

Effect of three different dental health preventive programmes on young adult individuals: a randomized, blinded, parallel group, controlled evaluation of oral hygiene behaviour on plaque and gingivitis

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Abstract

Aim: To evaluate, in young adults, the effect of different preventive programmes on oral hygiene and to determine whether the variables investigated are predictors of gingival health.

Material and Methods: This randomized, blinded, parallel, controlled clinical study examined the effectiveness of three dental health programmes. Four hundred subjects aged 20–27 years, 211 males and 189 females, participated in the study. They were recruited from a Public Dental Service clinic and from a private dental practice in Jönköping, Sweden. The effect of the programmes on plaque and gingivitis was evaluated over a 3-year period. The programmes included activities that were adapted for individuals as well as for groups. The plaque indices (PLI) and gingival indices (GI) were used to evaluate the programmes.

Results: All programmes resulted in a decrease in PLI and GI. The greatest decrease was found in the group that was followed-up every 2 months. Professional tooth cleaning was non-significant for the clinical result. Gingival health at baseline, participation in any of the test programmes, and knowledge of the dental diseases caries, gingivitis or periodontitis were significant predictors of good gingival health. **Conclusions:** The study confirms the efficacy of three different preventive programmes in reducing supragingival plaque and gingival inflammation. Professional tooth cleaning provided no clinical benefit beyond that derived from individual and group-based health education.

Anders Hugoson¹, Dan Lundgren², Barbro Asklöw² and Gun Borgklint²

¹School of Health Sciences, Department of Natural Science and Biomedicine, Jönköping, University, Jönköping, Sweden; ²Department of Periodontology, The Institute for Postgraduate Dental Education, Jönköping, Sweden

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Oral hygiene and dietary habits are strongly associated with the life circumstances and general health behaviour of an individual. Dental health work should therefore be carried out in accordance with the principles that apply to all health work. The model that good dental health is a result of good dental care should be replaced by the model that good dental health is a result of good self-care. It is thus important to make the individual aware of his or her own power of maintaining good dental health without participation of the dental profession with the exception of its

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advising and encouraging role. Furthermore, it is important to make clear to the public and to the patient the distinction between this power and the dental caring role of the profession when injuries to teeth and periodontium have occurred, and to clearly define the individual's own responsibility (Löe 2000, Sheiham &Watt 2003).

A number of studies in recent decades have demonstrated the positive effects of various measures, individual and group based, aiming at influencing the behaviour of individuals towards promotion of improved oral health (Ryant & Sheiham 1980, Tan et al. 1981, Hoogstraten & Moltzer 1983, Schou 1985, Moltzer & Hoogstraten 1986, Glavind 1990, Stewart et al. 1991, Nowjack-Raymer et al. 1995, Axelsson et al. 2004).

In several epidemiological studies, the total effect of different dental health promoting efforts has also been demonstrated on a population level, meaning more remaining teeth, fewer carious and filled tooth surfaces, and better periodontal health (Bratthall et al. 1996, Sundberg 1996, WHO 2002, Hugoson et al. 2005a, b).

As part of an evaluation of prevention in dental care, a longitudinal study was initiated comprising a group of young adults in the city of Jönköping, Sweden. The aim of the programmes was to influence dental health behaviour positively by means of information and instructions in oral hygiene. In doing this, it was essential to explain the role of the dental profession and the individual's responsibility to change her or his behaviour (Hugoson et al. 2003). The preventive programmes comprised measures according to three different models. One of the programmes was patterned after the so-called Karlstad model (Axelsson & Lindhe 1978). Two other programmes contained individual respectively groupbased preventive measures according to the National Swedish Board of Health and Welfare's preventive programmes for adults (Nyman et al. 1984).

The effect of the programmes on the behaviour of the participants could be

registered in three ways: as a questionnaire with questions concerning oral hygiene habits or by clinical recordings of plaque and gingivitis. The amount of plaque is considered a measure of the individual's ability to carry out oral hygiene procedures while the occurrence of gingivitis is a measure of the individual's daily level of oral hygiene or actual standard of oral hygiene. The registration of plaque examines "home care efficiency", the registering of gingivitis examines "home care efficacy"(Glavind 1990, Wilson 1998).

The self-reported oral hygiene habits of the subjects were published previously (Hugoson et al. 2003) with a detailed description of the patient material and design of the study.

The aim of this study was:

• to evaluate, in a population of young adults regularly seeking dental care, the effect of three different preventive programmes on oral hygiene and gingival status and to statistically analyse the impact of various background variables on gingival health.

Material and Methods Test subjects

Four hundred individuals in the ages 20-27 years participated in the study: 211 men and 189 women. They were recruited from two clinics, a large Public Dental Service (PDS) clinic and from a private two-dentist practice in Jönköping, a city in southern Sweden with approximately 120,000 inhabitants. The recruiting area of the PDS clinic comprised patients from both urban and rural areas. The individuals were offered a dental examination free of charge and were then contacted by telephone. Patients were summoned consecutively until 200 individuals from each clinic had replied. The inclusion criterion included was that the individual was not planning to move from Jönköping within the next few years.

Drop-outs

The drop-out rates during the study were 2.3% (nine individuals), 4.3% (17 individuals), and 6.5% (26 individuals) after 1, 2, and 3 years, respectively, or a total of 13% (52 individuals) after 3 years. The main reasons for the drop-outs (see Hugoson et al. 2003). The drop-outs were evenly distributed between the groups.

Examiners

The examinations were conducted by the authors, two experienced dental hygienists, and two dentists. Before the start of the study, as well as during the course of the study, the examiners were calibrated regarding the diagnostic criteria.

Baseline examination

A questionnaire was filled in by the individual immediately before the clinical and radiographic examination. Smoking was evaluated as non-smokers or daily smokers. At the clinical examination, presence of plaque and gingivitis, clinical caries, restorative dental care, attachment level, pocket depth, and supra and subgingival calculus were registered. Plaque and gingivitis were recorded on the buccal, lingual, mesial, and distal tooth surfaces of all teeth except the third molars.

The presence of plaque was recorded after the tooth surfaces were dried with air according to the criteria for the plaque index (PLI). A PLI score of 1, 2, or 3 was considered to be a positive indicator of plaque, and the surface was registered as positive. The presence of gingivitis was recorded according to the criteria for the gingival index (GI). A GI score of 2 or 3 was used as a measure of gingivitis. Thus, bleeding was registered after the pocket probe had been applied to the opening of the gingival pocket and passed along the tooth surface in question (Löe 1967).

Caries restorative measures and scaling were undertaken when needed to bring the oral hygiene of all participants up to the same baseline standard.

Grouping and programmes for preventive measures for caries and gingivitis/ periodontitis

After the baseline examination and any scaling and caries restorative measures had been performed, the subjects were randomly assigned, by help of a randomizing table, into four groups of 100 individuals each. Responsible for the randomization was one of the authors. Group 1 served as a control group and groups 2, 3, and 4 as test groups in the evaluation of the three different preventive programmes (see Table 1 for a description of the programmes and Fig. 1 for a flow chart of the study). The dental hygienist who carried out the baseline examination of the patient also examined the patient annually and was

Table 1. Grouping and preventive programme description (for a detailed description see Hugoson et al. 2003)

Group 1 – the control group

The individuals in this group underwent no organized prophylactic measures for caries and gingivitis/periodontitis within the framework of the study but had to answer a questionnaire about knowledge of dental diseases and oral hygiene behaviour. The subjects were recalled at 12-month intervals for follow-up examinations, identical to the baseline examination, over the next 3 years

Group 2 $(2_0 \text{ and } 2_1 2_2)$ – the "Karlstad Model"

In this group, all individuals received prophylactic care every second month (six times/year) according to the Karlstad model for adult individuals. At the first visit, information on caries and gingivitis/periodontitis was presented and oral hygiene instruction was given based on plaque disclosure. At the next five visits, at 2-month intervals, the individual's oral status was reviewed and, when necessary, information or oral hygiene instruction was repeated. Half the number of the individuals were also randomly chosen to have no other preventive measures (2_0). The other individuals were randomly chosen to undergo professional tooth cleaning at each visit. The cleaning was performed crosswise in two quadrants, which meant that the teeth in the right maxilla and the left mandible were professionally cleaned in 25 individuals (2_1) and in the left maxilla and the right mandible in 25 individuals (2_2). The 1-year follow-up comprised the same measures undertaken at the baseline examination. The remedial measures undertaken during the first year were repeated for the next 2 years with yearly follow-ups, the last one being the 3-year follow-up

Group 3 - individual educational

In this group, the individuals each underwent an individual basic preventive programme according to the National Swedish Board of Health and Welfare. The programme comprised three visits at 2-week intervals the first year. At the first visit information on caries and gingivitis/periodontitis was presented and oral hygiene instruction was given based on plaque disclosure. The individual's oral status was reviewed at the next two visits. The 1-year follow-up comprised the measures undertaken at the baseline examination. Directly after the follow-up, the individuals were scheduled for a repetition of indicated information and oral hygiene instruction. The same was done at the 2-year follow-up, after which the individuals were called for a 3-year follow-up

Group 4 – group education

The individuals in this group underwent the remedial measures recommended by the National Swedish Board of Health and Welfare for dental health preventive programmes for adults but modified for group-based information with three visits that had essentially the same content as the programme followed by group 3. The programme was conducted as group activities with 10 individuals in each group

Baseline examination		n	= 400 20) – 27 years	
Group	1		2	3	4
		2 ₀	2 ₁ 2 ₂		
n	100	50	50	100	100
		0	0	$\bullet \bullet \bullet$	
		0	0		
Remedial visit		0	0		
		0	0		
		0	0		
1-year follow-up					
		0	0	•	
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3-year follow-up		_			

Fig. 1. Experimental design (\circ , \bullet , \Box) remedial visits during years 1, 2, and 3: group 1 – the control group – no remedial visits. (\circ) Group 2 – individual remedial visits every second month without (2_0) and with ($2_1 2_2$) professional tooth cleaning. (\bullet) Group 3 – the individual basic preventive programme – three individual remedial visits after baseline examination I, thereafter, one visit after each of the 1- and 2-year follow-ups. (\Box) Group 4 – the group basic preventive programme – three remedial visits after baseline examination I, thereafter, one visit after each of the 1- and 2-year follow-ups in groups of 10 individuals.

unaware of which group the patient belonged to and which programme of preventive measures the participant was following. The remedial measures were carried out by another dental hygienist. The programmes followed a detailed, written working plan to ensure that all patients received the same information and instructions.

The three preventive programmes were designed with the intent to provide the patient with the same high level of information and oral hygiene instructions. The illustrated material used to inform the patients in the test groups about caries and gingivitis/periodontitis contained the same information. In groups 2 and 3, the information was in the form of a flip chart and in group 4 the information was in the form of a slide show with speaker text. The participants were asked to fill in a short quiz during the slide show, after which the quiz was jointly "corrected".

Instruction in oral hygiene

In all test groups, a soft toothbrush (Swedish brand "TePe", Malmö, Sweden) and either toothpicks (TePe) or dental floss (Johnson & Johnson dentotape, Sollentuna, Sweden) were used at the oral hygiene instruction sessions. Instructions on the Bass method (Bass 1954) were given if the subject's own brushing technique proved unsatisfactory, and all subjects were advised to start their brushing lingually in the lower jaw molar region. The patients were informed, according to routine procedures at the clinic, that the best way of establishing the habit of inter-dental cleaning is to clean the teeth proximally before brushing.

In groups 2 and 3, the oral hygiene instruction or reinstruction was carried out after the participants used a disclosing Diaplack tablet. The proximal aids, dental floss or toothpicks, were chosen depending on anatomical conditions, e.g. crowded teeth, and the degree of gingivitis when toothpicks were recommended in cases with severe proximal inflammation or "open" proximal spaces. The subjects were asked to demonstrate and practice the cleaning technique in their own mouths. In group 2, the "Karlstad model", half the number of the individuals underwent no further preventive measures (2_0) while half the number of the individuals $(2_1 \ 2_2)$ were randomly chosen to undergo professional tooth cleaning at each visit (Table 1).

In group $\overline{4}$ (group-based education), the oral hygiene instruction was given after the subjects had received their own plaque index printed on a "mouth status form" in order to relate to their own status. The technique of brushing and the use of toothpicks and dental floss were demonstrated by means of single slides from the slide show and on a dummy. The participants were then asked to test the aids in their own mouths and, after that, to choose an aid for proximal cleaning.

All participants in the three groups were also given a pamphlet with information on caries and gingivitis/periodontitis.

Fluoride toothpaste

Each year, all the test subjects were given enough fluoride toothpaste (Acta 0.22% sodium fluoride) to last for 1 year (eight tubes). Participants in need of more toothpaste could ask for more tubes.

Professional tooth cleaning

The professional tooth cleaning in group $2_1 2_2$, was carried out using polishing paste AV 130 (silicon dioxide, sodium fluoride, monofluorophosphate), a rotating rubber cup (Youngs), an midget-pointed brush (Youngs), and on proximal surfaces, reciprocating inter-proximal tips (Eva System* WA67A, WoH, Tüby, Sweden).

1-, 2-, and 3-year follow-ups

The 1-, 2-, and 3-year follow-ups comprised the measures undertaken at the baseline examination – a questionnaire, a clinical examination including registration of plaque and gingivitis and a radiographic examination.

Statistical methods

All statistical analyses were performed using the SPSS software package (SPSS for Windows 95, version 9.0, SPSS Inc., Chicago, IL, USA). The independent unit of observation (n) for the statistical analyses was the number of participants. Mean values, standard deviations (SD), and frequency distributions are given. One-way analyses of variance were used to make comparisons between groups and between examination sessions. A level of p < 0.05 was considered statistically significant. A multiple logistic regression model was used to find the model of gingival health with the best overall fit. The dependent variable "gingival health" was defined as a dichotomous variable according to the individual full-mouth GI where a value = 0comprised one-third of the individuals with the lowest GI scores and a value = 1comprised one-third of the individuals with the highest GI scores.

Results Smoking

At the baseline examination, 34% of the subjects were smokers. The numbers of daily smokers were unchanged during the study period.

Number of teeth

One tooth (47) was extracted during the 3 years of the study.

Oral hygiene

Mean values and SD are given for fullmouth numbers of tooth surfaces with plaque, calculated on four surfaces per tooth (Table 2a) and for proximal numbers of tooth surfaces with plaque,

Table 2a. Full-mouth number of tooth surfaces with plaque in the different groups at baseline and 1, 2, and 3 years after oral hygiene instruction

Group		Baseline	1 year			2 years	3 years		
	n	$\text{mean}\pm\text{SD}$	n	$\text{mean}\pm\text{SD}$	n	$\text{mean}\pm\text{SD}$	n	$\text{mean}\pm\text{SD}$	
1	100	54.2 ± 21.9	97	42.9 ± 23.9	96	39.4 ± 24.1	94	37.6 ± 24.3	
2_{0}	50	63.0 ± 18.7	49	21.7 ± 19.2	46	18.5 ± 17.7	47	12.9 ± 12.2	
$2_{1}^{\circ} 2_{2}$	50	63.6 ± 17.7	49	25.2 ± 21.4	48	23.1 ± 18.1	47	22.1 ± 21.1	
3	100	60.7 ± 22.8	98	29.9 ± 25.2	97	24.4 ± 23.1	93	24.5 ± 23.6	
4	100	59.2 ± 23.1	98	31.4 ± 22.9	96	27.6 ± 26.1	93	21.6 ± 20.9	

At baseline: group 1 had statistically significant less plaque than the other groups (p < 0.05). After 3 years: in all groups the presence of plague decreased (p < 0.05). Group 1 had more plague (p < 0.05) than the test groups. The difference between the test groups were statistically non-significant.

Table 2b. Proximal number of tooth surfaces with plaque in the different groups at baseline and 1, 2, and 3 years after oral hygiene instruction

Group	Baseline		1 year			2 years	3 years		
	n	mean \pm SD	n	mean \pm SD	n	$\text{mean}\pm\text{SD}$	n	$\text{mean}\pm\text{SD}$	
1	100	41.6 ± 15.1	97	32.9 ± 17.8	96	31.3 ± 18.4	94	30.0 ± 18.9	
20	50	$47.5~\pm~\pm~11.6$	49	16.5 ± 15.7	46	14.7 ± 14.4	47	10.4 ± 10.6	
$2_1 2_2$	50	47.8 ± 11.5	49	20.1 ± 17.9	48	18.8 ± 15.8	47	18.4 ± 18.3	
3	100	45.0 ± 14.0	98	23.6 ± 20.6	97	18.9 ± 18.4	93	20.2 ± 19.8	
4	100	44.5 ± 15.0	98	23.4 ± 17.8	96	21.1 ± 19.7	93	16.5 ± 15.3	

At baseline: group 1 had statistically significant less plaque than the other groups (p < 0.05) and groups 2_0 and 2_1 2_2 had statistically significant more plague (p < 0.05) than groups 3 and 4. After 3 years: in all groups the presence of plague decreased (p < 0.05). The difference between group 2_0 and group 1 as well as between 2_0 and groups 2_1 2_2 , 3, and 4 was statistically significant (p < 0.05). The difference between group 1 and group 2_{122} , 3, and 4 was statistically significant (p < 0.05). The difference between group 1 and group 2_{122} , 3, and 4 was statistically significant (p < 0.05). The difference between group 2_1 2_2 , 3, and 4 was statistically non-significant. calculated on two surfaces per tooth (Table 2b), in the different groups at baseline and after 1, 2, and 3 years after oral hygiene instruction. Results are presented from a cross-sectional as well as from a longitudinal perspective.

At baseline, group 1 had statistically significant less plaque (54.2% of the tooth surfaces) than the other groups (63%, 63.6%, 60.7% and 59.2% for groups $2_0, 2_1, 2_2, 3$, and 4, respectively). The differences between the test groups were statistically non-significant. At the 3-year follow-up, the presence of plaque had decreased statistically significant in all groups but was statistically significant higher in group 1 (37.6%) compared with all test groups (12%, 22.1%, 24.5%, 21.6% for groups 20, 21 22, 3, and 4, respectively). There was no significant difference in full-mouth plaque scores between the test groups at the 3-year follow-up.

The majority, around 75%, of the total amount of plaque was found on proximal tooth surfaces.

At baseline, the proximal number of tooth surfaces with plaque was statistically significant lower in group 1 (41.6%) compared with the test groups (47.5%, 47.8%, 45%, 44.5% for groups 2_0 , 2_1 , 2_2 , 3, and 4, respectively). At the same time, groups 2_0 and 2_1 , 2_2 exhibited statistically significant higher levels of proximal plaque than the other groups.

After 3 years, the proximal number of surfaces with plaque was statistically significant lower in all groups compared with baseline but was highest in group 1 (30%) and lowest in test group 2_0 (10.4%). The differences between the other test groups, group 2_1 2_2 (18.4%), 3 (20.2%), and 4 (16.5%), were statistically non-significant, while the differences between these groups and group 1 and between these groups and group 2_0 were statistically significant.

Gingival status

Mean values and SD are given for fullmouth numbers of sites with gingivitis, calculated on four sites per tooth (Table 3a) and for proximal numbers of sites with gingivitis, calculated on two surfaces per tooth (Table 3b), in the different groups at baseline and after 1, 2, and 3 years after oral hygiene instruction. Results are presented from a crosssectional as well as from a longitudinal perspective.

At baseline, the full-mouth number of sites with gingivitis was statistically

Table 3a. Full-mouth number of sites with gingivitis in the different groups at baseline and 1, 2, and 3 years after oral hygiene instruction

Group	Baseline		1 year			2 years	3 years		
	n	$\text{mean}\pm\text{SD}$	n	$\text{mean}\pm\text{SD}$	n	$\text{mean}\pm\text{SD}$	n	$\text{mean}\pm\text{SD}$	
1	100	33.2 ± 19.5	97	30.2 ± 16.5	99	26.7 ± 18.2	94	28.5 ± 17.0	
2_0	50	40.4 ± 16.5	49	20.2 ± 13.4	48	15.4 ± 14.2	47	15.0 ± 12.1	
$2_{1}^{2}2_{2}$	50	46.7 ± 23.4	49	23.3 ± 17.7	49	19.3 ± 17.5	47	20.6 ± 19.7	
3	100	38.8 ± 22.1	98	22.2 ± 18.1	98	19.0 ± 17.7	93	19.4 ± 17.4	
4	100	36.3 ± 18.2	98	25.5 ± 17.6	97	22.8 ± 17.8	93	20.5 ± 16.6	

At baseline: groups 1 and 4 had statistically significant lower number of sites with gingivitis and groups 2_0 and $2_1 2_2$ statistically significant more sites with gingivitis than the other groups (p < 0.05). After 3 years: in all groups the number of sites with gingivitis decreased (p < 0.05). Group 1 had statistically significant more sites with gingivitis (p < 0.05) than the other groups. The difference between the test groups were statistically non-significant.

Table 3b. Proximal number of sites with gingivitis in the different groups at baseline and 1, 2, and 3 years after oral hygiene instruction

Group		Baseline	1 year			2 years	3 years		
	n	$\text{mean} \pm \text{SD}$	n	$\text{mean} \pm \text{SD}$	n	$\text{mean} \pm \text{SD}$	n	$\text{mean}\pm\text{SD}$	
1	100	27.6 ± 14.3	97	25.2 ± 12.5	99	21.9 ± 13.6	94	23.8 ± 13.1	
20	50	33.5 ± 11.7	49	17.6 ± 11.4	48	13.0 ± 11.7	47	13.3 ± 10.2	
$2_1, 2_2$	50	36.3 ± 14.4	49	19.5 ± 14.1	49	15.6 ± 13.6	47	16.3 ± 14.5	
3	100	31.9 ± 16.3	98	18.7 ± 13.7	98	15.9 ± 13.9	93	16.6 ± 14.2	
4	100	30.1 ± 14.3	98	21.0 ± 13.5	97	18.8 ± 13.5	93	17.3 ± 12.9	

At baseline: groups 1 and 4 had a statistically significant fewer sites with gingivitis than the other groups (p < 0.05). Group 2₁ 2₂ had statistically significant more sites with gingivitis than the other groups (p < 0.05).

After 3 years: in all groups the number of sites with gingivitis decreased (p < 0.05). Group 1 had statistically significant more sites with gingivitis (p < 0.05) than the other groups. The difference between the test groups were statistically non-significant.

significant lower in groups 1 (33.2%) and 4 (36.3%) compared with groups 2_0 (40.4%), $2_1 2_2$ (46.7%), and 3 (38.8%). Group 2_0 and $2_1 2_2$ had statistically significant more sites with gingivitis than the other groups.

The number of sites with gingivitis was statistically significant lower in all groups after 3 years of follow-up compared with the baseline values for the groups (e.g. for group 1, 33.2% versus 28.5% and for group 2₀, 40.4% versus 15%).

Group 1 had statistically significant more sites with gingivitis at the 3 year follow-up than the test groups. Differences between test groups were statistically non-significant.

Table 3b. At baseline, groups 1 (27.6%) and 4 (30.1%) had statistically significant fewer sites with proximal gingivitis than groups 2_0 (33.5%), 2_1 2_2 (36.3%), and 3 (31.9%). Group 2_1 2_2 had statistically significant more sites with proximal gingivitis compared with all other groups. After 3 years the number of proximal sites with gingivitis was statistically significant lower in all groups (group 1, 23.8%; group 2_0 , 13.3%; group $2_1 2_2$, 16.3%; group 3, 16.6%; and group 4, 17.3%) compared with the baseline values for the groups. However, the test groups had significantly fewer sites with proximal gingivitis than group 1. The differences between the test groups were non-significant.

Frequency distribution of individuals with regards to gingivitis

Figure 2a–e show the frequency distribution of full-mouth number of sites with gingivitis in relation to number of individuals in each group at the baseline examination and after 3 years.

Individual changes in gingival status

Figure 3 shows the mean number of sites with gingivitis at baseline for each subject and the individual change in gingival status – the difference in individual fullmouth number of sites with gingivitis between baseline and after 3 years.



Fig. 2. (a) Group 1 – frequency distribution of presence of gingivitis at baseline and after 3 years for the different groups. (b) Group 2_0 – frequency distribution of presence of gingivitis at baseline and after 3 years. (c) Group $2_1 2_2$ – frequency distribution of presence of gingivitis at baseline and after 3 years. (d) Group 3 – frequency distribution of presence of gingivitis at baseline and after 3 years. (e) Group 4 – frequency distribution of presence of gingivitis at baseline and after 3 years.

After 3 years, the gingival status of 30 individuals in group 1, none in group 2_0 , four in group 2_1 2_2 , 12 in group 3, and 18 in group 4 was impaired.

The importance for gingival health of various background variables

A multiple logistic regression analysis with a forward stepwise selection of variables was performed to detect variables of importance to gingival health (Table 4).

The statistical analysis showed that a good gingival status at baseline was the most important predictor for a healthy gingival status after 3 years. Participation in one of the three preventive programmes and knowledge of the two major dental diseases caries and gingivitis or periodontitis were also statistically significant variables. The other variables were statistically non-significant (Table 5).

Discussion

A previous study has demonstrated the effect of the tree dental health preventive programmes on the knowledge and behaviour of young adults (Hugoson et al. 2003). The present paper demonstrates the effect of the same programmes on the oral health behaviour of the participants in the test groups, recorded as changes in the presence of plaque and gingivitis.

The study was performed as a randomized controlled study with the outcome of the result blind. This is regarded as the method of choice for assessing therapeutic interventions and measuring effectiveness in clinical studies. It therefore, provides the strongest level of evidence on which to base clinical decisions (Cochrane 1972). It will also be possible to make more general interpretations of the findings or meaningful conclusions by this design.

The aim of the dental health programmes in this clinical trial was to use oral hygiene instruction and information about the aetiology of caries and gingivitis or periodontitis to influence the dental health behaviour of individuals in a traditional way, to strengthen the individuals' own sense of responsibility for their oral health. Differentiating between the role of dental personnel and the role of the individual was important.

That preventive dental work predominantly consists of chair sessions instead of measures where the only aim is



Fig. 3. Individual change in gingival status between baseline (x-axis) and after 3 years (y-axis).

Та	bl	e 4.	Ir	nportance	to	ging	ival	hea	lth	of	various	bac	kground	vari	abl	les
						<u> </u>							<i>u</i>			

Dependent variable
Gingival health
Independent variables
Sex
Smoking habits
Knowledge of the two major dental diseases
Knowledge of what part of the tooth is most important to clean
Knowledge of the cause of caries
Knowledge of the cause of gingivitis/periodontitis
Reported behaviour - "Do you perform interdental cleaning"?
Taking part in any of the four groups studied
Number of surfaces with gingivitis at baseline

Table 5.	Results	of the	multivariate	logistic	regression	analys	is
rable 5.	results	or the	mannvariace	rogiotic	regression	unuiyo	10

Explanatory variable	<i>p</i> -value	Odds ratio	95% CI
Knowledge of the two major	0.020	0.351	0.145-0.850
dental diseases			
Dental health programme			
Group 2 ₀	0.000	0.034	0.010-0.121
Group $2_1 2_2$	0.000	0.046	0.013-0.160
Group 3	0.000	0.066	0.023-0.184
Group 4	0.001	0.191	0.073-0.497
Gingival status at baseline	0.000	1.076	1.055-1.099

CI, confidence interval.

to influence the behaviour of the individual may present a risk. The content of the preventive programmes in this study differ in this respect. The subjects in the control group (group 1) received conventional dental care comprising prevention but mainly diagnostics and restorative care. The programme patterned after the "Karlstad model" (group 2) included not only preventive measures every second months (2_0) but also dental sessions and professional cleaning in half the group $(2_1 \ 2_2)$. The subjects in group 3 individually underwent a basic programme of prevention according to the recommendations of

the National Swedish Board of Health and Welfare, which included an annual follow-up. The programme that group 4 underwent was essentially the same as that followed by group 3 except that it had been modified for group activity. Apart from the professional cleaning there was no chair-side time and the dental personnel were present solely in the role as informers and instructors.

In this study, the number of tooth surfaces with plaque and sites with gingivitis according to Löe (1967) has been used. Dichotomized absence or presence scores for plaque were 0, and 1, 2, and 3 and for gingivitis 0, 1, and 2, 3. This way of presenting plaque and gingivitis was chosen to reduce the degree of subjectivity during scoring and is also the reason why there is a difference in the level of the two measurements.

In all test programmes, the full-mouth and proximal presence of plaque and gingivitis decreased significantly on the group level in relation to the control group. However, the control group was also affected positively concerning levels of plaque and gingivitis. One probable explanation may be improved awareness of the subjects taking part in a study with regular annual clinical examinations and the use of questionnaires that bring issues on dental health up to date.

The long-term beneficial effect of a plaque control programme on caries and periodontal disease in adults has earlier been shown by Axelsson et al. (2004). However, the importance of the professional cleaning sessions can be questioned. In the present study, the programme of group 2_0 had the best effect on the presence of proximal plaque, that is, the presence of plaque was statistically significant lower than in those individuals in group 2_1 2_2 who underwent the same programme but also received professional tooth cleaning regularly every 2 months. It can thus be concluded that professional plaque removal had no clinical significance besides toothbrushing and inter-dental cleaning. These results are in accordance with the conclusions of Needleman et al. (2005) where they state that repeated oral hygiene instructions might have an effect similar to that of professional mechanical plaque removal. On the other hand, the personal meeting, regular repetition, the check-ups of the individual's dental status, and, if required, the re-instruction in oral hygiene seemed to be of great importance in

helping the patient maintain a high standard of oral cleanliness (for review, see Egelberg 1999). It may even be that professional plaque removal lulls the patient into a false sense of security as a protective measure.

One model of preventive work long discussed is the possibility to influence dental health positively using preventive measures directed to the whole population, that is, basic prevention programmes, and then offering additional prophylaxis to individuals with a high or progressing dental disease activity. Basic factors in these strategies are the focus on fluorides, dietary counselling, and improvement in oral hygiene. These measures bring about both the chance to maintain health and a way of fighting disease. A high-risk approach, where individuals are identified by screening, has also been suggested. However, high-risk strategies for controlling dental diseases have been questioned, and it has been proposed that a population approach will provide virtually the same prevention effect with less effort and lower cost (Hausen et al. 2000, Sheiham & Watt 2003.). Löe (2000) and van Loveren (2000) have called attention to the role of plaque as a common factor in preventing these diseases.

In this connection it is interesting to compare the results from the different preventive programmes in this study. The control group (group 1) showed the highest plaque and gingivitis scores after 3 years of follow-up and the frequency distribution of individuals according to full-mouth mean number of sites with bleeding gingival tissues was unchanged during the period. The number of individuals with impaired gingival status reached 30% of the group. In this sense, the conventional chair side dental care was not effective enough to maintain gingival health or reduce the incidence of gingivitis.

The preventive programmes in groups 3 and 4, individual or group-based, followed the strategy for the whole population approach. At baseline professional information and instruction in oral hygiene was performed by two dental hygienists at three appointments followed by a 1-year follow-up. At that appointment a repetition of indicated information and instruction in oral hygiene was taken. The same was done at the 2- and 3-year follow-up. Irrespective of programme, groups 3 and 4 showed a statistically significant decrease in plaque and gingivitis scores compared

with the control group. The frequency distribution of individuals with bleeding sites shift to the left and the number of individuals with impaired gingival status decreased to about 15%. In contrast to the results in the control group and to the conclusions made in the systematic review of the effectiveness of self-performed mechanical plaque removal (van der Weijden & Hioe 2005) where only limited improvement could be expected from dental interventions in the form of prevention, this study has shown that traditional toothbrushing and interdental cleaning, depending on the programme, are effective in controlling plaque and gingivitis.

If the aim of the study had been to consider a preventive programme for individuals with a high disease activity it is interesting to note the result of the preventive programme for group 2_0 . This programme was more time consuming than the other preventive programmes as it contain remedial visits ever second month when necessary information and oral hygiene was repeated. That group had the lowest plaque and gingivitis scores after 3 years of follow-up, there was also a pronounced shift to left in the distribution of individual full-mouth number of gingivitis scores and no subjects show signs of gingival impairment.

The advantages and disadvantages of group-based information were discussed in a previous paper (Hugoson et al. 2003). It can be pointed out that the results of the group-based programme concerning plaque and gingival status were as good as the results of the programme of group 3. Concerning costs, it is mainly the direct expenses of the dental clinic that become lower in comparison with the chair-conducted programmes. However, the patients' costs can also be reduced if the group-based activity takes place somewhere else than in the clinic. This also paves the way for new research on how to disseminate a health message using modern technology.

The statistical analysis showed that the best predictor of good gingival status at the 3-year follow-up was good gingival health at baseline. Individuals who are already gingival healthy and have a positive health behaviour can thus further improve. This fact has been pointed out by Galgut and O'Mullane (1998) and must, of course, be considered when conclusions are drawn based on the results of different preventive programmes. Belonging to one of the test programmes, as well as having

documented knowledge of both caries and gingivitis or periodontitis were also significant predictors. In conclusion, the result showed that simple prophylactic models have an effect on and maintain young adult individuals' knowledge and behaviour concerning oral health. It has also been shown in an earlier paper that knowledge is remembered for long periods of time while changes in behaviour are maintained less well (Hugoson et al. 2003).On the other hand, gender and smoking habits were less significant. Contrary to the results of several other studies (Kay & Locker 1996, Sheiham & Watt 2003), this study found that knowledge is not unimportant in achieving good health behaviour.

Conclusion

This study investigated the effect of three oral health preventive programmes, individual as well as group-based, on the oral health behaviour in young adults expressed as changes in plaque and gingivitis levels. The study was performed as a randomized, blinded, controlled study. The results show clearly improved oral health in all the preventive programmes compared with the control group.

The greatest improvement was found in the group who visited the dentist for individual information and instruction in oral hygiene every second months. Professional tooth cleaning provided no clinical benefit beyond that derived from individual and group-based health education.

The statistical analysis showed that the variables "gingival health at baseline", "belonging to one of the test programmes", and "knowledge of both caries and gingivitis or periodontitis" were the best predictors of good oral health.

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Address: Anders Hugoson Department of Natural Science and Biomedicine School of Health Sciences PO Box 1026 SE-551 11 Jönköping Sweden E-mail: anders.hugoson@hhj.hj.se

Clinical Relevance

Scientific rational for the study: The model that good dental health is a result of good dental care should be replaced by the model that good dental health is a result of good self-care. With this as an initial position the current study was designed to investigate the effect of various preventive programmes on the presence of plaque and gingivitis. *Principle findings*: The study clearly show that traditional tooth brushing and inter-dental cleaning is effective in controlling plaque and gingivitis. It was also shown that professional tooth cleaning was non-significant for the clinical result in this population consisting of young individuals. *Practical implications*: The results are of great importance for the carrying out and cost, the direct expenses of the clinic as well as for the patient, of preventive interventions. This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.