compared with ordinary toothpaste (1450 ppm F) [22]. Subjects aged 14–16 years (mean age 15) were assigned to the study and the inclusion criteria were DMFS $\geq$ 5. The adolescents were recruited at the public dental service clinic in the city of Varberg, Sweden. Varberg is a small town, located on the Swedish west coast, with one public dental service clinic, at which almost every adolescent receives his/her dental care. The study was approved by the Ethics Committee at Sahlgrenska Academy, University of Gothenburg (Dnr 289-04), and signed consent forms were obtained before starting the study.

Sixty-eight of the 279 adolescents (24%) did not complete the study; the reasons were starting orthodontic treatment (26), no wish to attend or to continue the study (15), moving from the clinic (11) and not attending their appointments (11), while four subjects became seriously ill and two individuals were excluded as outliers (one in each group). The intervention study was therefore based on 211 adolescents. The distribution of participants, toothpastes, gender, age and dropouts is presented in Figure 1. At the last appointment, i.e. at the end of the two-year trial, the subjects were asked to fill in a self-administered anonymous questionnaire, comprising a total of nine semi-closed questions, at the clinic. A total of 206 adolescents (of 211) answered the questionnaires and the two groups were pooled. The answers were marked with an identification code and entered by a secretary unidentified in a database for analysis.

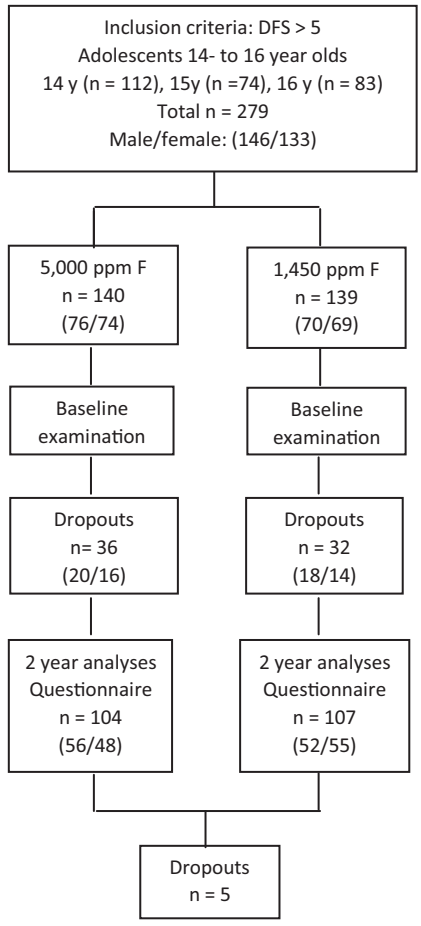

Figure 1. Participants, distribution of toothpastes, gender, age, dropouts.

Statistical analyses

The analyses of the collected data were made in SPSS 18.0 (Statistical Package of Social Sciences, SPSS Inc., Chicago, IL). Both a descriptive and an analytical approach were used. Bivariate analyses were performed using the Fishers exact test for the statistical evaluation. *p*-values below .05 were considered statistically significant.

Results

Frequency of toothbrushing

The majority, 93% (191), of the adolescents brushed their teeth every day, while 7% (15) brushed their teeth only occasionally (now and then). Most participants 77% (159) brushed twice a day, while 12% (25) brushed just once a day. Almost half, 48% (99), of the adolescents who brushed just once a day forgot to brush in the evening, while 27% (55) forgot in the morning (Table 1).

Amount of toothpaste

Almost half the adolescents, 47% (96), used 2 cm, while the other half, 48% (100), used 1 cm of toothpaste. Only 5% (10) used less than 1 cm (Table 1).

Table 1. Distribution of responses regarding toothbrushing and use of toothpaste among the participants.

Question no	%	*n*
1. How often do you brush your teeth?		
Several times a month	1	3
Several times a week	3	6
Every other day	3	6
Every day	93	191
Total	100	206
2. How many times/day do you brush?		
More than twice a day	4	7
Twice a day	77	159
Once a day	12	25
Less than once a day	7	15
Total	100	206
3. If you forget to brush, when do you forget?		
In the morning	27	55
In the evening	48	99
I don't forget so often	25	52
Total	100	206
4. How much toothpaste do you use?		
Two centimetres	47	96
One centimetre	48	100
Less than one centimetre	5	10
Total	100	206
5. How long do you brush your teeth?		
Less than 1 min	12	24
One minute	37	77
Two minutes	41	85
More than 2 min	10	20
Total	100	206
6. Do you rinse with water after brushing?		
Yes	73	151
No	27	55
Total	100	206
7. How many times do you rinse with water?		
Several times	16	32
Twice	24	50
Once	35	72
I don't rinse	25	52
Total	100	206
8. What do you use for rinsing?		
Cup	56	116
Hand	34	69
Tap	10	20
Total	100	205
9. Why do you brush your teeth?		
Several options possible		
Avoid tooth decay, Fresh breath, Clean teeth	43	89
Avoid tooth decay, Avoid bleeding gums, Fresh breath, Clean teeth	28	57
Fresh breath (all included)	81	168

Both percentages (%) and frequencies (*n*) are given.

Duration of brushing

About half the participants, 49% (101), brushed for less than 2 min, 41% (85) for 2 min and 10% (20) for more than 2 min (Table 1).

Post-brushing water rinsing

The majority, 73% (151), rinsed with water after brushing, whereas fewer than one-third, 27% (55), did not rinse at all. More than half, 56% (116), of those who rinsed used a cup, 34% (69) used a hand and 10% (20) used the tap (Table 1).

Gender

A statistical difference between boys and girls was observed; 87% of the girls brushed twice a day, whereas only 67% of the boys did so ($P < .0001$). In addition, boys more frequently forgot to brush in the evening; 38% of the girls answered 'I don't forget so often', while only 13% of the boys gave this answer ($P < .05$) (Figure 2).

Other behavioural aspects

When performing oral hygiene, teenagers appear to be driven by motives, such as having fresh breath, clean teeth, avoiding tooth decay and bleeding gums. Forty-three per cent (89) reported avoiding tooth decay, fresh breath and clean teeth as a major reason for performing oral hygiene, while 28% (57) included avoiding bleeding gums as well. The majority 81% (168) included 'fresh breath' as a reason for performing oral hygiene.

Discussion

This study showed that 93% of caries-active adolescents in Sweden have embraced the habit of brushing with F toothpaste every day. This result is in accordance with other Swedish studies [14,25]. However, 7% of the adolescents brushed their teeth only occasionally (now and then) and 12% just once a day, which is around one fifth of the adolescents. This is in accordance with other studies showing that toothbrushing is not performed twice a day [7–9]. Tseveenjav et al. [26] found that toothbrushing at least twice daily was reported by 47% of the men and by 79% of the women; 86% and 96%, respectively reported the daily use of fluoride toothpaste. Jensen et al. [27] concluded that good toothpaste behaviour, identified as brushing at least twice a day, using at least 1 cm of toothpaste, brushing for 2 min or longer and using a small amount of water when rinsing was reported by only 10% of the respondents. In addition, there was great potential for improvement regarding the techniques for using fluoride toothpaste effectively, especially among the older respondents. Several studies have shown that the frequency of toothbrushing has a significant association with caries prevalence, as well as caries incidence in children [28,29].

Another factor of importance is the amount of toothpaste used per application. The amount used varied among adolescents in the present study; 47% of the respondents used 2 cm on the toothbrush and the other half used 1 cm or even less toothpaste (48 + 5%). The significance of the amount of toothpaste has been discussed. Most studies support the view that a larger amount of toothpaste increases the F content in saliva and thus produces a longer caries-preventive effect [12,30]. According to den Besten et al. [30], the mean salivary F levels after brushing with 0.25 g of toothpaste were approximately one-third of those obtained after brushing with 1.0 g of toothpaste. The application of 1 g (≈ 2 cm) or more of toothpaste is therefore recommended in adults and schoolchildren to increase both the F

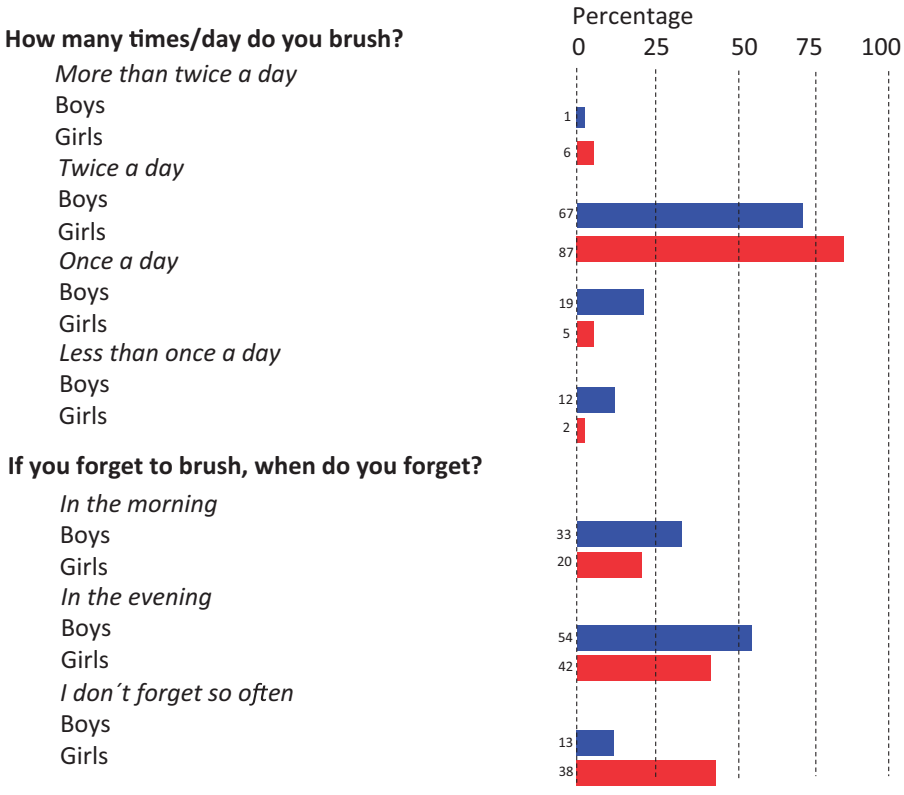

Figure 2. Frequency of toothbrushing in relation to gender.

uptake in the enamel surface and the F concentration in the oral fluid [31].

The duration of brushing time determines how long the relatively high F concentration in the dentifrice slurry stays in contact with the teeth and plaque, allowing F uptake to take place. The brushing time in the present study varied among the respondents and just half (51%) of them reported brushing for 2 min or longer; 49% brushed for less than 2 min. An earlier study by Watson et al. [32] reported that more F was absorbed after 120 sec than after just 30 sec in plaque grown *in situ*, exposed *in vivo* to 1000 ppm F. All these results suggest that the time spent brushing with a dentifrice within the range of common practice can influence F retention in the oral cavity and thereby enamel de- and remineralisation.

Another important determinant of efficacy is the post-brushing behaviour. Post-brushing water rinsing has been routinely advised by the dental profession to remove debris and to avoid swallowing an excess of F toothpaste, especially in younger children. Seventy-three per cent of the informants in our study described rinsing with water after brushing. There were also those who had been advised to avoid post-brushing water rinsing and 27% did not rinse at all. Furthermore, a recent study by Duckworth et al. [33] supports the recommendation that mouth rinsing with water after brushing should be kept to a minimum in order to increase the F retention. There seems to be agreement among researchers that the extensive use of water has a negative effect on F retention in the oral cavity and thereby a negative effect on F-toothpaste efficiency [12,13,19]. A logical conclusion must be that the extensive use of water during and after brushing must have a negative effect on the retention of F toothpaste and dilutes the levels of F concentration in the oral cavity and saliva.

In the present study, there was a difference between boys and girls; 87% of the girls brushed twice a day, whereas only 67% of the boys did so. In addition, boys more frequently forgot to brush in the evening. This is in accordance with previous studies reporting a difference in the frequency of toothbrushing between boys and girls [9,26,27]. The findings in the present study also revealed that, when performing oral hygiene, teenagers appear to be driven by motives such as having fresh breath, clean teeth, avoiding tooth decay and bleeding gums. The majority (81%) included 'fresh breath' as a reason for toothbrushing. Similarly, Jensen et al. [34] found that people's desire for a fresh-feeling mouth and to fit in socially must be affirmed and used by dental staff in health promotion.

The results in this questionnaire study are related to caries-active (DMFS $\geq$5) Swedish adolescents, aged 14–16 years. One should therefore be careful to draw conclusions about other populations. The participants were recruited as caries-active two years before the present study and the groups were equivalent regarding DMFS. The clinical study by Nordström and Birkhed [22] indicated that the subjects were still caries-active, even though the 5000 ppm F group had lower progression of caries (preventive fraction 40%) than the 1450 ppm F group. Furthermore, there were no significant differences in caries increments in relation to their toothbrushing habits.

Conclusions

Attitudes and behavioural factors relating to toothbrushing and the use of F toothpaste among Swedish caries-active adolescents are still inadequate after two years of toothpaste intervention. There are several areas where improvements can be made, such as frequency of brushing, brushing time, amount of toothpaste and post-brushing procedures. When performing oral hygiene, the majority of the adolescents included 'fresh breath' as a reason for toothbrushing and this aspect can be used by dental staff in health promotion.

Disclosure statement

No potential conflict of interest was reported by the authors.

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