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Self-reported changes in using fluoride toothpaste among older adults in Sweden: An intervention study

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Abstract

Objective. The aim of the study was to investigate the possibility of increasing knowledge about the caries-reducing effects of fluoride (F) toothpaste and to increase the use of F toothpaste among older adults through an intervention. ***Materials and methods.*** 63–67-year-olds in Sweden, who 2 years earlier had answered a questionnaire about their knowledge of F toothpaste, toothbrushing and toothpaste habits and who had shown less favourable habits with regard to toothpaste use, were invited to participate. The 20-min intervention, performed at a Public Dental Clinic, was implemented by a dental hygienist (author OJ) and consisted of individual information and instruction on the use of F toothpaste. The questionnaire was repeated 4 months after the intervention and a population in another city in Sweden served as control. ***Results.*** In the intervention group, 68 individuals responded and 151 in the control group. Knowledge of the benefits of F toothpaste in the intervention group had improved between the times of the first and second questionnaires, but the same effect was also noted in the control group. After the intervention, a clear improvement concerning the use of F toothpaste was reported: the individuals brushed for a longer time, used more toothpaste and used less water during and after brushing. In the control group, there were no changes of habits between the first and second occasions. ***Conclusion.*** Individually-based interventions performed by a dental hygienist had a positive effect on changing the way older adults used F toothpaste.

Key Words: *attitude, behaviour, fluoride toothpaste, dental health promotion, knowledge*

Introduction

The prevalence of caries has decreased in most industrialized countries since fluoride (F) toothpaste was introduced in the 1960s. The consensus among experts is that the decrease is mainly due to the daily use of F toothpaste [1–3], but also to other preventive measures such as oral health education [4]. However, the WHO estimates that only 20% of the global population has knowledge about the caries preventive effect of F [5]. The use of F toothpaste twice a day is the most effective method to prevent caries [2,6], but the effect has mainly been evaluated in children and adolescents. However, in a randomized controlled study, the effect of toothpaste containing 1100 ppm F was evaluated in an older population (mean age 69 years) and a relative caries reduction of 41–67% was achieved [7]. The efficacy of F toothpaste is not only dependent on brushing frequency, but also on the F concentration, the amount of toothpaste applied on the brush, brushing time and post-brushing rinsing behaviour [8–11].

Few studies have investigated adults' knowledge and behaviour with regard to toothbrushing with F toothpaste. In two studies, 73–95% of adults in Sweden stated that they brushed their teeth at least twice a day [12,13]. In the study by Wikén Albertsson and van Dijken [13], 75% reported rinsing with water after brushing and only 9% used a method described in an earlier study, called the toothpaste slurry method [14]. Elderly people who were dependent on daily support brushed their teeth less often and only 69% stated that they brushed twice a day [15]. Hugoson et al. [12] showed that knowledge about caries among adults in Sweden was limited and it had not increased in the last 30 years despite massive

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information from different sources. The main source of dental health information was reported to be the dental team [12]. When adults of varying ages in Sweden were interviewed about toothbrushing habits and their use of F toothpaste, knowledge of the effects of F toothpaste varied greatly. Respondents were sceptical of advertisements but stated that they had great confidence in oral health professionals when given advice [16]. In a recent Swedish study, only 10% of the 2023 respondents reported that they used F toothpaste according to guidelines, i.e. brushing twice per day or more, using at least one centimetre of toothpaste or more, brushing for 2 min or longer and using only a handful of water when rinsing after brushing [17]. Amongst the age groups 61–65 and 76–80 years, only 9% and 6% respectively described this optimal behaviour and only a few stated that they had been informed by dental professionals how to use F toothpaste when brushing.

People's own commitment and empowerment is important in behavioural change. However, few studies have investigated effective methods for changing habits. A systematic review showed that, for improving oral hygiene, an advisory dialogue with follow-up was found to be effective, with benefits being achieved at relatively low costs [18].

In Sweden, the number of people aged 65 years and older was over 1.8 million in 2012 (corresponding to 19% of the population) and this number will increase to 31% by the year 2030 [19]. Since the elderly have an increased risk of developing caries [20], the combination of continuing population growth among elderly people and the fact that the elderly retain more natural teeth today compared to 20–30 years ago, bring new challenges for the individual and society when it comes to preventing tooth decay [21,22]. The aim of the present study was to investigate the possibility of increasing knowledge about the caries-reducing effects of F toothpaste and to increase the use of F toothpaste among 63–67-year-olds through an intervention, whereby information and instruction were given by a dental hygienist.

Materials and methods

The Ethics Committee at the University of Gothenburg, Sweden, approved the study (No. 011-12). Informed consent was obtained from all participants before the intervention was performed at the Public Dental Clinic in Stenungsund, in the western part of Sweden. The intervention targeted an age group (63–67-year-olds) who had taken part in a previous study in 2010 where they had answered a questionnaire and reported deviations from optimal use of F toothpaste [17]. The control group was chosen from the eastern part of Sweden, Enköping, who had also answered the same questionnaire in 2010 and had also reported unfavourable toothpaste use [17]. The participants in the initial study 2010 were randomly selected. The randomization process, the reasons for the selection of the two municipalities and the procedure to reach validity and reliability of the questionnaire have been described in the previous study [17].

Study population

In total, 313 individuals in the intervention group (IG) and 286 individuals in the control group (CG), aged 61–65 years, had answered the questionnaire in 2010 (Figure 1) [17]. Deviations from optimal toothpaste behaviour were identified among the respondents through their responses regarding toothbrushing behaviour and use of toothpaste [17]. The deviations were: (1) brushing ≤ once per day, (2) using ≤1 cm toothpaste, (3) brushing for less than 2 min, (4) always using large amounts of water during brushing, (5) always using large amounts of water after brushing, (6) brushing before breakfast and/or (7) brushing immediately after dinner. In IG, 304 individuals had at least one deviation and in CG 276. The criteria for inclusion in the intervention were:

- All respondents who stated that they brushed ≤ once per day.
- All other respondents who had 3–7 deviations, i.e. areas for improvement to achieve optimal toothpaste behaviour.

In IG, 168 individuals and in CG, 173 individuals, 54 and 60% of the total numbers, respectively, fulfilled the inclusion criteria. The mean number of deviations among the included individuals was 3.8 (median 4) in both groups. The individuals in IG were invited by letter to participate in an intervention. Approximately 1 week after sending the letter, the individuals in IG were contacted by telephone by a dental hygienist (author OJ). If the person agreed to participate in the study an appointment was booked for the intervention. Participants in the intervention were chosen by random selection from the group of 168 individuals. As several individuals chose not to take part in the intervention, finally all 168 individuals had to be included to reach the number of participants decided by the statistical power calculation.

The intervention

The intervention took place in a Public Dental Clinic and consisted of information and instruction free of charge. A pre-determined concept was followed which took ~20 min (Table I). The intervention was performed as follows:

(1) Ten minutes of conversation using a dialogue form [23] including five questions (1–5) concerning the person's currant toothpaste and

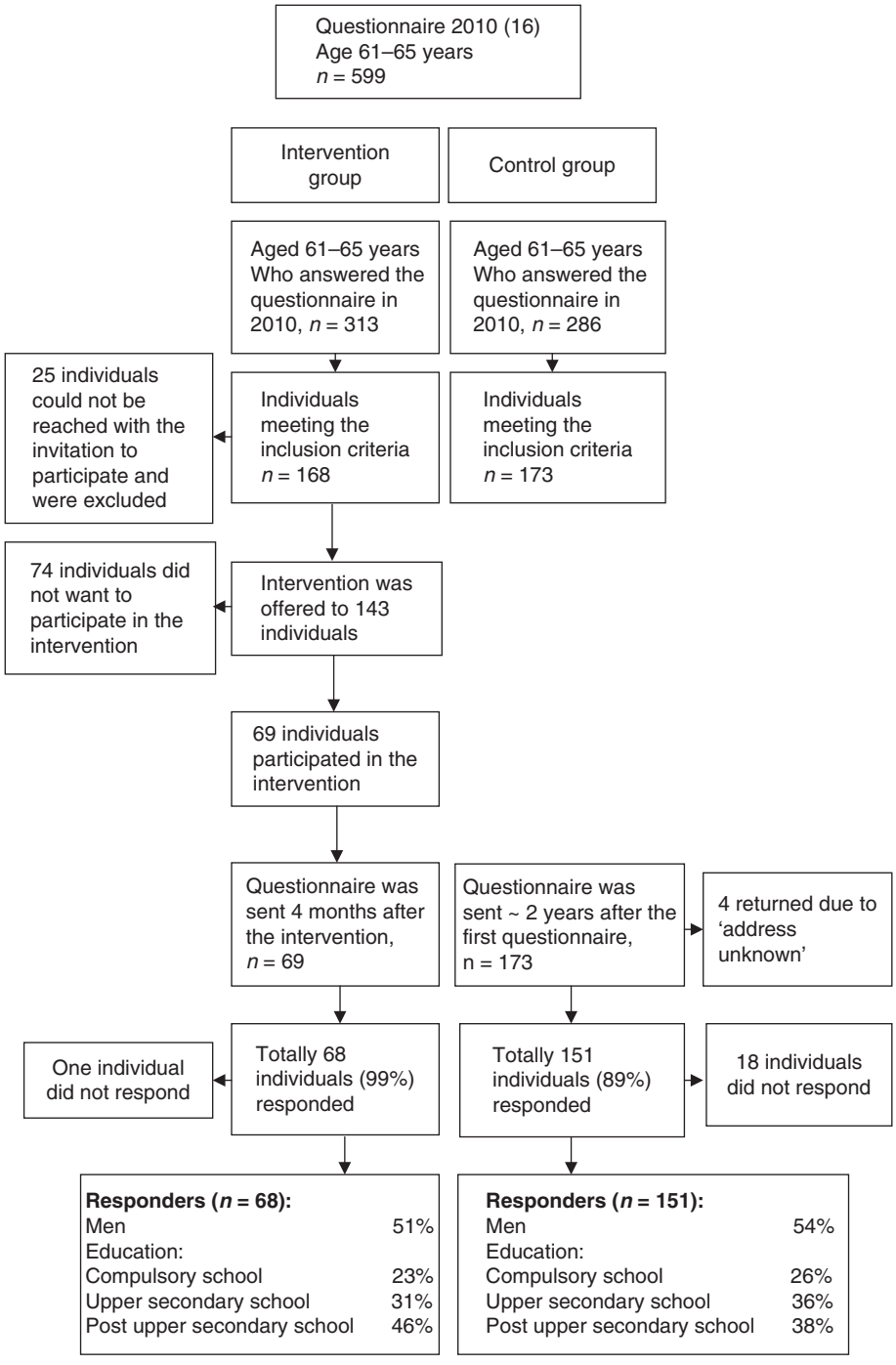

Figure 1. Flowchart showing the study design, number of respondents and drop outs and some characteristics of the respondents in the study.

toothbrushing habits: (1) How many times do you brush your teeth? (2) When do you brush? (3) How much toothpaste do you apply to your brush? (4) How long do you brush? (5) How much water do you use during and after brushing? The participants' current habits were identified and the differences between this behaviour and more favourable toothpaste behaviour were clarified. The dental hygienist could, based on the participants' previous knowledge, thereby tailor the information to each individual.

(2) Ten minutes were used for instruction in toothpaste technique. Participants were asked to brush their teeth with toothpaste, as he/she usually brushed at home. The amount of toothpaste on the brush was weighed to the nearest 0.1 g by a digital scale and time of brushing was noted, as well as habits including the amount of water used during brushing. The participant got feedback on the observed behaviour and was then shown with toothpaste and brush (regular or electric, depending on which the persons used

Table I. Description of the information content of the intervention.

Information area	Information content
Fluoride toothpaste	Toothbrushing should be performed with toothpaste containing at least 1000 ppm F, preferably 1500 ppm F
Toothbrushing frequency	Toothbrushing should be performed twice a day or more often; after breakfast and before going to bed
Amount of toothpaste	Two centimetres toothpaste should be applied on the brush (corresponding to 1.5 g), i.e. a full brush head length of toothpaste If an electric toothbrush with a round head is used, toothpaste should be applied twice on the brush
Toothbrushing time	Toothbrushing should be carried out for at least 2 min
Post-brushing behaviour	Use as little water as possible if rinsing after toothbrushing and use the toothpaste slurry as a rinse Avoid extensive use of water during brushing, such as dipping the brush under running water
Resting time	Avoid drinking or eating for at least half an hour after toothbrushing, if possible up to 2 h

daily) how to use F toothpaste more efficiently at home. Time was measured by a clock. A soft toothbrush (No 332 120/872, TePe Munhygienprodukter AB, Malmö, Sweden) or electric toothbrush (Professional Care 5000 XL, Braun GmbH, Kronberg/TS, Germany) and a toothpaste containing 1450 ppm F as NaF (No 5050, Folktandkräm, Proxident AB, Falun, Sweden) were used as tools for instruction.

(3) The participant was offered to take home the dialogue form, a soft toothbrush (TePe), toothpaste (Folktandkräm, 100 ml), an hourglass measuring 2 min and a brochure describing the three most important recommendations when brushing, i.e. brushing twice a day for 2 min using 2 cm of F toothpaste.

During the information session both the participant and the dental hygienist sat on regular chairs, while instruction was given in front of a washbasin and mirror. The intervention was carried out between April and December 2012. All the interventions were performed by a dental hygienist (author OJ). The participants were informed during the intervention that a follow-up questionnaire would be sent later.

Questionnaire

Four months after the intervention a follow-up questionnaire was sent to the participants to evaluate the effect of the intervention. The questionnaire was based on the previous questionnaire used in the study in 2010 [17], which consisted of 26 questions. The follow-up questionnaire included 17 of the initial multiple choice questions. They included background data and questions about knowledge, attitudes and behaviour concerning F toothpaste [17]. The questionnaire was sent to all the individuals based on the inclusion criteria in CG (173 subjects) and in IG only to those who had received the intervention (69 subjects) (Figure 1). The questionnaires were sent by post with a pre-paid reply envelope and reminders were sent 3 weeks later to non-responders. When the individual had responded, their answers to the questionnaire were entered into a database. Both questionnaires were paired and could not thereafter be traced to a specific individual.

Good toothpaste behaviour

'Good toothpaste behaviour' was defined as brushing with F toothpaste twice per day or more, brushing for at least 2 min or longer, using at least 1 cm of toothpaste or more or putting toothpaste on the electric brush twice and rinsing with no more than a handful of water after brushing [17].

Statistical analysis

The size of the test and the control group was decided by a statistician through a power calculation. A sample size of 61 individuals in the IG and CG was calculated as having 95% power to detect a difference of 30% with respect to knowledge and behaviour between the groups when the answers in the questionnaire were compared (unpaired samples). The paired samples included individuals in the intervention and the control group before and after intervention. When these samples were analysed, a sample size of 31 was calculated as showing an improvement of 30% with 95% power.

The frequency distribution of the answers in the questionnaires with respect to knowledge and behaviour was organized in contingency tables with the IG and CG presented separately. The McNemar test was used to analyse the differences between the first and second questionnaires within the same group, i.e. a paired statistical test. The differences between IG and CG on the second occasions were analysed by Fisher's Exact Test, i.e. an un-paired test. The association of several factors with the constructed variable 'good toothpaste behaviour' was also analysed by Fisher's Exact Test. The tested factors were gender, education level, knowing that fluoride strengthen the teeth and believing that brushing with fluoride toothpaste is important. Since a large number of statistical tests

were performed the risk of mass significances were increased. This risk was limited by a conservative interpretation of the analysis. The level of statistical significance was set at $p < 0.05$.

Results

Of 168 individuals in IG, it was possible to reach 143 individuals (85%) with the invitation to participate. A total of 69 individuals (48%) took part and all except one answered the follow-up questionnaire, 54% men and 46% women, respectively. The reasons for declining to participate in the intervention were lack of interest or time, already seeing a dentist or dental hygienist, no need for further information or illness. The questionnaires were answered on average 4.4 months (range = 4–6 months) after the intervention. In CG, 151 (89%) answered the questionnaire, 51% men and 49% women, respectively. A flow chart shows participants, drop outs and the distribution of gender and level of education (Figure 1). There were no differences concerning gender or education between participants and drop outs within the groups. In addition, the analyses showed no differences between the participants and drop outs concerning deviations from optimal toothpaste behaviour. The mean number of deviations in IG drop outs was 3.7 and in CG drop outs was 3.8.

Knowledge

Knowledge concerning F toothpaste, caries and toothbrushing is presented in Table II. The percentage of individuals who knew, 'F strengthens the teeth', was high already on the first occasion (76% and 79%, respectively) and had improved 2 years later among all the respondents (91%), but did not differ between the groups. A similar change could be seen in answers to the question 'What is most important in avoiding cavities?' The respondents mentioned F toothpaste to a greater extent in their answers on the second occasion (78% and 88%, respectively), with no difference between the groups.

Few respondents in CG stated that they had received instructions about how to use toothpaste and there was no difference between the first and the second occasions (28% and 27%, respectively). In IG, on the second occasion more respondents answered that they had received toothpaste instruction (35% and 96%, respectively, $p < 0.0001$), leading to a clear difference between IG and CG ($p < 0.0001$). When the respondents had received instruction, dental personnel were the main sources of instruction.

Attitude

Almost all respondents in both groups thought already on the first occasion that toothbrushing was 'very important' or 'quite important' and they had the same opinion about brushing with F toothpaste [17]. On the second occasion the attitudes concerning F toothpaste and toothbrushing had not changed in either of the cities studied (data not shown).

Table II. Distribution of responses regarding knowledge about F toothpaste and toothbrushing on occasion of first (61–65-year-olds) and second questionnaires (63–67-year-olds). Differences between the first and the second questionnaires in the intervention and control group is analysed by McNemar test (paired test). Differences between intervention group and control group (IG vs CG) on the second occasion is analysed by Fisher's Exact test (un-paired groups).

	Intervention group			Control group			
Questions	61–65 years (%)	63–67 years (%)	*p*-value	61–65 years (%)	63–67 years (%)	*p*-value	IG vs CG
What is the effect of fluoride in toothpaste?							
n	68	66		149	150		
Makes teeth whiter	1	6		4	3		
Strengthens the teeth	76	91	< 0.01	79	91	< 0.01	
Clean teeth	10	20		16	9	< 0.05	<0.05
Makes your mouth fresh	26	30		23	28		
Do not know	6	2		8	3	< 0.05	
What is most important to avoid cavities?							
n	67	66	< 0.001	151	151	< 0.001	
Toothbrushing	39	12		38	22		
Fluoride in toothpaste	1	15		7	13		
Toothbrushing and toothpaste are equally important	60	73		55	65		

Table III. Distribution of responses regarding F toothpaste and toothbrushing behaviour on occasion of first (61–65-year-olds) and second questionnaires (63–67-year-olds). Differences between the first and the second questionnaires in the intervention and control group are analysed by McNemar test (paired test). Differences between the intervention group and control group (IG vs CG) on the second occasion are analysed by Fisher's Exact test (un-paired groups).

	Intervention group			Control group			
Questions	61–65 years (%)	63–67 years (%)	*p*-value	61–65 years (%)	63–67 years (%)	*p*-value	IG vs CG
How many times do you brush per day?							
n	68	68		151	150		
Less than once per day	3	3		2	1		
Once per day	19	12		21	18		
Twice per day	68	70		66	68		
Three times or more	10	15		11	13		
When do you brush your teeth?							
n	68	68		150	151		
Before breakfast	40	21	< 0.01	38	34		<0.05
After breakfast	53	78	< 0.001	55	58		<0.01
Before dinner	0	0		2	3		
After dinner	3	9		6	9		
Before going to bed	96	94		90	91		
How long do you brush your teeth?							
n	68	66	< 0.001	150	151		<0.0001
0.5 min or less	3	0		11	6		
1 min	35	11		28	34		
Less than 2 min	29	18		31	26		
2 min	22	61		20	26		
More than 2 min	10	10		10	8		
How much toothpaste do you put on your toothbrush?							
n	53	55	< 0.0001	134	121		<0.0001
Size of a pea	8	2		7	7		
0.5 cm	30	2		22	17		
1 cm	51	13		54	51		
2 cm	11	83		16	24		
n	37	30	< 0.001	43	42		<0.0001
Once on electric toothbrush	92	43		91	93		
Twice on electric toothbrush	8	57		9	7		
How often do you dip your toothbrush under running water when brushing?							
n	68	68	< 0.001	148	151		<0.001
Never dip	28	48		22	28		
1–2 times	32	43		42	42		
3 times or more	40	9		36	30		
Do you rinse your mouth with water after brushing?							
n	68	68	< 0.0001	151	151		<0.0001
Never	16	29		8	11		
Occasionally	10	28		5	12		
Often	6	15		13	9		
Always	66	28		74	68		
How much water do you use for rinsing?							
n	58	47	< 0.0001	137	135	< 0.001	<0.01
A handful	48	81		34	52		

Table III. (*Continued*).

Questions	Intervention group			Control group			IG vs CG
	61–65 years (%)	63–67 years (%)	*p*-value	61–65 years (%)	63–67 years (%)	*p*-value	
Two handfuls	16	4		31	21		
Half a glass of water	31	15		27	20		
A full glass of water	5	0		8	7		

Behaviour

On the first occasion, the majority of the respondents did not eat, drink or have any other intake after brushing in the evening. Although not statistically significant, there was a tendency towards a decreased food and drink intake after toothbrushing in the evenings in IG after the intervention (from 12% to 3%) and a clear difference between the two groups could be found on the second occasion ($p < 0.05$). Already on the first occasion, the majority of respondents (77–78%) brushed twice a day or more often and a similar increase to 81% and 85% in IG and CG, respectively, had taken place by the second occasion. After the intervention, the number of individuals who brushed 'after breakfast' had increased in IG (Table III). Most individuals in both groups reported that they brushed their teeth for less than 2 min on the first occasion. The proportion of individuals in IG who brushed for at least 2 min showed a clear increase from 22% to 61% (Table III). On the first occasion most respondents reported using 1 cm of toothpaste on the toothbrush. After the intervention there was a significant increase among those who used 2 cm of toothpaste on the brush (from 11% to 83%) in IG. When an electric toothbrush was used, a similar improvement in IG was noted (Table III). The habit of dipping the brush under running water during brushing was reported by the majority of respondents in both groups on the first occasion. In IG, dipping behaviour was strongly reduced after the intervention. In addition, there was a large decrease amongst those who stated that they always used water after brushing and also in the amount of water they used (Table III). The clear behavioural improvements in IG, regarding when to brush, for how long, the amount of F toothpaste used and the use of water during and after brushing, led to significant differences between the groups on the second occasion (Table III).

On the first occasion, none of the respondents in the two groups reported 'good toothpaste behaviour', since this was an inclusion criterion for participating in this study. On the second occasion, 28% of the respondents in the intervention group reported 'good toothpaste behaviour' compared to 8% in the control group ($p < 0.0001$). The only factor that significantly increased the chance of improving 'Good toothpaste behaviour' was higher education levels ($p < 0.05$). The mean number of deviations from optimal toothpaste technique decreased from 3.8 before the intervention to 1.2 after the intervention in IG. The corresponding values in CG were 3.8 and 3.1.

Discussion

This study shows that an intervention consisting of information and instruction about how to use F toothpaste in an effective way, could improve toothbrushing behaviour in 63–67 year old individuals in Sweden. After the intervention, the participants reported that they brushed for a longer time, used a greater amount of F toothpaste, used less water during and after brushing and chose to brush at more appropriate times compared to the control group.

The number of drop outs in the intervention group was large, forming 52% of those who had been invited to participate. The non-participants justified their choice through lack of time or interest and this may indicate that they considered they already had sufficient knowledge and that their behaviour was appropriate. There were no differences concerning gender and education levels between participants and those who declined to participate and the inclusion criteria ensured that there were no differences in toothpaste behaviour at baseline. The number of drop outs from the questionnaire on the second occasion was small, 1.4% in the intervention group and 11% in the control group.

Knowledge of the effects of F toothpaste on caries prevention is widely known among oral health professionals but is less known among the population [5]. However, in this study the majority of the respondents stated that 'F strengthened the teeth'. When the target of an intervention is to achieve changes in knowledge, several health promotion theories can be used. The Social Cognitive Theory introduced by Bandura [24] proposes the use of both 'observational learning', i.e. observe the behaviours of others, and 'participatory learning', i.e. supervised practice and repetition. The intervention in this study included both the provision of information and supervised practice. The respondents showed improvements in levels of knowledge, but already on the first occasion most respondents had good levels of knowledge about the effect of F in

toothpaste. Even if more respondents thought F toothpaste was most important in preventing caries, the majority still believed that toothbrushing and toothpaste were equally important. A person can experience good oral health, even if he/she lacks appropriate knowledge, and this may negatively affect the person's willingness to increase knowledge levels. In this study, respondents in CG also had increased levels of knowledge and this may be due to other sources of knowledge about F toothpaste. Another explanation may be that the questionnaire itself may have triggered the individuals to search for knowledge on their own. Despite equal levels of knowledge, the change of habits differed significantly. In none of the areas described in Table III did CG show any changes, while IG had significant improvements in all areas except one. This indicates that the supervised practice and repetition and cognitive support connected with the intervention were important and effective. Toothbrushing behaviour may be affected by education level and socio-economic status as well as life-style factors and self-esteem [25,26]. In this study, higher education levels correlated to the adoption of good toothpaste behaviour. According to the health literacy concept, individuals with higher levels of general literacy, i.e. higher education, cognitive and social skills, can better understand and use information and, thus, adopt healthier behaviour [27,28].

Knowledge of how attitudes are formed is relevant for understanding and predicting an individual's health behaviour [29]. Already in the first questionnaire the respondents had a very positive attitude towards using F toothpaste when brushing and, therefore, attitudes could not be further improved, a result in line with other studies [30]. Health education can be effective in increasing knowledge, altering attitudes and beliefs. However, although improvements in knowledge and attitudes may be achieved, these are not always directly related to changes in behaviour [31].

Studies have shown that caries protection from F toothpaste can improve when toothpaste is used in a proper way. Zero et al. [11] showed that 30% of the applied toothpaste still remained in the brush after 30 s of brushing and dropped to ~10% after 3 min of brushing. In the present study, the intervention increased brushing time and the amount of F toothpaste on the brush. Rinsing with water after brushing has been reported to have a negative impact on the caries-preventive effect of F toothpaste and the F concentration in saliva decreased by 1–2-times after a single water rinse and 4–5-times after a double water rinse after brushing, compared with no rinsing [32,33]. On the other hand, other studies have found no relation between F concentration in saliva and caries increment and post-brushing behaviour [34,35]. Recently, however, an expert group, after an evaluation of scientific reports, concluded that rinsing with water after brushing can reduce the benefits from F toothpaste [36]. Water rinsing after toothbrushing seems to be a well-established habit among individuals, especially amongst the elderly [17]. Also in this study the respondents used too much water during and after brushing before the intervention. The intervention seems to have created an understanding of the negative effects of rinsing the F toothpaste away with water after brushing. However, it must be remembered that the outcome in the study is self-reported behaviour improvements and it could not be excluded that the respondents may have reported a better behaviour than the one they actually performed. Another limitation of the study was that the follow-up period was relatively short, just over 4 months.

Higher caries reduction has been shown after supervised toothbrushing [6]. The present study found that supervised instruction in F toothpaste technique had a positive effect on changing the use of F toothpaste. The simplified advice to brush twice per day for 2 min using 2 cm of toothpaste seems to have made the advice easier to remember. In addition, the brochure, the dialogue form and the hourglass may have contributed to the positive effect of the intervention. The dialogue form had previously resulted in a decreased caries increment when used as a supporting tool during prevention [23].

In everyday life most behaviours are performed without much cognitive effort [37]. Repeated information and oral health instruction have a positive effect on oral health habits when compared to no advice [38]. Interventions aimed at preventing the establishment of less favourable behaviours and the promotion of more favourable habits must be a natural priority of all dental health professionals. Still, patients often do not receive adequate self-care advice when they visit the dental clinic [13,39]. As Twetman et al. [6] concluded, brushing with F toothpaste is under-utilized as a preventive measure both at community and individual level. We agree that toothbrushing with F toothpaste needs continuous promotion and reinforcement in all age groups. Although the intervention used in this study needs to be tested by different care providers and in different clinical settings to confirm the external validity, this study shows that it is possible to change oral health behaviour in older adults.

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