








ORIGINAL ARTICLE

A person-centred, theory-based, behavioural intervention programme for improved oral hygiene in adolescents: A randomized clinical field study

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Abstract

Aim: To test the effectiveness of a person-centred and theory-based educational intervention to increase adolescents' adherence to adequate oral hygiene behaviour, that is, self-performed periodontal infection control.

Materials and Methods: Data were derived from a prospective, multi-centred, two-arm, quasi-randomized field study in which treatment was performed by dental hygienists (DHs) within the Public Dental Service, Västra Götaland, Sweden. Adolescents with poor oral hygiene conditions were invited to participate. The test intervention was based on cognitive behavioural theory and principles, and the DHs used a collaborative communicative approach, inspired by motivational interviewing. The control intervention consisted of conventional information/instruction. Clinical assessments and oral hygiene behaviours were evaluated at 6 months.

Results: Three-hundred and twelve adolescents were enrolled, of whom 274 followed the treatment to 6-month follow-up. There were significant improvements in gingival bleeding and plaque scores for both treatment groups at 6 months, with significantly greater improvements in the test group. Adolescents in the test group brushed their teeth and used interdental cleaning aids more frequently compared to participants in the control group at 6 months.

Conclusion: A person-centred and theory-based oral health education programme is more effective than conventional oral health education in improving adolescents' oral hygiene behaviour and periodontal infection control. ClinicalTrials.gov (NCT02906098).

KEYWORDS

adolescents, behavioural intervention, gingivitis, oral hygiene, prevention

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Clinical Relevance

Scientific rationale for study: Infection control by means of adequate oral hygiene behaviour is essential for the prevention of periodontitis. Epidemiological studies have shown that periodontal infection control among Swedish adolescents is poor and therefore more effective behavioural interventions are needed.

Principal findings: At 6 months, there were significantly greater improvements in gingival bleeding and plaque scores for a person-centred, theory-based, oral health education programme compared to conventional oral health education.

Practical implications: A person-centred oral health education programme can be used by specially trained DHs to effectively improve oral hygiene behaviours in adolescents.

1 | INTRODUCTION

To educate and strengthen patient motivation for adequate oral hygiene, that is, self-performed periodontal infection control, is fundamental for the prevention of periodontal disease (Tonetti et al., 2015). Prevention is also the issue in focus for the free-of-charge dental care offered to all Swedish children and adolescents by the organized community dental care. Epidemiological studies have, however, shown a high degree of plaque and gingivitis among Swedish adolescents (Hugoson et al., 1998; Abrahamsson et al., 2006; Ericsson et al., 2009; Wahlin et al., 2018). These findings raise questions about the quality and benefits of current oral health educational approaches directed to young individuals.

Plaque-induced gingivitis is a reversible condition but may, if left untreated, progress into periodontitis. Periodontitis is one of the most common diseases in humans (Kassebaum et al., 2014; Tonetti et al., 2015), with a prevalence of about 40% in Swedish adults, with 10% considered having advanced forms of the disease (Wahlin et al., 2018; SKaPa, 2020). Results from repeated cross-sectional studies in Sweden suggest a positive trend in periodontal health in the adult population (Wahlin et al., 2018). However, this trend does not include the youngest age group of 20-year-olds who showed a significant increase in gingivitis between the years 2003 and 2013. In addition, observations by The Swedish Quality Registry for Caries and Periodontal Disease (SKaPa, 2020) indicate that the extent and severity of periodontal disease have increased from 2010 to 2019, especially in younger adults. Considering the high prevalence of periodontitis in the adult population, and the recent somewhat alarming observations among younger adults, measures to improve the efficacy and cost effectiveness of prevention programmes for periodontal disease are of great importance.

A health education programme is claimed to be more beneficial for the patient if it is guided by a theory of health behaviour (Bandura, 2004; Ogden, 2019). Systematic reviews indicate that person-centred educational approaches based on social-cognitive constructs, and with dental professionals using a collaborative communicative approach like motivational interviewing (MI) (Miller & Rollnick, 2013), can reinforce adherence to an adequate oral hygiene behaviour in adults with periodontal disease (Newton & Asimakopoulou, 2015; Werner et al., 2016; Carra et al., 2020). A

person-centred approach refers to acknowledging the individual behind the patient with his/her own will, feelings, and needs, to engage the person as an active partner in treatment (Ekman et al., 2011). Moreover, Newton and Asimakopoulou (2015) concluded that behavioural change techniques (BCTs) such as goal setting, planning, and self-monitoring of behaviours seem to be effective components in interventions aimed at improving oral hygiene. Based on the limited evidence, there is, however, a need for further studies within this area including not only adults with periodontitis but also other age and patient groups (Werner et al., 2016) along with studies where interventions are tested in general dental practice, that is, effectiveness studies (National Board of Health and Welfare, 2011). Accordingly, the aim of the current study was to test the effectiveness of a person-centred, theory-based, educational intervention to increase adolescents' adherence to adequate oral hygiene behaviour, that is, self-performed periodontal infection control.

We hypothesized that in adolescents, a person-centred oral health education programme, based on cognitive behavioural theory and principles combined with a collaborative communicative approach inspired by MI, would add positive effects with respect to oral health outcomes as compared with conventional educational interventions for self-performed periodontal infection control.

2 | MATERIALS AND METHODS

The data analysed derived from a prospective, multi-centre, two-arm, quasi-randomized field study focusing on the effectiveness in general practice of educational interventions to increase adolescents' adherence to self-performed periodontal infection control. Ethical approval was obtained from the Regional Ethical Review Board, Gothenburg, Sweden (Dnr: 284-15). The study was registered at ClinicalTrials.gov (NCT02906098).

2.1 | Randomization procedure

The board of the Public Dental Service (PDS) in Region Västra Götaland (VG), Sweden, was asked to identify at least 30 dental hygienists (DHs) regularly treating adolescents and who worked at

dental clinics in areas with different socio-demographic characteristics within VG. Thirty-one DHs at 17 clinics voluntarily signed up for the study after receiving verbal and written information.

Based on the clinic at which they worked, the DHs were stratified and then randomized to a test group or a control group by tossing a coin. The rationale behind this step-wise procedure was to achieve a balanced distribution in the test and control group with regard to DHs working at clinics representing areas with different socio-demographic characteristics within VG.

2.2 | Education of DHs

All the DHs received education (test = 2 days; control = half a day) including Good Clinical Practice in research, a detailed review of the respective study protocol, and a calibration/training session regarding clinical assessments. For the DHs in the test group, the education also included the philosophy behind the use of cognitive behavioural strategies and BCTs and the use of an MI-inspired communicative approach. Clinical training of the test intervention was practiced in pairs under supervision of a psychologist (Jesper Lundgren), and the DHs were encouraged to train the test intervention at their home clinic before the enrollment of study patients. Two guiding manuals were presented: a comprehensive and detailed one used during training, and a brief one to provide support during the study appointments.

2.3 | Sample size calculation and enrollment of study patients

Eighty-six subjects per group (172 patients) were required to have a 95% power to detect a difference of 10% in final mean marginal bleeding index (MBI; primary clinical outcome) between the groups. To compensate for potentially higher drop-out rate in field studies, approximately 155 patients per group (i.e., about 10 patients/DH) were to be included.

Adolescents, 16–17 years old, with marginal gingival bleeding and/or dental plaque at $\geq 50\%$ of tooth surfaces at the time of regular dental examination were eligible for participation in the study. In order to make a considered choice about participation, patients judged as capable to understand the study information were asked about their willingness to participate (The Swedish Ethical Review Act; SFS 2003:460, § 18). Because of the study design, patients with obvious difficulties with the Swedish language were not invited. All patients gave a written informed consent before entering the study and were enrolled from January 2016 to June 2018.

The clinical cut-off values for inclusion were based on the clinical guidelines, by the PDS in VG, in which individuals with this magnitude of gingivitis and/or plaque are considered to be at increased risk of oral disease progression and therefore should be offered individual preventive measures. A gingivitis score of $\geq 50\%$ was assumed in 40%–60% of adolescents living in different areas of VG (Abrahamsson et al., 2006; Ericsson et al., 2009).

2.4 | Data collection

2.4.1 | Clinical assessment

Marginal bleeding was assessed as present (1) if bleeding was detected following pressure with a periodontal probe of the gingival sulcus area, or absent (0), at four sites on each tooth (mesial, distal, buccal, and lingual) (Ainamo & Bay, 1975). Plaque was assessed as present (1) or absent (0) following staining with a disclosing solution (Diaplac[®]; Wallco AB, Enköping, Sweden) at the same four tooth sites on all teeth (O'Leary et al., 1972). MBI and plaque index (PI) were expressed as a percentage by dividing the number of tooth sites with bleeding/plaque by the total number of examined sites (third molars excluded). Clinical assessments were performed by the DH who provided the intervention. All clinical data related to the project were entered and stored in the patient's electronic dental record.

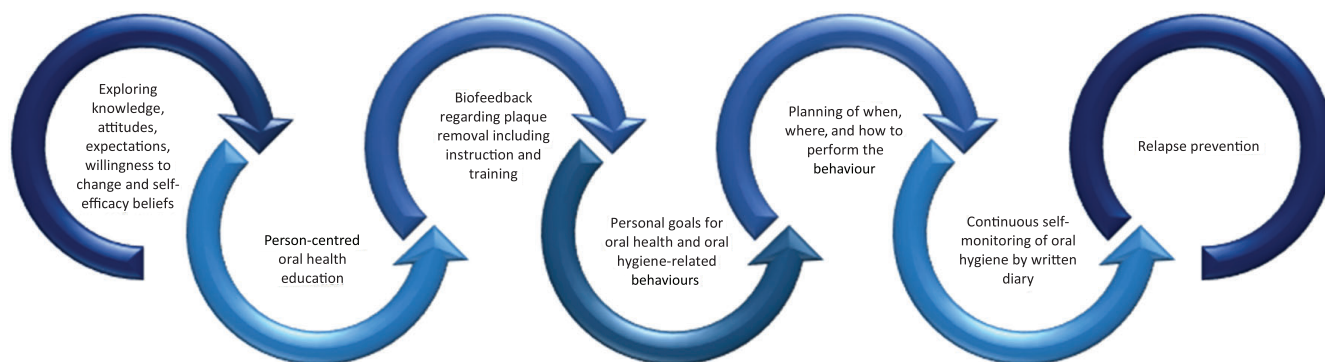


FIGURE 1 Structure of the test intervention (person-centred oral health education programme) inspired by Jönsson et al. (2009)

TABLE 1 Components of the initial intervention phase in the person-centred oral health education programme

Person-centred oral health education programme
<p>Session 1 (baseline)</p> <ul style="list-style-type: none"> Explore and analyse health beliefs, knowledge, needs, etc. Person-centred education Explore willingness for behavioural change Summary, mutual agreement Training of oral hygiene skills Individual goals for behaviour and planning of behaviour to the next session (in writing) Explore self-efficacy for a behavioural change Introduce diary for self-monitoring of oral hygiene behaviour (in writing to bring back at the next session) Summary of the session and short introduction to the next session
<p>Session 2 (2–3 weeks)</p> <ul style="list-style-type: none"> Introduction: Short summary of Session 1 Complementary person-centred education if required/requested Follow-up of oral hygiene behaviour/behavioural change and dialogue based on the diary Explore willingness to behavioural change if required and ambivalence (pros/cons) for a behavioural change Follow-up of oral hygiene performance (staining of dental plaque in order to visualize for the patient) and further training of skills if required Follow-up of individual goals for behaviour and planning of the behaviour to the next session (in writing) Explore self-efficacy to carry out the behaviour in question Diary for self-monitoring of oral hygiene behaviour (in writing, to bring back at the next session) Summary of the session and short introduction to the next session
<p>Session 3 (10–12 weeks)</p> <ul style="list-style-type: none"> Introduction: Short summary of Session 2 Complementary person-centred education if required/requested Follow-up of oral hygiene behaviour/behavioural change and dialogue based on the diary Explore willingness to behavioural change if required and ambivalence (pros/cons) for a behavioural change Follow-up of oral hygiene performance (staining of dental plaque in order to visualize for the patient) and further training of skills if required Follow-up of individual goals for behaviour and planning of the behaviour (in writing): dialogue with focus on relapse prevention and maintenance of new behaviours Explore self-efficacy to carry out the behaviour in question Follow-up at 6 months (schedule appointment)

2.4.2 | Questionnaire-based data

The questionnaires were based on questions evaluated in adolescent populations and results of previous studies (for an overview,

see Ericsson, 2013). For the current report, information about individual background characteristics (gender, native country, occupation, tobacco habits, and medication) and baseline data on self-rated oral and general health were used. Self-rated oral and general health were assessed with global questions to be answered on a four-point scale (good, quite good, quite poor, and poor). In addition, frequency of toothbrushing and interdental cleaning and time spent on daily oral hygiene were assessed at baseline and 6 months.

Clinical assessments were performed and questionnaires distributed at baseline and 6 months. The questionnaires were to be answered in the waiting room before treatment and returned in a sealed envelope.

2.5 | Interventions

2.5.1 | Test group: Person-centred oral health education programme

The protocol for the test intervention was based on cognitive behavioural theory and principles (Bandura, 2004) and commonly used BCTs, such as goal setting, planning, and self-monitoring of behaviour (Michie et al., 2011, 2013). In addition, a person-centred and collaborative communicative approach, inspired by MI (Catley et al., 2010; Miller & Rollnick, 2013), was used by the DHs to elicit and strengthen the adolescents' motivation for behavioural change and facilitate guidance towards appropriate and effective oral hygiene habits. Accordingly, the individual's problem, knowledge, capability, motivation, and goals regarding oral health were taken into account, as well as strategies to fit beneficial oral hygiene behaviours into everyday life. The programme followed a specific structure, inspired by Jönsson et al. (2009), which is outlined in Figure 1. The initial intervention phase contained three treatment sessions, 45–60 min each, during a period of 10–12 weeks. The components of the intervention programme at each session are presented in Table 1. For extended details about the intervention, see Table S1.

2.5.2 | Control group: Conventional oral health education

The adolescents in the control group received information/instruction at one or several occasions as judged by the DH, that is, “business as usual”. No specific directives in regard to therapy were provided.

In both groups, follow-up evaluation was performed at 6 months.

2.6 | Study monitoring

Various strategies were implemented to secure study quality and treatment fidelity (Perepletchikova & Kazdin, 2005; Borrelli, 2011).

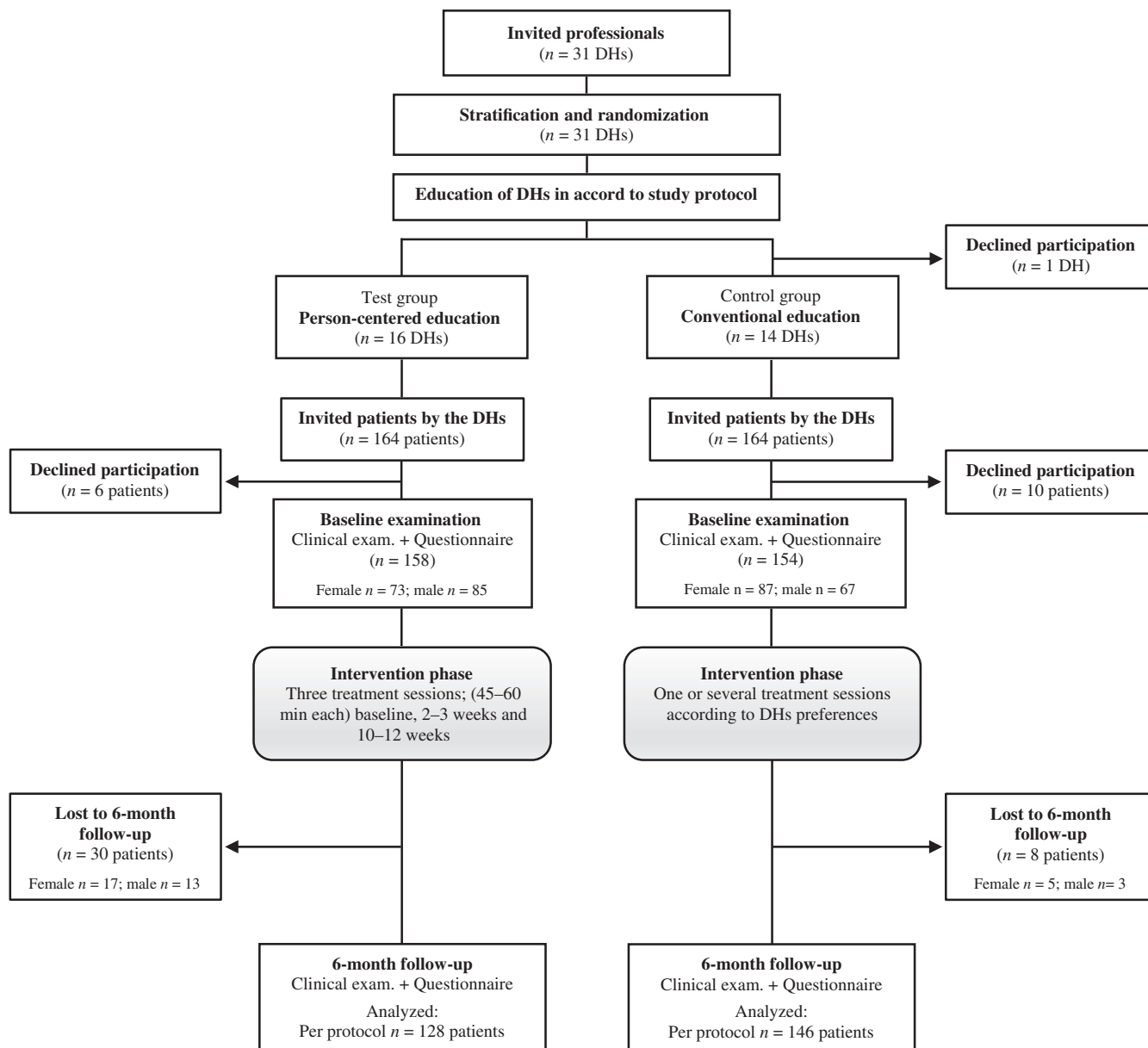


FIGURE 2 Study flow chart. Abbreviations: DH, dental hygienist; exam, examination

Regular site visits were carried out by a study monitor to ensure that the DHs followed study protocols and that, for example, clinical assessments were performed and recorded as intended. Time spent on behavioural intervention at each visit was noted by all the DHs.

Immediately after each session, the DHs treating the test group checked that the components of the intervention had been performed by using a checklist protocol. Reasons for any deviations were explained. Each DH was monitored at one intervention session by the study monitor (Sandra L. Dimenäs) and feedback was given immediately. If indicated, additional monitoring visits were scheduled to ensure a satisfactory implementation of the intervention.

2.7 | Statistical methods

All analyses were performed using the Statistical Package for Social Sciences for Mac version 27 (IBM Corporation, Armonk, NY), and findings were considered as statistically significant if $p < .05$.

Baseline characteristics are presented as numbers (n) and proportions stratified by treatment groups. Number of treatment sessions are presented as median (mean and standard deviation [SD]). Treatment time and time spent on daily oral hygiene are presented as mean (SD). Comparisons between groups at baseline and follow-up on MBI and PI are presented as means and mean changes with 95% confidence intervals (CI). All continuous variables were analysed with t -test (unpaired for comparison between groups and paired for

TABLE 2 Characteristics of the study sample at baseline

Variables	Test, n (%)	Control, n (%)	p Value
Gender			
Female	56 (43.7)	82 (56.2)	.040
Male	72 (56.3)	64 (43.8)	
Native country			
Sweden	107 (84.9)	120 (82.8)	.630
Other	19 (15.1)	25 (17.2)	
Occupation			
Studying	121 (95.3)	142 (97.9)	.222
Other	6 (4.7)	3 (2.1)	
Smoker			
No	118 (92.2)	130 (89.7)	.469
Yes	10 (7.8)	15 (10.3)	
Snuff user ^a			
No	122 (96.1)	134 (91.8)	.144
Yes	5 (3.9)	12 (8.2)	
Self-rated oral health			
Good	25 (19.7)	27 (18.5)	.594
Quite good	72 (56.7)	91 (62.3)	
Quite poor or poor	30 (23.6)	28 (19.2)	
Self-rated general health			
Good	59 (46.1)	75 (51.7)	.475
Quite good	63 (49.2)	61 (42.1)	
Quite poor or poor	6 (4.7)	9 (6.2)	
Regular medication			
No	97 (75.8)	118 (81.4)	.259
Yes	31 (24.2)	27 (18.6)	

Note: Person-centred oral health education programme (test) $n = 128$; conventional oral health education (control) $n = 146$. Percentage (%) represents the proportion of those who answered the item, and when numbers in columns do not equal n , there is internal loss in that variable. Between groups analyses with χ^2 test.

^aSwedish type, low-nitrosamine, smokeless tobacco.

within group analyses). Categorical variables were analysed with χ^2 test for comparison between groups. Cohen's d is presented to show a standardized effect size based on differences in mean changes between groups. A Cohen's d of 0.2 is considered as small, 0.5 as medium, and 0.8 as large effect (Cohen, 1988). In addition, a multiple linear regression analysis was performed to adjust for potential confounding factors associated with the primary clinical outcome (MBI) at 6 months.

In the current study, the main analyses were performed as per protocol (PP) including patients who followed treatment to the 6-month follow-up. To determine how the primary outcome (MBI) was affected if drop-outs were included in the analysis, missing values at 6 months were replaced by using the multiple imputation method (Jakobsen et al., 2017) and the result from the multiple imputation was applied in a sensitivity analysis (De Souza et al., 2016).

3 | RESULTS

A total of 312 patients (test = 158; control = 154) received treatment at the baseline appointment, of whom 274 (88%; test = 128; control = 146) followed treatment to the 6-month follow-up (analysed; see Figure 2). Baseline characteristics of the study sample are presented in Table 2.

A drop-out analysis showed that the 38 patients who were not included in the PP analysis were more likely to be smokers and snuff users but did not differ with regard to other baseline characteristics.

The median number of treatment sessions for the initial intervention phase, that is, 6-month examination excluded, was 3 (mean 2.9 and SD 0.3) for the test and 1 (mean 1.2 and SD 0.4) for the control group. Mean total time (minutes) used for the initial intervention was 123 (SD 20.7) and 41 (SD 10.3) for the test and control group, respectively.

3.1 | Clinical outcomes

Both groups showed significant improvements between baseline and the 6-month follow-up for all clinical parameters ($p < .001$), with significantly greater improvements in the test group than in the control group (Table 3).

At 6 months, 58% of the adolescents in the test group and 42% in the control group had an MBI score $\leq 20\%$, while 36% in the test and 17% in the control had a score $< 10\%$. An MBI score of $\geq 50\%$ at 6 months was assessed in 5% and 10% of the individuals in the test and control group, respectively. Furthermore, 33% of the participants in the test group and 22% in the control had a PI score $\leq 20\%$, while a PI score of $\geq 50\%$ was assessed in 20% and 37% in the test and control group, respectively, at 6 months.

The multiple model (adjusted for treatment group, MBI at baseline, gender, smoking, and native country) showed that treatment group and MBI at baseline were the only significant variables associated with MBI at 6 months (for details, see Table S2).

The sensitivity analysis, including all participants with baseline data, revealed a mean MBI score at 6 months of 20.3 (95% CI: 18.0 to 22.6) and 25.7 (95% CI: 22.8 to 28.5) for the test and control group, respectively. The mean change between baseline and 6 months was -19.2 (95% CI: -22.2 to -16.2) for the test and -12.0 (95% CI: -15.2 to -8.8) for the control group, with an effect size of 0.37 (95% CI: 0.14 to 0.59; $p = .001$).

3.2 | Oral hygiene behaviours

Frequency of toothbrushing and interdental cleaning are presented in Table 4. At 6 months, a significantly higher proportion of adolescents in the test group brushed their teeth twice daily and cleaned interdentally ≥ 3 times a week than participants in the control. At 6 months, a higher proportion of adolescents in the control group

TABLE 3 Bleeding (marginal bleeding index) and plaque index scores at baseline and 6 months and the mean change differences between baseline and 6 months

	Baseline		6 months		Change from baseline to 6 months	
	Mean % (95% CI)		Mean % (95% CI)		Mean % (95% CI)	Effect size Cohen's <i>d</i> (95% CI)
Bleeding score %						
All surfaces						
Test	39.4 (36.1 to 42.7)		19.7 (16.8 to 22.6)		-19.6 (-23.0 to -16.2)	0.43 (0.18 to 0.67)
Control	37.0 (33.6 to 40.4)		25.9 (22.9 to 28.9)		-11.2 (-14.5 to -7.8)	
<i>p</i> Value	.314		.004		<.001	
Proximal						
Test	50.4 (45.1 to 55.6)		23.8 (19.6 to 28.0)		-26.4 (-31.4 to -21.5)	0.47 (0.23 to 0.71)
Control	47.4 (43.1 to 51.6)		33.6 (29.6 to 37.6)		-13.8 (-18.1 to -9.6)	
<i>p</i> Value	.377		.001		<.001	
Plaque score %						
All surfaces						
Test	58.8 (55.0 to 62.5)		31.8 (27.8 to 35.7)		-27.0 (-31.2 to -22.9)	0.40 (0.16 to 0.64)
Control	61.5 (57.7 to 65.4)		43.2 (39.1 to 47.4)		-18.2 (-21.6 to -14.9)	
<i>p</i> Value	.315		<.001		.001	
Proximal						
Test	67.2 (62.2 to 72.1)		37.9 (32.5 to 43.2)		-29.3 (-34.6 to -23.9)	0.33 (0.09 to 0.57)
Control	72.3 (67.5 to 77.1)		52.0 (46.7 to 57.3)		-20.1 (-24.3 to -16.0)	
<i>p</i> Value	.143		<.001		.008	

Note: Person-centred oral health education programme (test) $n = 128$; conventional oral health education (control) $n = 146$. All values are presented as mean percentage (95% CI). Between groups analyses with unpaired *t*-test and standardized effect size based on differences in mean changes. Abbreviation: CI, confidence interval.

TABLE 4 Self-reported oral hygiene behaviour at baseline and 6 months

Variables	Baseline		<i>p</i> Value	6 months		<i>p</i> Value
	Test, <i>n</i> (%)	Control, <i>n</i> (%)		Test, <i>n</i> (%)	Control, <i>n</i> (%)	
Frequency of tooth brushing						
≥2 times a day	88 (68.8)	95 (65.5)	.540	99 (78.0)	90 (62.9)	.023
Once a day	25 (19.5)	36 (24.8)		15 (11.8)	32 (22.4)	
Less often	15 (11.7)	14 (9.7)		13 (10.2)	21 (14.7)	
Frequency of interdental cleaning						
≥3 times a week	13 (10.1)	15 (10.3)	.683	26 (20.6)	14 (9.8)	.010
1-2 times a week	34 (26.6)	32 (22.1)		43 (34.1)	41 (28.7)	
Less often or never	81 (63.3)	98 (67.6)		57 (45.3)	88 (61.5)	

Note: Person-centred oral health education programme (test) $n = 128$; conventional oral health education (control) $n = 146$. Percentage (%) represents the proportion of those who answered the item, and when numbers in columns do not equal n , there is internal loss in that variable. Analysed with χ^2 test for differences between test and control.

reported brushing their teeth less often than daily compared with baseline.

The mean time used for daily oral hygiene was 6.9 min (SD 5.3) at baseline and 7.6 min (SD 5.7) at 6 months for the test group. The corresponding value for the control group was 7.0 min at both time points (SD 5.4 and 6.7, respectively), with no statistically significant differences between the study groups.

4 | DISCUSSION

Both interventions resulted in improvements in bleeding and plaque scores, with significantly greater improvements for the test intervention (small to medium effect sizes). A significantly higher proportion of adolescents in the test group brushed their teeth twice daily and cleaned interdentally ≥3 times a week at 6 months compared with

participants in the control group. Hence, the hypothesis was confirmed.

Comparing our findings with those of previous studies is not straightforward because of the heterogeneity in study designs, for example, different age groups, study settings, and structure/components of the interventions. Nevertheless, Münster Halvari et al. (2012) found that an intervention based on self-determination theory, delivered by a DH, was more effective than conventional treatment in reducing gingivitis and plaque scores in university students (mean age 23 years). With respect to the limited number of studies on behavioural interventions directed towards adolescents by dental professionals, the findings could be compared to those of Jönsson et al. (2009), who included adult patients with periodontitis and tested a similar intervention. In that study, the patients receiving the test intervention showed significantly greater improvements in bleeding and plaque scores compared to those receiving conventional intervention. The findings from the current study are also in line with those from a systematic review by Newton and Asimakopoulou (2015) including studies on adults with periodontitis.

Findings from the current study showed that adolescents in the test group improved self-reported oral hygiene behaviours during the 6-month trial, while participants in the control group reported no improvements. Wide et al. (2018) tested an intervention carried out in PDS, Sweden, based on acceptance and commitment therapy (ACT) directed towards young adults with caries. The participants were randomized to ACT + standardized information or standardized information alone. The standardized information was delivered by a dental nurse. The ACT intervention included two individual sessions with a psychologist. At 3-week follow-up, significant positive changes in self-reported oral hygiene behaviours were shown in favour of the ACT group (Wide et al., 2018), but with no significant differences between the study groups after 4.5 months (Werner, 2021). Sixty-one percent of the participants in the ACT group brushed their teeth at least twice a day after 4.5 months compared to 78% in the current test group at 6 months. Comparisons between the studies should be done with caution considering different study designs with partly different behaviours in focus for the respective intervention. However, the results reported by Wide et al. (2018) and Werner (2021) rely on patients' self-reports. In the current study, both clinical and self-reported data supported the clinical significance of the behavioural intervention delivered by specially trained DHs.

The person-centred education programme is a "package" and therefore it is not possible to identify which of the components had the greatest impact on behavioural change. However, positive effects on self-reported oral hygiene behaviours have been demonstrated in several studies performed in school-based settings using goal setting, planning, and self-monitoring (Sniehotta et al., 2007; Schüz et al., 2009; Gholami et al., 2015; Schwarzer et al., 2015; Zhou et al., 2015), which also were components of the current intervention. The number of visits (three appointments) could also be a possible explanation for the effect of the test intervention. Surprisingly, most adolescents in the control group were offered only one appointment (baseline) without further follow-up until 6 months. The DHs in the

control group were encouraged to plan the treatment as "business as usual", and the results may thus reflect what adolescents with poor oral hygiene conditions usually are offered, or even more than usually offered considering a possible Hawthorn effect of the study. The number of sessions for educational intervention will be further considered in a health-economic perspective in future studies.

The study being performed in general dental care and integrated in the DHs' everyday treatment schedule is unique to and a strength of the study. Various strategies were implemented to secure study quality and treatment fidelity, and the findings are based on both clinical and patient-reported measures. The drop-out rate was low (12%) considering the study design and the number of patients and DHs involved. Drop-out rates of about 20%–22% were reported in other studies on health behavioural interventions including adolescents with a 6-month follow-up (Karlson & Rapoff, 2009; Džiaugytė et al., 2017). In the current study, however, a higher proportion of adolescents dropped out in the test group. A systematic review (Crutzen et al., 2015) on differential attrition in health behaviour change trials indicated a slightly higher attrition in the test intervention groups in comparison with control, but found no relationship between attrition rate and potential moderators, for example, the amount of human contact in delivery or intensity of the intervention (Crutzen et al., 2015). Still, in the current study the participation rate in both groups was high (81% and 95% in the test and control group, respectively). The sensitivity analysis revealed consistent findings with the PP analysis on the primary clinical outcome (MBI), indicating robust findings (De Souza et al., 2016) and that the differences between study groups could be attributed to the test intervention. The generalizability of the findings is high, considering that the study was conducted at 17 PDS clinics representing areas with different socio-demographic characteristics within VG, which is one of the largest regions in Sweden with both urban and rural areas and a total population of approximately 1.7 million inhabitants. The fact that a majority of Swedish adolescents are listed at the PDS and regularly recalled contributes to the generalizability of the results.

This study adds warranted knowledge on psychological/behavioural interventions directed towards young patients in general dental care. The study will likely contribute to the implementation of more effective behavioural interventions directed towards young patients in general dental care, provided that dental professionals are offered additional education and training in person-centred communication, health behavioural theories, and effective BCTs. Future research needs to address the long-standing effects and cost effectiveness of such behavioural interventions. Moreover, studies using a qualitative research approach could contribute to the understanding of how different components of such behavioural intervention programmes exert their effects and provide suggestions for improvements.

5 | CONCLUSION

A person-centred and theory-based oral health education programme is more effective than conventional oral health education in improving

adolescents' oral hygiene behaviour and periodontal infection control when delivered by DHs in general practice.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Sandra L. Dimenäs conducted this study as part of her PhD studies at the University of Gothenburg, Sweden. Kajsa H. Abrahamsson was the principal investigator of the study, which was designed in collaboration with Birgitta Jönsson, Jessica S. Andersson, Jesper Lundgren, and Prof. J.L. Wennström (deceased). Sandra L. Dimenäs and Jessica S. Andersson were actively engaged in study monitoring and data sampling procedures. The statistical analyses were mainly performed by Sandra L. Dimenäs, Kajsa H. Abrahamsson, and Birgitta Jönsson. Max Petzold contributed with specific statistical expertise. All authors contributed to the analytical interpretation of data and with critical comments and review of the manuscript in preparation, and all authors reviewed and approved the final manuscript.








DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Ethical approval was obtained from the Regional Ethical Review Board, Gothenburg, Sweden (Dnr:284-15). All patients gave a written informed consent before entering the study.

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