

Behavioral Intervention for Improved Oral Hygiene in Adolescents

A Person-Centered and Theory-Based Approach

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“I know how to keep my mouth healthy.

The problem is that I don’t do it.”

*Comment by a 17-year-old, captured in the
questionnaire used in the clinical field study*

To Håkan, Carl & Alva with love and gratitude.

You are my everything.

Abstract

To educate and enhance patients' motivation for adequate oral hygiene, that is self-performed periodontal infection control, is essential in the prevention of periodontal disease. Surveys have shown poor oral hygiene conditions among Swedish adolescents, indicating a need for more effective educational/behavioral interventions. The overall aim was to contribute to the development of efficient educational interventions, directed at adolescents, to improve oral hygiene behavior and promote periodontal health.

Studies I & II were based on a randomized field study on the effectiveness of a person-centered, theory-based, behavioral intervention (test) for improved oral hygiene, compared with conventional information/instruction (control). The field study involved 312 adolescents and 30 dental hygienists (DHs). **Study I** included 274 adolescents treated per protocol and with clinical data from baseline and 6 months. Bleeding and plaque scores improved in both groups, with greater improvements in the test group. At 6 months, adolescents in the test group used oral hygiene aids more frequently compared with the control group. **Study II** included 276 adolescents treated per protocol and with questionnaire data from baseline and 6 months. The test group was more satisfied with the education provided and the communication with the DH during therapy, compared with the control group. In addition, the test group reported to a larger extent that they were much more careful regarding their oral hygiene habits after treatment and had higher confidence about keeping up healthy gingival conditions.

Studies III & IV were qualitative interview studies. **Study III** included 19 adolescents treated in accordance with the test intervention. They experienced the intervention towards improved oral hygiene behavior as a challenging journey and highlighted the importance of a person-centered approach in treatment. Personal insight about the importance of improved oral hygiene was fundamental for behavioral change. Planning and monitoring of behavior, with guidance and support, facilitated behavioral change and encouraged continued efforts. Still, they expressed a need of reminders and support to keep up oral hygiene routines over time. **Study IV** included 13 DHs who had worked in accordance with the test intervention. They experienced a changed professional approach, going from experts to encouraging partnership, which was considered challenging but more enjoyable. Prerequisites for implementing such an intervention in daily practice were adequate knowledge and skills, own interest and willingness for a change and a supportive work environment. The expenditure of time in relation to economic demands were seen as main barriers.

In conclusion, the findings suggest that a person-centered, theory-based, behavioral intervention is more beneficial for the adolescent patient compared with conventional information/instruction. The findings contribute to further development of such a person-centered, theory-based, approach, and provide an understanding of the prerequisites and barriers on a professional and organizational level to consider for implementation in daily practice.

Keywords: adolescent, behavioral intervention, dental hygienist, gingivitis, health education, oral hygiene, person-centered, prevention, qualitative interview

Sammanfattning

Att utbilda och stärka patienters motivation till adekvat munhygien, det vill säga att själv bidra till parodontal infektionskontroll, är av central betydelse för att förebygga parodontal sjukdomsutveckling. Studier har dock visat att svenska ungdomar har bristande munhygien vilket tyder på ett behov av mer effektiva undervisnings/beteendeinterventioner. Det övergripande syftet var att generera kunskap för utveckling av effektiva interventioner för att öka ungdomars motivation till adekvat munhygienbeteende och därmed främja parodontal hälsa.

Studie I & II baseras på en randomiserad fältstudie som testade effekten av en personcentrerad och teoribaserad beteendeintervention (test) för förbättrad munhygien, i jämförelse med konventionell information/instruktion (kontroll). Fältstudien involverade 312 ungdomar och 30 tandhygienister (TH). **Studie I** inkluderade 274 ungdomar behandlade enligt protokoll och med kliniska data vid baseline och 6 månader. Båda grupperna förbättrade sina blödnings- och plackvärden till 6 månader, men testgruppen förbättrades mer. Vid 6 månader så använde ungdomarna i testgruppen munhygienhjälpmedel mer frekvent än kontrollgruppen. **Studie II** inkluderade 276 ungdomar behandlade enligt protokoll och med enkätdata vid baseline och 6 månader. Testgruppen var mer nöjda med den utbildningen de fått och kommunikationen med TH under behandlingen i jämförelse med kontrollgruppen. En högre andel i testgruppen rapporterade också att de var mycket mer noggranna med sina munhygienvanor efter behandlingen och hade högre tilltro till att kunna bibehålla friska parodontala förhållanden.

Studie III & IV var kvalitativa intervjustudier. **Studie III** inkluderade 19 ungdomar som behandlats i enlighet med testinterventionen. De hade upplevt interventionen mot förbättrat munhygienbeteende som en utmanande resa och belyste betydelsen av ett personcentrerat förhållningssätt i behandlingen. Personlig insikt om vikten av förbättrad munhygien hade lagt grunden till en beteendeförändring. Att planera och själv monitorera sitt munhygienbeteende, med guidning och stöd, hade underlättat beteendeförändringen och uppmuntrat till fortsatta ansträngningar. För att kunna bibehålla munhygienvanorna över tid framfördes dock ett behov av påminnelser och fortsatt stöd. **Studie IV** inkluderade 13 TH som hade arbetat i enlighet med testinterventionen. De hade upplevt ett förändrat professionellt förhållningssätt, från att vara experter till att uppmuntra partnerskap i behandlingen, vilket ansågs utmanande men roligare. Tillräcklig kunskap och färdigheter, eget intresse och vilja till förändring samt en stödjande arbetsmiljö beskrevs som förutsättningar för att implementera en sådan intervention i det dagliga arbetet, medan tidsåtgången i förhållande till ekonomiska krav ansågs vara hinder.

Sammanfattningsvis, resultaten tyder på att en personcentrerad och teoribaserad beteendeintervention är mer fördelaktig för den unga patienten jämfört med konventionell information/instruktion. Resultaten bidrar också med kunskap för vidareutveckling av ett sådant personcentrerat och teoribaserat förhållningssätt, samt förståelse avseende professionella och organisatoriska förutsättningar och hinder att beakta för implementering i daglig praxis.

List of Papers

This thesis is based on the following studies, referred to in the text by their Roman numerals.

- I. Dimenäs SL, Jönsson B, Andersson JS, Lundgren J, Petzold M, Abrahamsson I & Abrahamsson KH. (2022). A person-centred, theory-based, behavioural intervention programme for improved oral hygiene in adolescents: A randomized clinical field study. *Journal of Clinical Periodontology*, 49, 378-387.
- II. Dimenäs SL, Andersson JS, Jönsson B, Lundgren J, Petzold M, Östberg A-L & Abrahamsson KH. (2024). Adolescents' self-reported experiences following a person-centred, theory-based educational intervention versus conventional education for improved oral hygiene: Analysis of secondary outcomes of a randomized field study. *Journal of Clinical Periodontology*, 51, 63-73.
- III. Dimenäs SL, Östberg A-L, Lundin M, Lundgren J & Abrahamsson KH. (2022). Adolescents' experiences of a theory-based behavioural intervention for improved oral hygiene: A qualitative interview study. *International Journal of Dental Hygiene*, 20, 609-619.
- IV. Dimenäs SL, Jönsson B, Lundin M, Lundgren J & Abrahamsson KH. Changing from disease-centered to person-centered - Swedish dental hygienists' views on a theory-based behavioral intervention for improved oral hygiene among adolescents. *Submitted for publication*.

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Abbreviations

| | |
|-------|---|
| BCT | Behavioral Change Technique |
| CI | Confidence Interval |
| DH | Dental Hygienist |
| MBI | Marginal Bleeding Index |
| MI | Motivational Interviewing |
| PI | Plaque Index |
| RCT | Randomized Controlled Trial |
| SCT | Social Cognitive Theory |
| SD | Standard Deviation |
| SKaPa | The Swedish Quality Registry for Caries and Periodontal Disease/Svenskt Kvalitetsregister för Karies och Parodontit |

Preamble

Adequate oral hygiene behavior is fundamental for the prevention of periodontal disease. However, as a dental hygienist (DH) in the Public Dental Service, I frequently met adolescents with inadequate oral hygiene, despite having received repeated disease information and instruction in the use of oral hygiene aids. This left me wondering why preventive efforts often seem to fail in promoting desirable oral health behavior in adolescents. Personally, I also felt frustrated about not being able to enhance adolescents' motivation for such beneficial behavior. I therefore sought additional knowledge to improve my skills in health communication and to learn about effective strategies for promoting behavioral change. This led me to a course in health psychology and theory-based behavioral interventions and later, to my participation in the research project on which this thesis is based. Accordingly, the focus of this thesis is on the evaluation of an intervention based on theory of health behavior, compared with conventional information/instruction, for improved oral hygiene in adolescents treated by DHs in general dental care.

Introduction

Adolescence

According to the Swedish Medical Subject Headings, an adolescent is defined as a person 13 to 18 years of age (Karolinska Institute, 2024). However, adolescence encompasses more than an age range. It is a transition from childhood to adulthood including not only physical changes due to puberty but also psychological/cognitive development of abstract thinking and personal identity, as well as social development including more prominent relationships with peers than with family. In addition, adolescents develop a desire to have control of their lives and autonomy (Christie & Viner, 2005; Crosby et al., 2009). During this transition, health professionals can be challenged when health responsibility is transferred from parent to adolescent (Christie & Viner, 2005). Yeager et al. (2018) argued that adolescents are sensitive to whether they are being treated with respect and accorded status. Hence, when adolescents are treated as competent and having autonomy, they can make choices that benefit their long-term health while feeling respected and having high status in the short term (Yeager et al., 2018).

Free-of-Charge Dental Care and The Swedish Dental Care Act

In Sweden, young individuals are provided with regular and free-of-charge dental care up to and including the age of 23 (SFS 1985:125). The Swedish Dental Care Act (SFS 1985:125) emphasizes that dental care should be based on respect for the patient's autonomy and integrity as well as promote an alliance between the patient and the dental professional.

Oral Health and Disease

According to the biomedical model, good health has traditionally been considered as absence of disease, as judged by health professionals. This model has, however, been criticized as being too limited. The biopsychosocial model describes health and disease in a broader sense, thus aiming at integrating biological, psychological and environmental (social) factors to explain health and disease (Duggan & Street Jr, 2015; Glick et al., 2016; Johnsen et al., 2022; Ogden, 2019).

The most recent definition of oral health, developed by the FDI World Dental Federation, is based on a holistic perspective emphasizing the multifaced nature of oral health (Glick et al., 2016). According to this definition, a person should be able to perform essential functions such as speaking, smiling and chewing without pain or disease and without feeling uncomfortable when interacting in social situations (Glick et al., 2016; WHO, 2023). Consequently, a person's oral health is not only judged by the dental professional but is also defined by the individuals themselves. Oral health is recognized as an essential component of overall health and well-being (Glick et al., 2016; WHO, 2023).

Oral diseases are, however, prevalent and affect about 3.5 billion people worldwide. Globally, caries and periodontitis are the most common oral diseases, with caries being the most frequent (Kassebaum et al., 2017; Wen et al., 2022; WHO, 2023). Caries and periodontitis have been linked to other non-communicable diseases such as cardiovascular disease and diabetes, with which they share common determinants and risk factors. Non-communicable diseases, including caries and periodontitis, are largely preventable. Thus, effective strategies to promote behavioral change have been highlighted as an important part of improving oral as well as general health (Wolf et al., 2021).

Watt et al. (2020) highlight key messages from *The Lancet* Oral Health Series, emphasizing the necessity for radical reform of dental care. This

involves moving from a treatment-dominated approach to preventive strategies and interventions to address the burden of oral diseases. Watt et al. (2020) also suggested implications for dental research, including working across disciplines to explore the interconnected pathways that link e.g. environmental, behavioral, psychological and biological factors to disease processes and outcomes. In addition, conducting research where dental care is provided was encouraged to ensure relevance and applicability.

Gingivitis and Periodontitis

Gingivitis is a reversible inflammatory condition of the marginal soft tissues surrounding teeth (gingiva). It is caused by biofilm (dental plaque) located on the tooth surface and characterized clinically by swelling, redness and bleeding on gentle probing. Hence, non-disrupted dental plaque becomes dysbiotic and initiates soft tissue inflammation (Løe et al., 1965; Tonetti et al., 2015).

If left untreated, gingivitis may progress over time to periodontitis. Periodontitis is characterized by tissue inflammation and destruction of tooth-supporting structures, which could lead to tooth loss, impacting both oral and general health (Ferreira et al., 2017; Papapanou et al., 2018). Severe/advanced periodontitis is the sixth most prevalent disease in humans affecting about 11% worldwide (Kassebaum et al., 2014). In Sweden, the prevalence of periodontitis is about 40% among adults, whereas about 10% having a more severe/advanced form of the disease (SBU, 2004; SKaPa, 2023; Wahlin et al., 2018). The prevalence of periodontitis increases with age (SKaPa, 2023; Wahlin et al., 2018). Thus, periodontitis constitutes a major public health problem (Papapanou et al., 2018; Tonetti et al., 2015). The disease does not only affect the individual but also society, given the considerable costs of treatment and subsequent rehabilitation (Bishop, 2021; Dumitrescu, 2016).

The onset of periodontitis rarely occurs before 20 years of age (Thorbert-Mros et al., 2017), and the incidence of the more severe/advanced form of the

disease has been shown to peak in the late thirties (Kassebaum et al., 2014). Gingival inflammation/bleeding is a key risk factor for the onset and progression of periodontitis. Hence, the management of gingivitis is a primary prevention strategy for periodontitis (Chapple et al., 2015; Tonetti et al., 2015).

Periodontal Health in Swedish Adolescents

Surveys have shown high levels of plaque and gingivitis in Swedish adolescents (Abrahamsson et al., 2006; Ericsson et al., 2009; Hugoson et al., 1998; Wahlin et al., 2018). The epidemiological surveys by Abrahamsson et al. (2006) and Ericsson et al. (2009) revealed that 40-60% of 19-year-olds, living in different parts of Region Västra Götaland, had gingivitis at $\geq 50\%$ of tooth surfaces. A more recent publication by Wahlin et al. (2018), based on a series of cross-sectional surveys of the Jönköping population, showed a significant increase in periodontal pockets ≥ 4 mm between 2003 and 2013 among 20-year-olds, explained by an increasing prevalence of gingivitis. The authors concluded that periodontal health had improved in the adult population, except in the 20-year age group (Wahlin et al., 2018). These somewhat alarming findings are further supported by the Swedish Quality Registry for Caries and Periodontal Disease (SKaPa, 2023), indicating that the extent and severity of periodontal disease have increased between 2012 and 2022, particularly among young adults.

Despite the results indicating poor oral hygiene conditions among Swedish adolescents/young adults, approximately 90% reported that they considered their oral health to be very good/good (SKaPa, 2023). This could indicate a lack of awareness among young people about their periodontal health condition. Such potential unawareness was also indicated in the epidemiological study by Ericsson et al. (2012), where 89% of the adolescents considered their knowledge of gum diseases as insufficient (quite poor/poor).

In addition, 55% in a subgroup with high levels of gingivitis ($\geq 80\%$) reported that their gums seldom/never bled when brushing (Ericsson et al., 2012).

The results of previous studies are noteworthy, considering that the dental care provided to Swedish children and adolescents should focus on oral health promotion and prevention of oral diseases (National Board of Health and Welfare, 2011, 2022; SFS 1985:125). This indicates a need for oral health educational interventions that are more beneficial to the young individual. In addition, a recently published retrospective registry-based cohort study (Trullenque-Eriksson et al., 2023) found that probing pocket depth ≥ 4 mm at the age of 19 was associated with the onset of periodontitis in young adulthood. Hence, it is important to promote periodontal health early in life.

Prevention by Periodontal Infection Control

Periodontal infection control refers to the reduction of the bacterial load below an individual's threshold for disease, thus resulting in resolution of inflammation in soft tissues (Tomasi & Wennström, 2009). Self-performed periodontal infection control by means of adequate oral hygiene is essential in the prevention and treatment of periodontal disease (Axelsson & Lindhe, 1981; Chapple et al., 2015; Tonetti et al., 2015; Wennström et al., 2005).

Swedish surveys reveal that about 80-90% of adolescents reported brushing their teeth at least twice a day but very few use interdental cleaning aids (Abrahamsson et al., 2006; Ericsson et al., 2009; Norderyd et al., 2015). However, the frequency of using different oral hygiene aids is not equal to sufficient oral hygiene. The patient also needs accurate skills (dexterity) to handle the oral hygiene aids in question (Claydon, 2008).

The Swedish National Guidelines for Dental Care (National Board of Health and Welfare, 2022) highlight the importance of measures to promote patient participation in periodontal treatment to reach the desired results. Accordingly, great focus should be placed on behavioral intervention for

adequate oral hygiene, i.e. self-performed periodontal infection control. Still, promoting such desirable behavior has been described as a major challenge by dental professionals (Forbes et al., 2015; Liss et al., 2020; Stenman et al., 2010). Moreover, as dental professionals, we cannot simply provide the patient with such beneficial behavior. So, how can we promote a desirable behavioral change and can we learn from other areas outside dentistry?

Psychosocial Factors Associated with Oral Hygiene Behaviors and Conditions

Previous studies have emphasized a variety of personal and psychosocial factors associated with oral hygiene behaviors and periodontal conditions in young individuals. Thus, studies have shown that e.g. gender, living area, upper secondary school program, tobacco habits and physical activity interact with oral hygiene behaviors and periodontal conditions among adolescents and young adults (Diamanti et al., 2021; Dorri et al., 2010; Ericsson et al., 2009; Ericsson et al., 2016; Virtanen et al., 2019; Östberg et al., 2010). Furthermore, a recently published study by Trullenque-Eriksson et al. (2023) found that smoking, in addition to increased probing pocket depth, at the age of 19 was associated with the onset of periodontitis in young adulthood. Oral health perceptions and attitudes (Broadbent et al., 2006; Diamanti et al., 2021; Ericsson et al., 2012; Tolvanen et al., 2012) as well as self-efficacy beliefs (e.g. confidence in the ability to perform a behavior) (Dolatabadi et al., 2022; Ericsson et al., 2016; Hamilton et al., 2017; Mizutani et al., 2012; Zhou et al., 2015) have also shown to be associated with oral hygiene behaviors and periodontal conditions in young individuals. Moreover, perceived support by peers and family has been associated with oral hygiene behaviors among young individuals (Dorri et al., 2010; Gazzaz et al., 2021).

Such personal and psychosocial factors need to be recognized by dental professionals meeting young individuals and underscore the importance of a biopsychosocial perspective in dental care.

Health Education and Theory of Health Behavior

Health behavior is any activity with the purpose of promoting health and well-being and preventing disease (Conner & Norman, 2015; Nutbeam & Muscat, 2021). Individuals can thus affect their own health by avoiding health-compromising behaviors, like smoking, and adopting health-enhancing behaviors, like exercising (Conner & Norman, 2015). Consequently, behavioral change is sometimes needed to promote health and prevent disease (Nutbeam & Muscat, 2021).

Health education has a long history as a fundamental tool in the promotion of health and prevention of disease. A goal of health education is to improve an individual's health literacy, thereby being better equipped to make positive health behavioral choices (Nutbeam, 2000; Nutbeam & Muscat, 2021). The term health literacy refers to personal knowledge and competencies to access, understand and use information to promote health and prevent disease (Nutbeam & Muscat, 2021).

Traditional Strategies in (Oral) Health Education

Traditionally, (oral) health education has been provided as information and advice, focusing on the assumption that an increased quantity of knowledge automatically leads to behavioral change. This supports a perspective where the health professional is the expert and the patient a passive recipient, rather than an active partner, in treatment (Freeman, 1999; Naidoo & Wills, 2016; Ogden, 2019).

In periodontal care, health/patient education has traditionally been described as information about the etiology of the disease, instruction of oral

hygiene aids and skills training to influence oral hygiene behaviors (Rylander & Lindhe, 2003). Such a conventional educational approach can result in improved oral hygiene and gingival health in the short term, but the long-lasting effects are questionable as there is a lack of long-term studies (Watt & Marinho, 2005). In addition, a review by Brukiene & Aleksejuniene (2009) investigated the effect of different strategies to promote oral health in adolescents. Most of the included studies were based on a traditional educational approach (information/instruction) and reported only short-term and varying effects on plaque and gingival health with a tendency to relapse over time. The authors highlighted the need for further research to evaluate educational approaches, including approaches based on psychological theories relating to human behavior.

Health Education Guided by Theory of Health Behavior

It has been claimed that a health educational intervention is more beneficial to the individual if guided by a health behavior theoretical framework (Glanz et al., 2015a; Ogden, 2019). Theories of health behavior contain constructs that can explain and predict behavior and suggest ways of achieving behavioral change (Glanz et al., 2015b). In addition, interventions guided by such a theoretical framework acknowledge the individual's personal cognitions and socioenvironmental context when providing health education (Jönsson & Abrahamsson, 2020).

Social Cognitive Theory (SCT) is one of the most common theories guiding behavioral change interventions (Davis et al., 2015). This theory proposes that behavior, personal cognitive and socioenvironmental factors interact and, thus, that a person's behavior and cognitions are shaped by the people with whom they interact (Figure 1) (Bandura, 1986, 2004; Kelder et al., 2015). Bandura (2004) emphasizes core constructs, or determinants, in SCT, i.e. knowledge of health risks and benefits of health behaviors, self-efficacy, outcome

expectations, personal goals and plans for realizing them as well as facilitators and barriers to change.

Self-Efficacy

Self-efficacy, a fundamental construct in SCT, is considered as the foundation of human motivation and action. It reflects the confidence to handle a specific behavior and belief in the ability to produce desired outcomes by own action (Bandura, 2004). Self-efficacy can be influenced by e.g. the individual's own performance, vicarious experiences (others' performance) and persuasion (verbal encouragement from others). Perceived success with own performance can increase self-efficacy, while failure can decrease self-efficacy (Bandura, 1977). Self-efficacy can affect behavior directly and indirectly through other constructs in SCT. Hence, individuals with high self-efficacy usually set higher goals and stay committed to them to a greater extent than people with low self-efficacy. In addition, high self-efficacy is suggested to influence individuals to expect favorable outcomes and to keep going in the face of obstacles (Bandura, 1977, 2004).

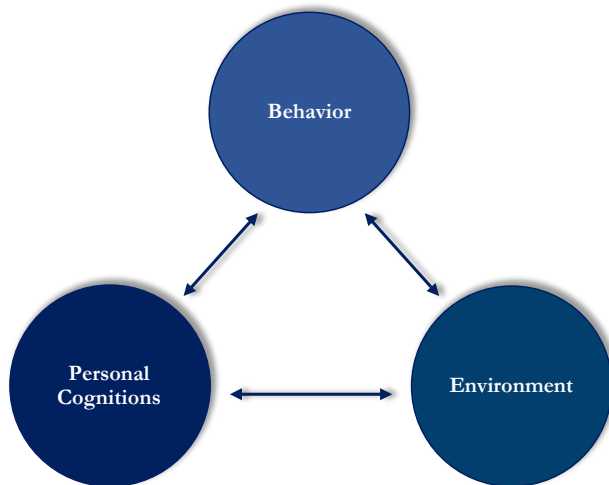


Figure 1. According to Bandura's model of Social Cognitive Theory (1986), health behavior, personal cognitive and socioenvironmental factors all interact and influence each other.

Behavioral Change Techniques

There are many theories to choose from when designing theory-based behavioral interventions and the constructs included in theories are often similar and overlapping (Bandura, 2004; Glanz et al., 2015b). The use of different theories in behavioral change interventions creates a diversity that makes it difficult to compare studies, to evaluate the results and synthesize the evidence (Davis et al., 2015; Michie, 2008). To make the application of theory in clinical practice less complex and to facilitate evaluation, reporting and replication of interventions, it has been suggested to focus on key constructs of theories and practical means, i.e. behavioral change techniques (BCTs), to influence those constructs (Michie et al., 2009; Michie et al., 2005). Michie et al. (2013) developed a taxonomy of BCTs for consensus in the reporting of behavioral change interventions. Examples of BCTs are goal setting, planning and self-monitoring (Michie et al., 2014; Michie et al., 2013).

Goal Setting

Personal goals enhance motivation to engage in a behavior (Bandura, 2004; Latham & Locke, 2007). Long-term goals set the course of behavioral change but may not necessarily influence current behavior. Hence, short-term goals that are considered more attainable encourage and guide efforts in the present. Goals are a way of realizing intentions to achieve behavioral change. However, goals that are set without knowledge of how to reach them could deter the motivational effect (Bandura, 2004).

Action and Coping Planning

An action plan for when, where and how to reach an intended goal enhances the intention to succeed and coping planning implies reflecting upon potential barriers to carry out the behavior in question and how to overcome such

barriers. Planning is considered as the bridge between the intention/goal and health behavior (Gollwitzer, 1999; Sniehotta et al., 2005).

Goal setting, action and coping planning belong to the domain “Goals and planning” according to the BCT taxonomy (Michie et al., 2013).

Self-Monitoring

To observe own performance is a way of influencing motivation and action to achieve goals. To acknowledge success could lead to the next step of setting more challenging goals and a new behavior is more likely to be maintained since attaining goals strengthens self-efficacy (Bandura, 1977, 1991). In addition, self-monitoring provides the opportunity to see how behavior may be connected to socioenvironmental influences and situations, e.g. when a behavior is successfully performed or not (Bandura, 1991).

Self-monitoring of behavior is included in the domain “Feedback and monitoring” according to the BCT taxonomy (Michie et al., 2013).

Theory-Based Behavioral Interventions in Dental Care

Tentative evidence suggests that theory-based behavioral interventions can improve oral hygiene behaviors and conditions. Hence, the results of systematic reviews indicate that interventions based on social cognitive constructs and with dental professionals using a communicative approach, like motivational interviewing (MI), can strengthen adherence to beneficial oral hygiene behavior in adult patients with periodontal disease (Carra et al., 2020; Newton & Asimakopoulou, 2015; Vilar Doceda et al., 2023; Werner et al., 2016). In addition, interventions incorporating goal setting, planning and self-monitoring of behavior have shown to be effective (Newton & Asimakopoulou, 2015; Vilar Doceda et al., 2023). However, the systematic reviews highlight difficulties in comparing included original studies due to the heterogeneity in design, e.g. the different theoretical frameworks and

components, duration/intensity, follow-up time, outcome measures and different health professionals performing the interventions. Furthermore, the need to evaluate theory-based interventions to improve oral health behavior in other patient and age groups, beyond adults with periodontal disease, has been emphasized (Werner et al., 2016). Moreover, there is a need to evaluate such interventions performed in general dental settings, i.e. effectiveness studies (National Board of Health and Welfare, 2011, 2022; SBU, 2004). Table 1 gives an overview of publications evaluating theory-based behavioral interventions directed at adults with periodontal disease.

A recent systematic review by Xiang et al. (2021) focused on the application of theory-guided oral health interventions in adolescents. Ten randomized controlled trials (RCTs) were identified as eligible for inclusion and most interventions were performed in a school-based setting and sometimes not delivered by dental professionals. Overall, the heterogeneity across studies was evident in terms of design, theoretical constructs and components of the intervention, duration/intensity etc. The cautious conclusions drawn by the authors was that theory-guided interventions for improving oral hygiene status among adolescents appear to be more effective in the long term than traditional interventions. However, the authors also emphasized that further studies are required to support the implementation of such theory-based approaches in the clinical setting (Xiang et al., 2021). For an overview of studies evaluating theory-based behavioral interventions directed at adolescents/young adults in dental settings, see Table 2.

Table 1. Overview of publications evaluating theory-based behavioral interventions directed at adults with periodontal disease. The publications presented have a follow-up time of at least 3 months.

| Authors & Aim | Study population & Follow-up | Design & Methods | Findings & Authors' conclusion |
|--|--|---|--|
| <p>Tedesco et al. (1992)</p> <p>To test the influence of cognitive restructuring on oral health behaviors.</p> | <p>Patients (21-65 years) with gingivitis ($\geq 55\%$ bleeding sites).</p> <p>Allocated study sample, n=167.</p> <p>Follow-up at 3 and 9 months.</p> | <p>RCT. Interventions delivered by DH.</p> <p>4 intervention visits for both groups.</p> <p>Test Based on social cognitive theory and theory of reasoned action. Information/instruction. Prophylaxis. Analysis of self-efficacy for oral hygiene behavior. Visualization of own subgingival flora on video monitor (before/after prophylaxis). Continuous visualization of subgingival flora to emphasize accomplishment.</p> <p>Control Information/instruction. Prophylaxis. Feedback on performance of oral hygiene procedures.</p> <p>Per protocol analyses.</p> | <p><u>Clinical outcomes</u> Bleeding (Marginal) No significant differences at any time point.</p> <p>Plaque No significant differences at any time point.</p> <p><u>Self-reported outcomes</u> Brushing & Interdental cleaning No significant differences at any time point.</p> <p>Intention, attitude, norms and beliefs about oral hygiene behaviors No significant differences at any time point.</p> <p>Self-efficacy (confidence in ability to perform oral health behaviors) No significant differences at any time point.</p> <p>Although a trend towards significant differences between groups emerged favoring the test intervention, which was deemed as producing a delayed relapse, the study did not show significant differences between groups regarding clinical or self-reported outcomes.</p> |
| <p>Little et al. (1997)</p> <p>To assess the effect of a group-based behavior intervention on oral hygiene skills, adherence and clinical outcomes for older patients with periodontal disease.</p> | <p>Patients (50-70 years) with periodontitis (mild/moderate).</p> <p>Allocated study sample, n=107.</p> <p>Follow-up at 4 months.</p> | <p>RCT. Interventions delivered by DHs.</p> <p>Test Based on social learning and self-management principles. 5 weekly oral hygiene classes (90 min; 7-10 patients) at dental clinics as an adjunct to periodontal maintenance care. Individualized instruction and skills training. Personal goal setting, action plan, self-monitoring and feedback.</p> <p>Control Periodontal maintenance care (prophylaxis, information/instruction).</p> <p>Per protocol analyses.</p> | <p><u>Clinical outcomes</u> Bleeding (Marginal & BoP) Significantly greater improvements in the test group.</p> <p>Plaque Significantly greater improvements in the test group.</p> <p>PPD No significant differences (all sites). Significantly greater improvements for pockets 3-6 mm in the test group.</p> <p><u>Self-reported outcomes</u> Brushing & Interdental cleaning Significantly higher frequencies in the test group.</p> <p>Group oral health interventions, based on behavioral change principles, provide an effective means for improved adherence to self-care regimen.</p> |

| Authors & Aim | Study population & Follow-up | Design & Methods | Findings & Authors' conclusion |
|---|--|--|---|
| <p>Jönsson et al. (2009)</p> <p>To evaluate the effectiveness of an individually tailored oral health educational program in patients with periodontitis compared with standard treatment.</p> | <p>Patients with periodontitis.</p> <p>Allocated study sample, n=113.</p> <p>Follow-up at 3 and 12 months.</p> | <p>RCT. Interventions delivered by DHs.</p> <p>Both groups received integrated non-surgical instrumentation. The number of sessions was planned to vary between four and six (individualized).</p> <p>Test Based on social cognitive constructs. Motivational interviewing as communicative approach. Analysis of knowledge, expectations and motivation. Tailored information. Individual long-term goals. Disclosing of plaque and discussion about oral hygiene aids. Practice of manual dexterity. Individual goals for oral hygiene behavior. Exploration of self-efficacy and readiness to change. Action plan. Self-monitoring (diary). Generalization of behaviors.</p> <p>Control Information/instruction and skills training.</p> <p>ITT analyses for clinical outcomes and self-reported oral hygiene behavior.</p> <p>Other variables evaluated at 12 months with per protocol analyses.</p> | <p><u>Clinical outcomes</u> Bleeding (Marginal) Significantly lower scores and greater improvements in the test group at both time points.</p> <p>Plaque Significantly lower scores and greater improvements in the test group at both time points.</p> <p><u>Self-reported outcomes</u> Brushing No significant differences at any time point.</p> <p>Interdental cleaning No significant differences at 3 months. At 12 months, a significantly higher proportion reported daily interdental cleaning in the test group.</p> <p>Performance of oral self-care A significantly higher proportion reported more positive performance in the test group at 12 months.</p> <p>Compliance with skills obtained during treatment A significantly higher proportion reported daily compliance in the test group at 12 months.</p> <p>Likelihood to maintain new habits A significantly higher proportion reported likelihood to maintain new habits in the test group at 12 months.</p> <p>Satisfaction with care No significant difference at 12 months.</p> <p>An individually tailored oral health educational program, based on social cognitive constructs, is more effective than standard treatment for achieving beneficial long-term oral hygiene behavior and clinical outcomes.</p> |
| <p>Jönsson et al. (2010)</p> <p>To evaluate an individually tailored oral health educational program on periodontal health compared to standard treatment.</p> | <p>See Jönsson et al. (2009).</p> | <p>See Jönsson et al. (2009). ITT analyses.</p> | <p><u>Clinical outcomes</u> Bleeding (BoP) Significantly lower scores in the test group at both time points.</p> <p>PPD No significant differences at any time point.</p> <p>Pocket closure† No significant differences at any time point.</p> |

| Authors & Aim | Study population & Follow-up | Design & Methods | Findings & Authors' conclusion |
|--|---|--|--|
| <p>Stenman et al. (2012)</p> <p>To evaluate the effect of a single session of MI on self-performed periodontal infection control.</p> | <p>Patients with periodontitis.</p> <p>Allocated study sample, n=44.</p> <p>Follow-up at 6 months.</p> | <p>RCT. MI session conducted by a psychologist and conventional treatment conducted by DHs.</p> <p>Test</p> <p>A single MI session before initiation of conventional periodontal treatment (see control).</p> <p>Control</p> <p>Conventional information/instruction and non-surgical periodontal treatment.</p> <p>ITT analyses.</p> | <p>Treatment success[‡] (evaluated at 12 months)</p> <p>A significantly higher proportion reached success in the test group.</p> <p>An individually tailored oral health educational program in combination with scaling is preferable to standard treatment in non-surgical periodontal treatment.</p> |
| <p>Brand et al. (2013)</p> <p>To evaluate whether the use of brief MI is effective in improving motivation for oral hygiene behavior.</p> | <p>Patients in periodontal maintenance care with $\geq 40\%$ BoP or at least two teeth with PPD ≥ 5 mm.</p> <p>Allocated study sample, n=56.</p> <p>Follow-up at 3 months.</p> | <p>RCT. MI session conducted by trained counsellor (not dental professional). Oral health education (information/instruction) delivered by DH.</p> <p>Test</p> <p>A single MI session in addition to traditional oral health education (see control).</p> <p>Control</p> <p>Information/instruction.</p> <p>Per protocol analyses.</p> | <p><u>Clinical outcomes</u></p> <p>Bleeding (BoP)</p> <p>No significant differences.</p> <p>Plaque</p> <p>No significant differences.</p> <p>PPD</p> <p>No significant differences.</p> <p><u>Self-reported outcomes</u></p> <p>Knowledge about periodontal health</p> <p>No significant differences.</p> <p>A single MI session is insufficient for improving oral hygiene behaviors beyond what is achievable with traditional oral health education for patients in periodontal maintenance care.</p> |

| Authors & Aim | Study population & Follow-up | Design & Methods | Findings & Authors' conclusion |
|--|--|---|---|
| <p>Ramsay et al. (2018)</p> <p>To compare the effectiveness of theory-based, personalized oral health advice with routine care, in general dental practice, in improving periodontal health in adults.</p> | <p>Adult patients with periodontal health, gingivitis or moderate periodontitis.</p> <p>Allocated study sample, n=1877.</p> <p>Follow-up at 3 years.</p> | <p>Multicenter RCT.</p> <p>Interventions delivered by DHs and dentists. All participants received baseline periodontal instrumentation.</p> <p>Test</p> <p>Personalized oral health advice based on social cognitive theory and implementation intention theory including an action plan in addition to oral hygiene advice. 5 min, designed to be implemented during an ordinary consultation.</p> <p>Control</p> <p>Oral hygiene advice.</p> <p>ITT analyses.</p> | <p><u>Clinical outcomes</u></p> <p>Bleeding (BoP)</p> <p>No significant differences.</p> <p>PPD</p> <p>No significant differences.</p> <p><u>Self-reported outcomes</u></p> <p>Brushing & Interdental cleaning</p> <p>No significant differences.</p> <p>Self-efficacy (confidence in ability to perform oral health behaviors)</p> <p>No significant differences.</p> <p>Perceived behavioral control, attitude and subjective norms</p> <p>No significant differences.</p> <p>There were no differences between the two treatments regarding clinical or self-reported outcomes.</p> |
| <p>Stenman et al. (2018)</p> <p>To evaluate whether a single session of MI might be beneficial in preventing relapse of oral hygiene behaviors among patients treated for periodontitis compared with conventional periodontal treatment.</p> | <p>See Stenman et al. (2012).</p> <p>Follow-up at 3 years.</p> | <p>See Stenman et al. (2012).</p> <p>Per protocol analyses.</p> | <p><u>Clinical outcomes</u></p> <p>Bleeding (Marginal)</p> <p>No significant differences.</p> <p>Plaque</p> <p>No significant differences.</p> <p><u>Self-reported outcomes</u></p> <p>Interdental cleaning</p> <p>No significant differences.</p> <p>A single MI session as an adjunct to conventional periodontal treatment did not show long-term additive beneficial effect regarding prevention of relapse of oral hygiene behavior.</p> |
| <p>Asimakopoulou et al. (2019)</p> <p>To determine the effects of treatment as usual vs a risk communication intervention vs a goal setting, planning and self-monitoring intervention on</p> | <p>Patient with moderate oral hygiene (no requirement of attachment loss).</p> <p>Allocated study sample, n=97.</p> <p>Follow-up at 3 months.</p> | <p>RCT. All interventions delivered by dentist.</p> <p>Test I & II were inspired by protection motivation theory and the Capability-Opportunity-Motivation-Behavior model (COM-B).</p> <p>Test I</p> <p>5-10 min explanation of individual risk</p> | <p><u>Clinical outcomes</u></p> <p>Bleeding (BoP)</p> <p>Significant reduction in all groups.</p> <p>Plaque</p> <p>Significant reduction in test groups but not in the control group.</p> <p>PPD</p> <p>Significant reduction in all groups.</p> <p><u>Self-reported outcomes</u></p> <p>Brushing</p> <p>No significant improvement.</p> |

| Authors & Aim | Study population & Follow-up | Design & Methods | Findings & Authors' conclusion |
|--|---|--|--|
| outcomes in patients with periodontal disease. | | (susceptibility and severity) using an online tool in addition to information/instruction. Test II Procedures similar as Test I supplemented with personal goal setting, planning and self-monitoring of behavior. Control Information/instruction. ITT analyses. | Interdental cleaning Significant improvements in the test groups but not in the control group. Self-efficacy (ability to control periodontal disease) No significant improvements. A simple behavioral intervention using individual periodontal risk communication, with or without goal setting, planning and self-monitoring, reduced bleeding and plaque and increased interdental cleaning. |
| Holloway et al. (2021) To determine the impact of an oral hygiene behavior change intervention compared with oral hygiene advice on BoP in patients with gingivitis. | Adult patients (categorized as either $\geq 20\%$ BoP or $< 20\%$ BoP). Allocated study sample, n=733. Follow-up at 3 months. | Multicenter RCT. All intervention delivered by dentists. Test Information/instruction and skills training. Personal goal setting and planning. Patients with $\geq 20\%$ BoP signed a "contract". Control Oral hygiene advice/instruction. Per protocol analyses. | <u>Clinical outcomes</u> Bleeding (BoP) Significantly greater reduction in the test group. Plaque Significantly greater reduction in the control group. <u>Self-reported outcomes</u> Brushing & Interdental cleaning No significant differences. An oral hygiene behavioral change intervention significantly reduced gingivitis compared with the control intervention. |

Note: "No significant differences" refers to comparison between treatment groups.

† PPD ≤ 4 mm after treatment that was > 4 mm before.

‡ Bleeding $\leq 15\%$, plaque $< 20\%$, $\geq 75\%$ of pockets > 4 mm at baseline closed at 12 months.

Abbreviations: BoP, Bleeding on probing; DH, Dental hygienist; ITT, Intention to treat; MI, Motivational interviewing; PPD, Probing pocket depth; RCT, Randomized controlled trial.

Table 2. Overview of publications evaluating theory-based, oral health behavioral interventions directed at adolescents/young adults in dental settings. No restrictions regarding minimum follow-up time due to the limited number of publications.

| Authors & Aim | Study population & Follow-up | Design & Methods | Findings & Authors' conclusion |
|---|--|---|--|
| <p>Münster Halvari et al. (2012)</p> <p>To test whether an autonomy-supportive competence-promoting intervention would increase dental behaviors and decrease plaque and gingivitis relative to conventional care.</p> | <p>Students (18-32 years).</p> <p>Allocated study sample, n=158.</p> <p>Follow-up at 5.5 months.</p> | <p>RCT. Interventions delivered by DH.</p> <p>Test Based on self-determination theory. The intervention consisted of one extra session (45 min) in addition to conventional care. Exploring the patient's perspective. Information, offering rationales for dental behaviors, instruction and skills training with feedback. Delivered in an autonomy-supportive manner, promoting competence.</p> <p>Control Conventional information/instruction.</p> <p>Per protocol analyses.</p> | <p><u>Clinical outcomes</u> Bleeding (Marginal) Significantly lower score in the test group.</p> <p>Plaque Significantly lower score in the test group.</p> <p><u>Self-reported outcomes</u> Brushing & Interdental cleaning Significantly greater improvements in the test group.</p> <p>Autonomous motivation for dental home care No significant differences.</p> <p>Perceived dental competence Significantly higher scores in the test group.</p> <p>A competence-enhancing intervention, delivered in an autonomy-supportive way, improved clinical outcomes and oral hygiene behaviors, motivation and dental competence relative to conventional treatment.</p> |
| <p>Wide et al. (2018)</p> <p>To evaluate the effect of acceptance and commitment therapy (ACT) on oral health behavior in young adults with poor oral health.</p> | <p>Young adults (18-25 years) with ≥ 2 manifest proximal dental caries lesions.</p> <p>Allocated study sample, n=135.</p> <p>Follow-up at 3 weeks.</p> | <p>RCT at two dental clinics. ACT conducted by a psychologist. Oral health information delivered by dental nurses.</p> <p>Test 2 ACT sessions in addition to oral health information. ACT including conceptualization and functional analysis of behavior. A plan for behavioral change.</p> <p>Control Oral health information.</p> <p>ITT & per protocol analyses.</p> | <p><u>Self-reported outcomes</u> Brushing Significant improvements in the test group but not in the control group.</p> <p>Interdental cleaning (flossing/toothpicks) Significant improvements in the test group. Significant improvements in the control group regarding flossing (non-significant after Bonferroni correction).</p> <p>Use of fluoride Significant improvements for both groups (non-significant for control group after Bonferroni correction).</p> <p>No differences between ITT and per protocol analyses.</p> <p>A psychological intervention showed positive effect with improved oral health behaviors among young adults with high prevalence of caries.</p> |

| Authors & Aim | Study population & Follow-up | Design & Methods | Findings & Authors' conclusion |
|--|--|---|---|
| <p>Hagman et al. (2022)</p> <p>To evaluate the effect of a brief version of ACT on reducing gingivitis and plaque levels.</p> | <p>See Wide et al. (2018)</p> <p>Follow-up at 9 and 18 weeks.</p> | <p>See Wide et al. (2018)</p> | <p><u>Clinical outcomes</u></p> <p>Bleeding (Marginal) No significant differences at any time point. Both groups improved significantly over time.</p> <p>Plaque No significant differences at any time point. Both groups improved significantly over time.</p> <p>No differences between ITT and per protocol analyses.</p> <p>A brief ACT intervention was not more effective than oral health information alone at improving oral health among young adults with poor oral health.</p> |
| <p>Rigau-Gay et al. (2020)</p> <p>To evaluate the effectiveness of a single session of MI in enhancing oral hygiene in orthodontic patients compared with conventional education.</p> | <p>Patients with fixed appliances (12-25 years).</p> <p>Allocated study sample, n=130.</p> <p>Follow-up at 1 and 6 month(s).</p> | <p>RCT. Both interventions delivered by orthodontist.</p> <p>Test A single MI session in addition to oral health education. Scales (0-10) assessing readiness and confidence in making a change.</p> <p>Control Oral health education (information/instruction and skills training).</p> <p>Per protocol analyses.</p> | <p><u>Clinical outcomes</u></p> <p>Bleeding (Marginal) Significantly lower scores in the test group at both time points.</p> <p>Plaque Significantly lower scores in the test group at both time points.</p> <p>A single MI session in addition to conventional education is useful to improve oral hygiene in young patients with fixed appliances and showed stable improvements after 6 months.</p> |
| <p>Gunpinar & Meraci (2022)</p> <p>To investigate the effect of a periodontal health education session on plaque control and bleeding in young patients with gingivitis.</p> | <p>Young adults with gingivitis (22-35 years; >50% plaque).</p> <p>Allocated study sample, n=60.</p> <p>Follow-up at 1, 3 and 6 month(s).</p> | <p>RCT. MI-based session delivered by periodontist and non-surgical periodontal treatment and oral hygiene education by research assistant. All patients received non-surgical periodontal treatment.</p> <p>Test A single session of periodontal health education (MI-based session) in addition to oral hygiene education.</p> <p>Control Oral hygiene education (instruction and skills training).</p> | <p><u>Clinical outcomes</u></p> <p>Bleeding (Marginal) Significantly greater improvements in the test group when comparing change from baseline to all time points.</p> <p>Plaque Significantly greater improvements in the test group when comparing change from baseline to 3 and 6 months (not significant for change to 1 month).</p> <p><u>Self-reported outcomes</u></p> <p>Knowledge (evaluated directly after intervention) Significantly higher scores in the test group after intervention.</p> <p>Motivation (evaluated at 1 month) Significantly higher scores in the test group.</p> |

| Authors & Aim | Study population & Follow-up | Design & Methods | Findings & Authors' conclusion |
|---------------|------------------------------|------------------------|---|
| | | Per protocol analyses. | The results indicate that knowledge of periodontal disease via educational MI session increased motivation and improved oral hygiene among patient with gingivitis. |

Note: "No significant differences" refers to comparison between treatment groups.

Abbreviations: ACT, Acceptance and commitment therapy; DH, Dental hygienist; ITT, Intention to treat; MI, Motivational interviewing; RCT, Randomized controlled trial.

Communication and Treatment Alliance

A good communication and treatment alliance between the patient and health professional has been described as the foundation in treatment (Horvath, 2001; Myran & Willumsen, 2022). The term treatment alliance illustrates the quality and strength of the relationship and refers to the emotional connection (trust and respect) and mutual agreement regarding treatment goals (Horvath, 2001; Myran & Willumsen, 2022). Pinto et al. (2012) conducted a systematic review investigating communicative factors associated with treatment alliance. The results showed that the alliance is strengthened when the health professional's communication style facilitates patient participation by listening to and involving the patient in conversation. Similar results were found by Everall & Paulson (2002) who interviewed adolescents who had received psychotherapy. To feel respected, acknowledged and listened to strengthened the treatment alliance and the alliance was considered as key to engagement in treatment and personal change (Everall & Paulson, 2002).

A previous study in dentistry by Liss et al. (2021) showed that a patient's experience of being involved in treatment decisions was a significant predictor of a more positive subjective as well as clinical treatment outcome among adults treated for periodontitis. However, the result of a qualitative interview study by Östberg (2005) elucidated that adolescents felt that dental professionals often seemed stressed, not having sufficient time for proper

communication and information. In addition, the adolescents stated that they sometimes felt like an object in dental care, neither listened to nor seen.

Person-Centered Approach

Person-centered care acknowledges the person behind the patient and their life outside the dental clinic. This means that patients should not be reduced to their disease. Person-centered care emphasizes collaboration between the health professional and the patient, treating the patient as a capable person with own preferences, desires and will, as well as an equal in the planning and performance of treatment (Ekman & Swedberg, 2022; Ekman et al., 2011).

To initiate and integrate person-centered care in clinical practice, health professionals can elicit the patient's narrative, agree on a health plan to achieve the patient's goals and document the plan (Ekman & Swedberg, 2022; Ekman et al., 2011). A person-centered approach has shown to improve health outcomes among adults and adolescents (Brorsson et al., 2019; Ekman & Swedberg, 2022; Ekman et al., 2011; Pirhonen et al., 2017) and to be associated with higher levels of work satisfaction among health professionals (Sjögren et al., 2015; Vassbø et al., 2019).

Motivational Interviewing

Motivation is highly valued because of its effect, i.e. getting people to act/change behavior. Still, motivation is not something that can be provided to a person but needs to come from within a person (Ryan & Deci, 2000).

Motivational interviewing (MI) is a person-centered and collaborative communicative style with the purpose of eliciting and strengthening a person's motivation and commitment towards behavioral change. The theoretical framework of MI highlights the importance of partnership and treatment alliance, and of patients being recognized as the experts of their own lives. When using this approach, health professionals explore the patient's personal

values and reasons for change and promote autonomy to make their own health-related decisions. However, for a patient to decide on changing behavior, the health professional should acknowledge potential ambivalence about change and elicit the discrepancy between current behavior and the patient's values and goals. In this process, it is important to express empathy and understanding of the patient's perspectives as well as strengthening the patient's belief in their ability to change behavior, i.e. to strengthen self-efficacy (Miller & Rollnick, 2013).

There are specific communication skills in MI that are helpful to encourage motivation for behavioral change, such as using open questions, affirmations, reflective listening and summarizing. Using open questions leads the patient to do much of the talking, which promotes an understanding of the patient's perspective. Affirmations help building a treatment alliance and support confidence by genuinely acknowledging the patient's strengths and efforts. Reflective listening incorporates repeating what the patient said, either by using the patient's own words or by reflecting on the underlying meaning of the statement. Reflective listening can demonstrate that you have listened to and understood the patient, but also encourage the patient to keep talking. The fourth skill is to summarize, both during the conversation and at the end of the session, with the intention to make sure that you understood the patient's perspectives, and this is also a platform for the next step in treatment (Miller & Rollnick, 2013).

Kopp et al. (2017) performed a systematic review to evaluate the effect of MI as an adjunct to periodontal treatment. Five RCTs were identified and included. The cautious conclusion drawn was that MI, as an adjunct to periodontal treatment, might have potential to improve clinical outcomes and self-efficacy related to oral hygiene (Kopp et al., 2017). In addition, and as previously mentioned, tentative evidence suggests that interventions that are guided by a theory of health behavior in which dental professionals use MI as

a communicative approach can reinforce adherence to beneficial oral hygiene behaviors (Carra et al., 2020; Newton & Asimakopoulou, 2015; Vilar Doceda et al., 2023; Werner et al., 2016). Furthermore, MI as an adjunct to conventional treatment has also shown potential to improve oral hygiene conditions among adolescents/young adults with gingivitis (Gunpinar & Meraci, 2022) and fixed (orthodontic) appliances (Rigau-Gay et al., 2020).

From a professional point of view, a questionnaire study by Liss et al. (2018) revealed that DHs who stated that they used specific methods, including MI, to promote behavioral change were more likely to consider themselves competent to treat patients with periodontal disease.

The Rationale of this Thesis

To improve periodontal health in Swedish adolescents, there is a need for more effective educational interventions that address the complexity associated with behavior and behavioral change. Evidence suggests that educational interventions guided by theory of health behavior and where dental professionals use a person-centered communication approach, such as MI, can reinforce adherence to beneficial oral hygiene behaviors in adults with periodontal disease. However, a knowledge gap exists regarding whether such an intervention is superior to conventional information/instruction in adolescents. In addition, studies are warranted where such theory-based behavioral interventions are tested in general dental practice. Educational interventions that are effective in strengthening adolescents' motivation for beneficial oral hygiene could enhance periodontal health in the broader population in the long-term, as the management of gingivitis is a primary prevention strategy for periodontitis.

Aim

The overall aim was to contribute to the development of efficient educational interventions, directed at adolescents, to improve oral hygiene behavior and promote periodontal health.

Specific Aims

- ◇ To test the effectiveness of a person-centered, theory-based, educational intervention to increase adolescents' adherence to adequate oral hygiene behavior, i.e. self-performed periodontal infection control (Study I).
- ◇ To analyze adolescents' self-reported experiences and behavioral outcomes of the person-centered, theory-based, intervention in comparison with conventional information/instruction for improved oral hygiene. Secondary aims were to identify potential individual factors and/or treatment-related experiences associated with patient-reported behavioral outcomes at 6 months and to analyze the association between patient-reported and clinical outcomes (Study II).
- ◇ To explore adolescents' experiences of a behavioral intervention in accordance with a person-centered, theory-based, oral health education program for improved oral hygiene (Study III).
- ◇ To explore DHs' views on a person-centered, theory-based, behavioral intervention for improving oral hygiene among adolescents and professional and organizational factors to consider in the implementation of such an intervention in daily dental practice (Study IV).

Material & Methods

This thesis is based on a randomized clinical field study (Studies I & II) and two qualitative interview studies (Studies III & IV). An overview of study design, participants, data collection and analysis in the included studies is shown in Table 3.

Table 3. Brief overview of design, participants, data collection and analysis in Studies I-IV.

| | Studies I & II | Study III | Study IV |
|------------------------|--|--|--|
| Design | Experimental. Randomized clinical field study. | Qualitative interview study. | Qualitative interview study. |
| Participants | Adolescents with gingival bleeding and/or plaque at $\geq 50\%$ of tooth surfaces. | Adolescents treated in accordance with the person-centered, theory-based, behavioral intervention (test) in the preceding field study. | DHs who performed treatment in accordance with the person-centered, theory-based, behavioral intervention (test) in the preceding field study. |
| Data Collection | Clinical assessments and questionnaires. | Semi-structured interviews. | Semi-structured interviews. |
| Data Analysis | Descriptive and inferential statistics. | Qualitative content analysis. | Qualitative content analysis. |

Abbreviation: DH, Dental hygienist.

The studies were reviewed and approved by the Regional Ethical Review Board, Gothenburg, Sweden (Studies I & II, Dnr: 284-15; Study III, Dnr: 357-18) and the Swedish Ethical Review Authority (Study IV, Dnr: 2019-03197). Potential participants were informed verbally and in writing and participants signed an informed consent before entering the respective study. In accordance with the Swedish Ethical Review Act (SFS 2003:460) §18, the adolescents signed the informed consents without involvement of legal guardians as they were ≥ 15 years old. All study procedures were conducted in accordance with ethical principles for medical research involving human subjects stated by the Declaration of Helsinki (World Medical Association, 2013). The randomized clinical field study was registered at ClinicalTrials.gov (NCT02906098).

Studies I & II

Study Design and Participants

A prospective, multi-center, two-arm, quasi-randomized field study, with a total duration of 18 months, was conducted at 17 dental clinics within the Public Dental Service, Region Västra Götaland, Sweden. The Consort 2010 guidelines for reporting randomized trials was carefully considered (Schulz et al., 2010). A flowchart of the field study is presented in Figure 2.

Randomization Procedure

Treatment was provided by 30 DHs who were randomized to either test (person-centered, theory-based, behavioral intervention) or control (conventional educational intervention, i.e. information/instruction). Before randomization, the DHs were stratified based on the clinic at which they worked with the purpose of obtaining a balanced distribution in the test and control groups of clinics representing varying sociodemographic areas within Region Västra Götaland. Thus, allocation of study participants to treatment protocol was based on the clinic/DH that the patient attended.

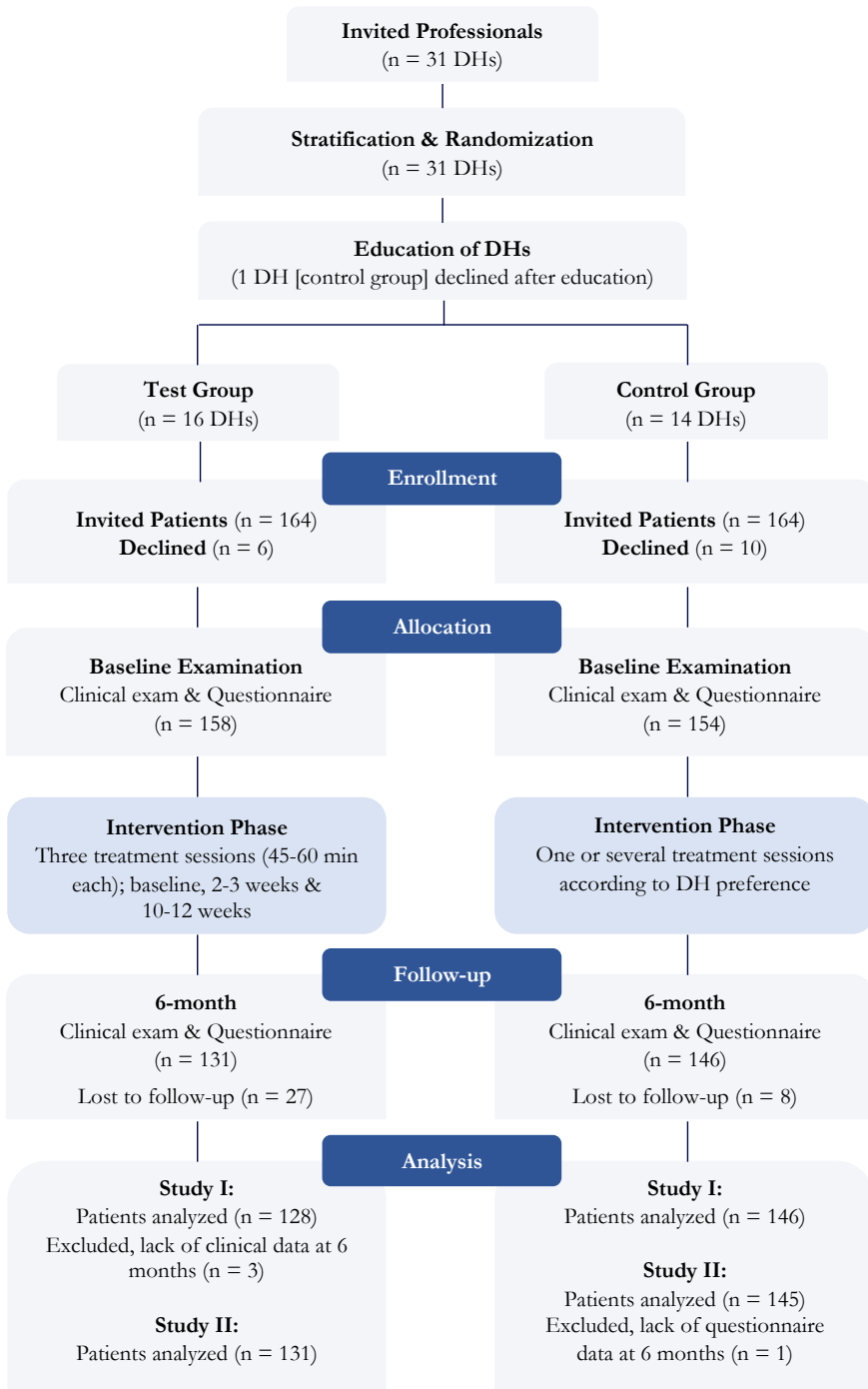


Figure 2. Flowchart of the clinical field study to the 6-month follow-up. Abbreviations: DH, Dental hygienist; Exam, Examination.

Education of DHs

The DHs received education before study start (Test group = two days; Control group = half a day), containing Good Clinical Practice in research, a detailed review of respective treatment protocols and a calibration session regarding clinical assessments. In addition, DHs in the test group received education regarding theory of health behavior, social cognitive theoretical constructs, BCTs and the use of a MI-inspired communicative approach. Clinical training of the test intervention was practiced under supervision of a clinical psychologist. The DHs received two guiding manuals, one comprehensive and detailed used during training and one brief to use as support during the study sessions. Before enrollment of study patients, the DHs were encouraged to practice the test intervention at their home clinic.

Sample Size Calculation

In order to detect a difference of 10% between groups in final mean marginal bleeding index (MBI; primary clinical outcome), with a power of 95%, 86 adolescents were required in each group (172 adolescents). However, to compensate for a potentially higher attrition rate in field studies, approximately 155 adolescents per group were to be enrolled (about 10 patients/DH).

Eligible Study Participants

Eligible study participants were 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. The rationale behind the 50% clinical cut-off value was based on guidelines presented by the Public Dental Service, Region Västra Götaland, in which adolescents with this magnitude of gingivitis/plaque were considered to be at increased risk of oral disease progression and should be provided with “individually tailored preventive measures”. Adolescents were enrolled from January 2016 to June 2018.

The Interventions

Person-Centered, Theory-Based, Behavioral Intervention (Test)

The test intervention was based on social cognitive theoretical constructs (Bandura, 2004; model inspired by Jönsson et al., 2009) including BCTs such as personal goal setting for oral health and oral hygiene, planning and self-monitoring (written diary) of behavior (Michie et al., 2013). In addition, the DHs used a person-centered and collaborative communicative approach inspired by MI (Miller & Rollnick, 2013). Hence, the communicative approach focused on fostering treatment alliance with guidance towards beneficial oral hygiene behavior and promotion of autonomy, thereby encouraging the adolescents to make own health behavioral choices. The components of the test intervention are shown in Figure 3.

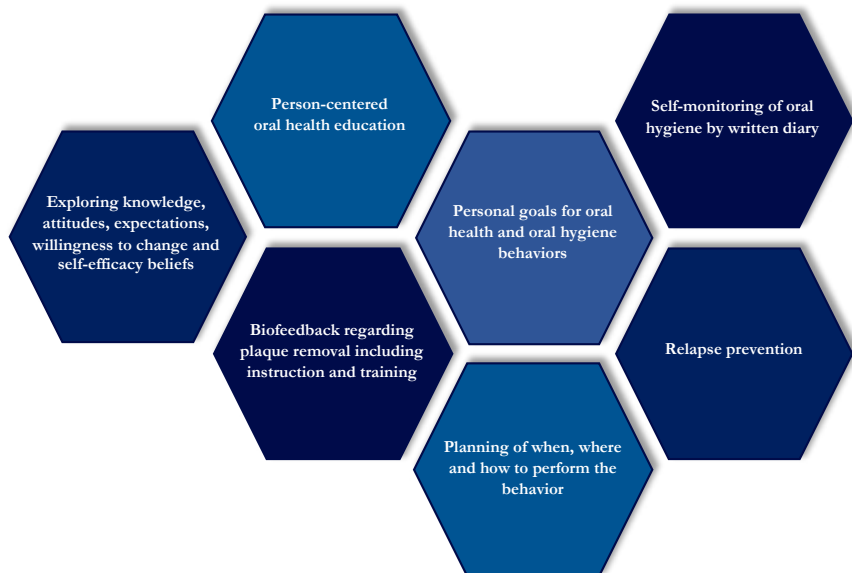


Figure 3. The components of the person-centered, theory-based, behavioral intervention.

The initial intervention phase included three treatment sessions (45-60 min each) conducted during a period of 10-12 weeks. The components of each session are shown in Figure 4.

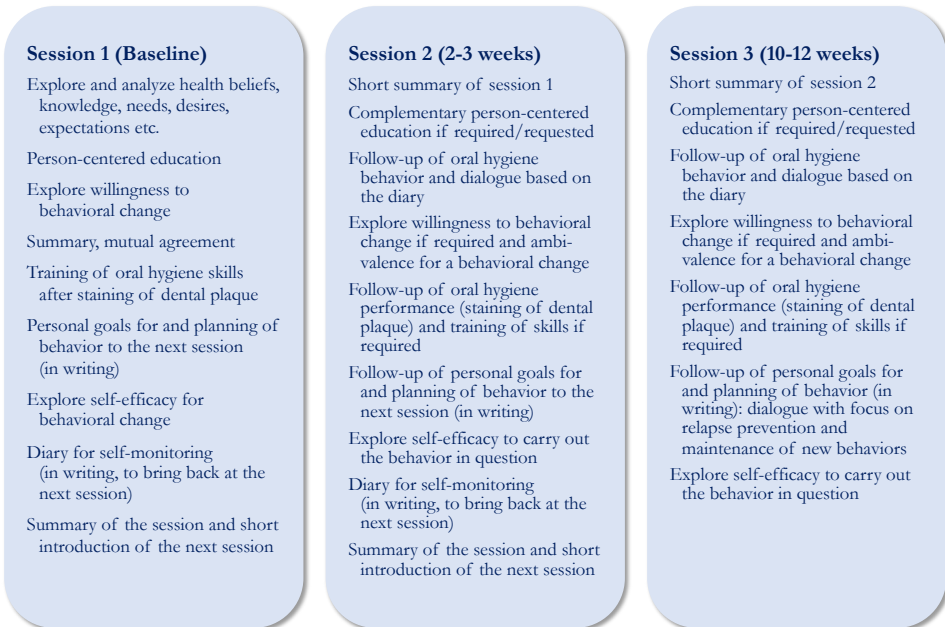


Figure 4. Components of each session in the initial intervention phase of the person-centered, theory-based, behavioral intervention.

In brief, an interview was initially conducted exploring the adolescent's knowledge, attitudes, expectations, needs, desires and oral hygiene behavior etc. In addition, the adolescent's willingness to change and self-efficacy beliefs were explored. Based on the information received, the DH provided person-centered oral health education in dialogue.

To visualize dental plaque to the patient and to initiate a discussion about oral hygiene and potential oral hygiene aids, the teeth were stained with a disclosing solution. Feedback was provided on where the adolescent cleaned successfully and on potential improvement. Practical skills training was conducted in front of a mirror and wash basin.

The adolescent formulated personal long-term goals for oral health as well as short-term goals for oral hygiene to be achieved until the next session. The goals were written down by the adolescent in a combined action/coping plan together with answers on how the goal could be reached, where the behavior, e.g. tooth brushing, should be performed and when. The adolescent finalized the plan by reflecting on potential barriers and how to overcome these.

A written diary was introduced to the adolescent for self-monitoring of behavior, which should be returned at the next session to be used as a basis for dialogue on performance in relation to the personal goals.

In the relapse prevention, the adolescent filled in a maintenance plan on how to keep up new behaviors going forward. The maintenance plan included to reflect on situations that could lead to relapse and how to handle such situations. The DHs prepared the adolescents that relapse is common in a behavioral change process.

For a more detailed description of the test intervention and the components of each session see Paper I; Table S1 (supplementary information, online); Dimenäs, Jönsson et al. (2022).

Conventional Educational Intervention (Control)

The control intervention contained information/instruction in accordance with conventional routines, as judged by the DH, without any further directives (business as usual). The control intervention was thereby to mirror what adolescents with poor oral hygiene conditions usually are offered in the Public Dental Service, Region Västra Götaland.

In both test and control groups, follow-up was performed at 6 months.

Data Collection

Clinical assessments were performed and questionnaires distributed at baseline and at the 6-month follow-up.

Clinical Data

Clinical assessments were performed by the DH who provided the intervention. The following clinical variables were scored at the mesial, distal, buccal and lingual/palatal site of each tooth and registered in the adolescent's electronic dental record:

- ◇ Marginal gingival bleeding was assessed as either present (1) or absent (0) following pressure with a periodontal probe of the gingival sulcus area (Ainamo & Bay, 1975).
- ◇ Plaque was assessed as either present (1) or absent (0) following staining with a disclosing solution (O'Leary et al., 1972).

MBI and plaque index (PI) were presented as a percentage calculated as the number of tooth sites with bleeding/plaque divided by the total number of assessed sites (third molars excluded).

Questionnaire Data

The questionnaires were based on questions from validated instruments as well as questions used and knowledge generated in previous empirical studies (Ericsson et al., 2016; Ericsson et al., 2012; Östberg et al., 2010; for an overview see Ericsson, 2013). Before study start, the readability and understanding of questions were tested among 18 adolescents (16-18 years old). Based on their comments, minor modifications were made.

The questionnaires were to be answered by the adolescent in the waiting room at the dental clinic in conjunction with, but before, the treatment session.

After answering, the adolescent placed the questionnaire in an envelope and sealed it to be returned to the research team.

Baseline information was collected regarding personal characteristics such as gender, native country, occupation and medication as well as information on self-rated general health, tobacco habits, weekly exercise, motivation to engage in the upcoming treatment and dental anxiety. In addition, at baseline and 6 months, information on oral hygiene behavior and oral health perceptions, attitudes and knowledge were collected. Moreover, at 6 months the adolescents answered questions regarding experiences of the intervention and behavioral outcomes of treatment. Most questions/statements were to be answered on a Likert scale with fixed answer alternatives e.g. *“How do you think you take care of your daily oral hygiene?”* were to be answered on a four-point scale: Good, quite good, quite bad or bad. The questions regarding *“Motivation to engage in the upcoming treatment”* and *“Confidence about keeping up healthy gingival conditions going forward”* were, however, to be answered on a visual analog scale from 0 to 10. In addition, time spent on daily oral hygiene was answered by typing the number of minutes, i.e. without preprinted alternatives. An overview of the questions analyzed in Studies I & II is presented in Table 4.

Table 4. Overview of the questions analyzed in Studies I & II.

| Questions analyzed | Study I | Study II |
|---|---------|----------|
| Oral hygiene behavior | | |
| Frequency of tooth brushing | X | |
| Frequency of interdental cleaning | X | |
| Time spent on daily oral hygiene | X | |
| Oral health perceptions, attitudes and knowledge | | |
| Self-rated oral health | | X |
| How important is it for you to have healthy oral conditions? | | X |
| How often have you had “bleeding gums” in the last 3 months? | | X |
| How do you think you take care of your daily oral hygiene? | | X |
| My knowledge about gingivitis is | | X |
| Experiences of the intervention | | |
| How do you consider the education about gingivitis provided by the DH? | | X |
| How do you consider the education about daily oral hygiene habits provided by the DH? | | X |
| Overall, how do you consider the communication between you and the DH? | | X |
| Behavioral outcomes of treatment | | |
| Change of oral hygiene habits after treatment in comparison with before | | X |
| Confidence about keeping up healthy gingival conditions going forward | | X |

Abbreviation: DH, Dental hygienist.

Study Monitoring

In the field study, various strategies were applied to secure study quality and treatment fidelity (Borrelli, 2011; Perepletchikova & Kazdin, 2005). Hence, a study monitor carried out regular visits to the clinics to support the DHs and to ensure that they followed the treatment protocols as well as performed and recorded the clinical assessments as intended. All DHs noted in protocols what had been done during the respective treatment sessions and how much time spent. In addition, after each session, the DHs treating the test group checked that the components of the intervention had been performed by using a checklist protocol. If deviations from the treatment protocol had occurred, the DHs were asked to record relevant details. Furthermore, at least one session was monitored/observed by the study monitor to ensure a satisfactory

implementation of the test intervention. Feedback was provided immediately after the monitoring session and if indicated, additional monitoring was scheduled.

Data Analysis

All statistical procedures were performed using the Statistical Package for Social Sciences (SPSS) for Mac version 27 & 28 (IBM corporation, USA). Findings were considered as statistically significant if p was <0.05 . See Table 5 for an overview of the statistical procedures in Studies I & II.

Table 5. Overview of the statistical procedures used in Studies I & II.

| Statistical method | Study I | Study II |
|--|---------|----------|
| Descriptive | X | X |
| Unpaired t -test for comparison between groups (Continuous variables) | X | X |
| Paired t -test for comparison within groups (Continuous variables) | X | |
| χ^2 test/Fisher's exact test for comparison between groups (Categorical variables) | X | X |
| Correlation analysis (Spearman rho) | | X |
| Linear regression analysis | X | X |
| Logistic regression analysis | | X |
| Per protocol analysis | X | X |
| Sensitivity analysis | X | |

Descriptive statistics were used to present numbers and proportions, mean values and standard deviation (SD). For continuous variables, unpaired and paired t -test was used for comparisons between and within treatment groups. Furthermore, for categorical variables, χ^2 test and Fisher's exact test were used to test for differences between treatment groups. Per protocol analyses were performed as the main approach to analyze patients who followed treatment to the 6-month follow-up and who had clinical data at baseline and 6 months (Study I) or questionnaire data at baseline and 6 months (Study II). In Study I,

however, a sensitivity analysis was conducted to determine how the primary outcome (MBI) was affected if dropouts were included. Thus, missing values at the 6-month follow-up were replaced using the multiple imputation method (Jakobsen et al., 2017). The result from the multiple imputation was applied in the sensitivity analysis (De Souza et al., 2016). In addition, in Study I, Cohen's *d* was presented to show the standardized effect sizes. Effect size was based on comparisons between test and control groups of mean changes of PI and MBI from baseline to 6 months. According to Cohen (1988), a Cohen's *d* of 0.2, 0.5 and 0.8 is considered as a small, medium and large effect, respectively.

In Study I, a multiple linear regression analysis was performed to adjust for potential confounding factors associated with the primary clinical outcome (MBI) at 6 months. In Study II, logistic and linear regression analyses were performed to identify individual factors and/or patient-reported experiences of treatment associated with patient-reported behavioral outcomes. These regression analyses were conducted both as univariate and adjusted full models. Subsequently, based on explanatory variables identified as significantly associated with the dependent outcome in the adjusted full model, a final reduced model was tested. Explanatory variables used in those regression analyses were chosen based on theoretical assumption of potential impact on the dependent outcomes and on results from previous studies to be associated with oral hygiene behaviors and conditions. As a complement, correlation analyses (Spearman rho) were performed to select explanatory variables associated with the outcomes and to avoid strong correlation among the explanatory variables. In addition, in Study II, correlation analyses (Spearman rho) were conducted to test for the association between patient-reported behavioral outcomes and MBI at 6 months. Supplementary linear regression analyses were also conducted to identify individual factors and/or patient-reported experiences of treatment associated with MBI at 6 months.

Studies III & IV

Study Design and Participants

Studies III & IV were conducted as qualitative interview studies. Consolidated criteria for reporting qualitative research (COREQ 32-item checklist) was carefully considered (Tong et al., 2007).

In Study III, eligible participants were adolescents who had received treatment in accordance with the test intervention and who had fulfilled participation in the clinical field study to the 18-month follow-up. Adolescents were thus informed of and received written information about the upcoming interview study at the end of the clinical field study. Potential participants were strategically selected to represent both genders and clinics situated in metropolitan, urban and rural locations with various sociodemographic profiles within Region Västra Götaland. They were subsequently contacted by phone and received further information about the study and were asked about their willingness to participate. If accepting the invitation, they were scheduled for an upcoming focus group interview. In total, 47 adolescents were contacted and 19 were interviewed. Data sampling was terminated when it was considered that an adequate amount of information had been obtained in relation to the aim of the study. All interviews were planned to be conducted as focus group interviews with four-five adolescents/group. However, due to cancellations and non-appearance at the time of interview, some focus group interviews were conducted with lower numbers of participants than initially planned or as individual interviews. Participating adolescents were reimbursed for any traveling expenses in relation to the interview and after the interview session they received four cinema tickets for taking the time to participate. Five focus group interviews were conducted with two-three adolescents and six individual interviews. Characteristics of the participating adolescents are presented in Paper III; Table 1; Dimenäs, Östberg, et al. (2022).

In Study IV, the participants were DHs who had treated adolescents in accordance with the test intervention in the preceding clinical field study. In total, 16 DHs (all women) were eligible for participation. The DHs were contacted by phone and if interested scheduled for a focus group interview, planned to be conducted with three-four participants in each group. Three DHs declined participation and consequently, 13 DHs were interviewed. The focus group interviews were, however, conducted with less individuals than planned or as individual and telephone interviews due to e.g. sickness or inconvenient traveling. Hence, three focus group interviews were conducted with two participants in each group as well as five individual and two telephone interviews. The DHs were reimbursed for potential traveling expenses.

Data Collection

Semi-structured interviews were performed, following an interview guide covering specific focus areas related to the aim of the current study. Both open-ended and probing questions were raised to produce rich data and to ensure proper elaboration of the subject of interest. When interviews were conducted as focus groups, an observer participated to take notes and ensure that no information was missed or needed further elaboration.

In Study III, adolescents were interviewed at neutral locations outside the dental clinic. The interviews were performed from January-December 2019 and lasted between 35-90 min (group interview mean 70 min and individual interview mean 50 min).

In Study IV, DHs were interviewed at locations that suited them best. Thus, some interviews were performed at dental clinics and some at more neutral locations. The interviews took place from September-December 2019 and lasted between 37-111 min (group interview mean 98 min, individual interview mean 73 min and telephone interview mean 42 min).

All interviews were audio-taped and transcribed verbatim.

Data Analysis

Interview data were analyzed with qualitative content analysis (Graneheim et al., 2017; Graneheim & Lundman, 2004; Lindgren et al., 2020). First, the interview data were read and listened to several times to gain a sense of the content. Subsequently, the software NVivo for Mac 11.4.3 and 12.7.0 was used to handle and organize data in the analysis process. The analysis followed succeeding steps with different degrees of interpretation, i.e. by condensation and abstraction. For an overview of the succeeding steps of the analysis process see Figure 5.

Data analysis was performed in close collaboration among authors representing different fields of expertise (odontology/oral health, education, psychology) and with extensive experience of qualitative methodology within the research group. Interpretations were discussed to elaborate on divergent understandings and to prevent researcher bias.

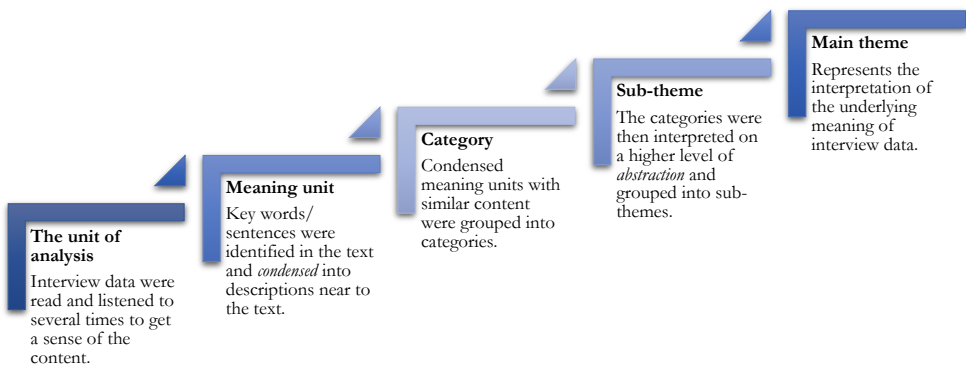


Figure 5. Description of the steps of the analysis process in Studies III & IV, using qualitative content analysis (Graneheim & Lundman, 2004).

Results

Study I

The study sample included 274 adolescent patients (Test = 128; Control = 146) treated per protocol to the 6-month follow-up and who had clinical data at baseline and 6 months (see flowchart, Figure 2).

The mean total time used in the initial intervention phase (6-month evaluation excluded) was 123 min (SD 20.7) for the test group and 41 min (SD 10.3) for the control group. The mean number of sessions in the initial intervention phase was 2.9 (SD 0.3) and 1.2 (SD 0.4) for the test and control groups, respectively.

Clinical Outcomes

Both groups showed significantly improved MBI (primary outcome) and PI scores at 6 months ($p < 0.001$), with significantly greater improvements in the test group compared to control and with small to medium effect sizes (Table 6). The results of the sensitivity analysis regarding MBI followed the same pattern (Table 6).

At 6 months, 58% of the adolescents in the test group and 42% in the control group had an MBI score $\leq 20\%$, whereas an MBI score $< 10\%$ was present in 36% and 17% in the test and control groups, respectively.

The multiple linear regression model (adjusted for treatment group, MBI at baseline, gender, smoking and native country) showed that variables significantly associated with MBI at 6 months were MBI at baseline and treatment group (Paper I; Table S2 [supplementary information, online]; Dimenäs, Jönsson, et al., 2022).

Table 6. Marginal bleeding index (MBI) and plaque index (PI) scores at baseline and 6 months and changes based on per protocol analysis, and sensitivity analysis regarding MBI.

| | Baseline | 6 months | Change from baseline to 6 months | |
|-----------------------------|---------------------|---------------------|----------------------------------|----------------------|
| | mean % (95% CI) | mean % (95% CI) | mean % (95% CI) | Effect size (95% CI) |
| Per protocol | | | | |
| MBI | | | | |
| 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 | 0.314 | 0.004 | <0.001 | |
| PI | | | | |
| 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 | 0.315 | <0.001 | 0.001 | |
| Sensitivity analysis | | | | |
| MBI | | | | |
| Test | | 20.3 (18.0 to 22.6) | -19.2 (-22.2 to -16.2) | 0.37 (0.14 to 0.59) |
| Control | | 25.7 (22.8 to 28.5) | -12.0 (-15.2 to -8.8) | |
| <i>p</i> -value | | 0.004 | 0.001 | |

Note: Between group comparison with unpaired *t*-test.

Abbreviation: CI, Confidence Interval; MBI, Marginal bleeding index; PI, Plaque index.

Self-Reported Oral Hygiene Behavior

At baseline, there were no significant differences between groups regarding self-reported oral hygiene behavior. Approximately 67% reported brushing ≥ 2 times a day and 10% cleaning interdentally ≥ 3 times a week. At 6 months, a significantly higher proportion in the test group compared with control reported brushing ≥ 2 times a day (78% vs 63%, $p=0.023$) and cleaning interdentally ≥ 3 times a week (21% vs 10%, $p=0.010$). For details, see Paper I; Table 4; Dimenäs, Jönsson, et al. (2022).

No significant differences were found between treatment groups regarding mean time spent on daily oral hygiene at either baseline or 6 months. Mean time spent was 6.9 min (SD 5.3) and 7.6 min (SD 5.7) for the test group at baseline and 6 months, respectively. Corresponding mean time for the control group was 7.0 min at both time points (SD 5.4 and 6.7, respectively).

Study II

The study sample included 276 adolescent patients (Test = 131; Control = 145) treated per protocol to the 6 months follow-up and who had questionnaire data at baseline and 6 months (see flowchart, Figure 2).

Oral Health Perceptions, Attitudes and Knowledge

There were no significant differences between test and control regarding self-rated oral health, importance of having healthy oral conditions and “bleeding gums” at either baseline or 6 months (Paper II; Table 2; Dimenäs et al., 2024). At 6 months, a significantly higher proportion in the test group considered that they took good care of their daily oral hygiene and reported that their knowledge about gingivitis was good compared with control (Table 7).

Table 7. Self-reported perception of daily oral hygiene care and knowledge about gingivitis at baseline and 6 months.

| | Baseline | | <i>p</i> -value | 6 months | | <i>p</i> -value |
|---|---------------|------------------|-----------------|---------------|------------------|-----------------|
| | Test n (%) | Control n (%) | | Test n (%) | Control n (%) | |
| How do you think you take care of your daily oral hygiene? | | | | | | |
| Good | 29 (22.1) | 34 (23.6) | 0.926 | 38 (29.2) | 24 (16.7) | 0.009 |
| Quite good | 74 (56.5) | 78 (54.2) | | 75 (57.7) | 85 (59.0) | |
| Quite bad/bad | 28 (21.4) | 32 (22.2) | | 17 (13.1) | 35 (24.3) | |
| My knowledge about gingivitis is: | | | | | | |
| Good | 10 (7.7) | 5 (3.5) | 0.255 | 21 (16.0) | 5 (3.5) | <0.001 |
| Quite good | 32 (24.6) | 28 (19.4) | | 67 (51.2) | 47 (32.6) | |
| Quite poor | 57 (43.8) | 75 (52.1) | | 25 (19.1) | 59 (41.0) | |
| Poor | 31 (23.9) | 36 (25.0) | | 18 (13.7) | 33 (22.9) | |

Note: Between group comparison with χ^2 test.

Percentage (%) represents the proportion of those who answered the item.

Experiences of the Intervention

As shown in Table 8, significantly higher proportions in the test group considered themselves as more satisfied with the education about gingivitis and daily oral hygiene habits provided by the DH as well as with the communication during therapy, compared with the control group at 6 months.

Table 8. Experiences of the intervention, reported at 6 months.

| | Test n (%) | Control n (%) | <i>p</i> -value |
|--|---------------|------------------|-----------------|
| How do you consider the education about gingivitis provided by the DH? | | | |
| Very good | 79 (60.8) | 52 (37.1) | <0.001 |
| Quite good | 44 (33.8) | 63 (45.0) | |
| Less good or poor | 7 (5.4) | 25 (17.9) | |
| How do you consider the education about daily oral hygiene habits provided by the DH? | | | |
| Very good | 111 (85.4) | 94 (66.2) | <0.001 |
| Quite good | 18 (13.8) | 43 (30.3) | |
| Less good or poor | 1 (0.8) | 5 (3.5) | |
| Overall, how do you consider the communication between you and the DH? | | | |
| Very good | 90 (68.7) | 72 (50.3) | 0.002 |
| Quite good | 40 (30.5) | 64 (44.8) | |
| Less good or poor | 1 (0.8) | 7 (4.9) | |

Note: Between group comparison with χ^2 test and Fisher's exact test.
Percentage (%) represents the proportion of those who answered the item.
Abbreviation: DH, Dental hygienist.

Patient-Reported Behavioral Outcomes

As shown in Figure 6 a higher proportion of the adolescents in the test group compared with the control group (30% vs 15%) reported that they were much more careful regarding their oral hygiene habits after treatment than before, while 9% in the test group and 19% in the control group reported no difference or being less careful ($p=0.002$).

The adolescents in the test group also considered themselves as having significantly higher confidence about keeping up healthy gingival conditions going forward compared with the control group at 6 months (mean 7.9 [95% CI 7.7-8.2] and 7.4 [95% CI 7.1-7.6] on a visual analog scale from 0 to 10 for the test and control groups, respectively, $p=0.002$).

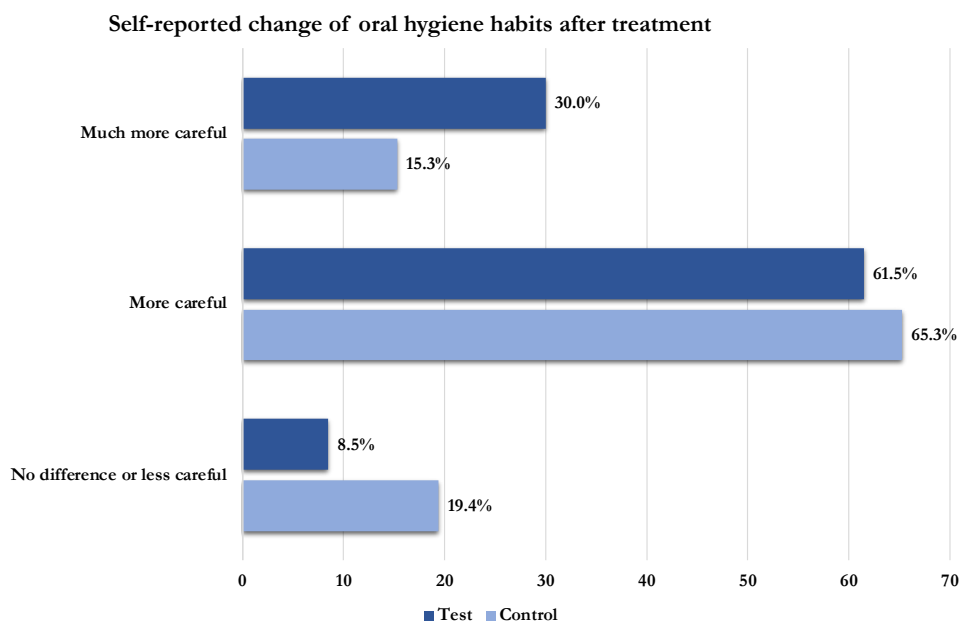


Figure 6. Self-reported behavioral outcome at 6 months.

Note: Between group comparison with χ^2 test; $p=0.002$. Test = 130; Control = 144.

Percentage (%) represents the proportion of those who answered the item.

Regression Analyses with Focus on Patient-Reported Behavioral Outcomes

The final reduced logistic regression model showed that the explanatory variables; less favorable MBI at baseline, to consider the communication with the DH during therapy as very good and treatment group (test) were significantly associated with the behavioral outcome “to be much more careful with oral hygiene habits after treatment” (Table 9 [Model I]; for univariate and adjusted full models see Paper II; Table 4; Dimenäs et al., 2024).

The final reduced linear regression model showed that to consider healthy oral conditions as very important at baseline, to consider the communication with the DH during therapy as very good and treatment group (test) were significantly associated with the behavioral outcome “confidence about keeping up healthy gingival conditions going forward” (Table 9 [Model II]; for univariate and adjusted full models see Paper II; Table 5; Dimenäs et al., 2024).

Table 9. Final reduced logistic (model I) and linear (model II) regression models to identify factors associated with the behavioral outcomes at 6 months.

| | Model I | | | Model II | | |
|---|---------|-------------|---------|----------|-------------|---------|
| | OR | 95% CI | p-value | B | 95% CI | p-value |
| Test group (ref. Control) | 1.98 | 1.06 – 3.67 | 0.031 | 0.53 | 0.17 – 0.89 | 0.004 |
| Male (ref. Female) | - | - | - | - | - | - |
| Native country other than Sweden (ref. Sweden) | - | - | - | - | - | - |
| Non-tobacco user (ref. Yes) | - | - | - | - | - | - |
| Weekly exercise (ref. No) | - | - | - | - | - | - |
| High motivation to engage in the upcoming treatment (ref. Else) | - | - | - | - | - | - |
| MBI baseline | 1.02 | 1.00 – 1.03 | 0.041 | - | - | - |
| Considered healthy oral conditions as very important (ref. Else) | - | - | - | 0.61 | 0.25 – 0.97 | 0.001 |
| Considered the communication with DH as very good (ref. Else) | 2.88 | 1.42 – 5.83 | 0.003 | 0.68 | 0.31 – 1.05 | <0.001 |

Model I: Final reduced logistic regression model for the behavioral outcome “Change of oral hygiene habits after treatment (much more careful)” including the variables significantly associated with the dependent variable in an adjusted full model. $n = 269$. Hosmer and Lemeshow goodness of fit $\chi^2 = 10.11$, degrees of freedom = 8, $p = 0.26$.

Model II: Final reduced linear regression model for the behavioral outcome “Confidence about keeping up healthy gingival conditions going forward (Scale 0-10, 0=being not at all confident)” including the variables significantly associated with the dependent variable in an adjusted full model. $n = 272$. Adjusted $R^2 = 0.12$. ANOVA p -value <0.001.

Note: Explanatory variables were reported/measured at baseline except communication with DH, reported at 6 months. Abbreviations: ANOVA, Analysis of variance; CI, Confidence interval; DH, Dental hygienist; MBI, Marginal bleeding index; OR, Odds ratio.

Associations Between Patient-Reported and Clinical Outcomes

To report “change of oral hygiene habits after treatment” in a positive direction showed a weak, but significant, association with more favorable self-performed infection control (MBI) at 6 months ($\rho=0.18$; $p=0.004$). No significant association was found between “confidence about keeping up healthy gingival conditions” and MBI at 6 months.

A final linear regression model, including the same explanatory variables as in the regression models for the two patient-reported behavioral outcomes (see Table 9), showed that favorable MBI at baseline and treatment group (test) were the only variables significantly associated with favorable MBI at 6 months. See Paper II; Table S1 [supplementary information, online]; Dimenäs et al. (2024).

Study III

The main theme “Adolescents on a guided and challenging journey towards beneficial oral hygiene behavior” was derived from three sub-themes which elucidated the different parts of the behavioral change process from initiation to maintenance. The sub-themes were composed by categories on a lower level of abstraction. An overview of the results is presented in Figure 7.

| Categories | Sub-themes | Main theme |
|--|---|--|
| <ul style="list-style-type: none"> ◆ Personalized, understandable information and practical skills training ◆ Personal goals and planning of how to reach them in everyday life ◆ Expressions of ambivalence between willingness and action | <p>Initiation: To gain insight and to feel involved - It is about me and my teeth</p> | Adolescents on a guided and challenging journey towards beneficial oral hygiene behavior |
| <ul style="list-style-type: none"> ◆ Realistic expectations and means to succeed ◆ Encouraged by means of a good treatment alliance and feedback on behavioral efforts ◆ Supported by significant others during behavioral change | <p>Action and change: To act by means of guidance and support</p> | |
| <ul style="list-style-type: none"> ◆ Keeping up new behaviors for one’s well-being and health ◆ Established beneficial new routines ◆ Need of reminders and support | <p>Maintenance: To keep up new behavioral routines, with continued need of reminders and support</p> | |

Figure 7. Condensed meaning units were grouped based on content into categories and sub-themes on different levels of abstraction in the analysis process. A main theme was identified covering the interpretation of the underlying meaning of interview data.

Initiation: To Gain Insight and to Feel Involved - It Is About Me and My Teeth

The adolescents described that the DH took the time to explain and explored their thoughts which made them feel acknowledged. In that manner, the information was perceived as more personalized “to me and my teeth” than previously experienced and they could thus relate to the information in a different way. The adolescents expressed that visualization of e.g. bacterial deposits made it easier to understand the information on a personal level.

Additionally, practical skills training with oral hygiene aids made them confident about what to do and how to perform these procedures at home.

The test intervention included formulation of personal goals which the adolescents described as somewhat difficult. Even so, they stated that the goal setting helped them to reflect on their oral conditions and to realize that a potential change of behavior was for their own sake. To write a plan for where, when and how they were to reach the goals and to reflect on barriers contributed to the treatment becoming more personal and serious. It was perceived as helpful to reflect on how to proceed in everyday life.

Despite good intentions for behavioral change and insight of the importance of improving their oral hygiene, the adolescents expressed ambivalence towards whether they would be able to accomplish their goals. This doubt was often related to previous experiences of failure.

Action and Change: To Act by Means of Guidance and Support

Realistic goals and planning were explained to increase the chance of achieving goals and that this differed from their previous experiences in dental care, which often were based on perceived expectations rather than own preferences. As part of the test intervention, the adolescents were to use a written diary to monitor their oral hygiene behavior. Most adolescents had not used the diary as intended and suggested a digital form instead, e.g. a smartphone-application, to avoid handling paper, while some expressed that the written diary had been a useful mean in their behavioral change.

To meet the same DH on several occasions and to talk about everyday things resulted in a more personal relationship and contributed to the feeling of being acknowledged as an individual and not be seen as one patient among many. The DH's statements were perceived to mean more if a good relationship was established. Feedback from the DH kept the motivation up and to actually see own progress in terms of e.g. less bacterial deposits

encouraged continued behavioral efforts. For some, support from e.g. a partner or parents had played a role in whether they succeeded with behavioral change.

Maintenance: To Keep up New Behavioral Routines, with Continued Need of Reminders and Support

The adolescents expressed that improved oral hygiene had contributed to feeling fresher and more confident when socializing. Maintaining beneficial oral health habits was considered important for future oral health.

If the new oral hygiene habits felt properly established, it was easier to maintain them after the initial intervention phase. For some, however, the pause in the field study between the 6- and 18-month follow-up was considered too long given the absence of any additional support by their DH.

Being a teenager was described as an intense period in life during which personal self-care, such as brushing your teeth, could easily be neglected. They discussed that adolescents might be in special need of reminders and support to maintain healthy habits.

Study IV

The main theme “From individual experts to partners – DHs changing direction from a disease-centered towards a person-centered approach” indicated that working in accordance with the test intervention entailed a changed professional approach. The main theme was derived from three sub-themes that in turn was composed by categories on a lower level of abstraction. An overview of the results is presented in Figure 8.

| Categories | Sub-themes | Main theme |
|---|---|---|
| <ul style="list-style-type: none"> ◆ Using open-ended questions and establishing a person-centered dialogue ◆ Visualizing oral hygiene conditions and practical skills training ◆ Scales as a mean to explore willingness and readiness for a change ◆ From professional goals and norms to the adolescents’ personal goals ◆ Promoting reflections on how to achieve goals and a commitment by incorporating planning | To initiate behavioral change by listening more and talking less – changing the expert role | From individual experts to partners – DHs changing direction from a disease-centered towards a person-centered approach |
| <ul style="list-style-type: none"> ◆ The need of time and follow-up visits ◆ Realizing the challenge with a written diary for self-monitoring ◆ Paying attention to and emphasizing personal success ◆ Assessing immediate improvements, but with difficulties maintaining new habits | To encourage continued efforts by acknowledging success and being supportive | |
| <ul style="list-style-type: none"> ◆ Having adequate competence to perform person-centered, theory-based, behavioral interventions ◆ Prerequisites and barriers for implementation of a person-centered, theory-based, behavioral intervention ◆ Reflecting on own professional responsibility for the quality of preventive care | To take responsibility in changing established work routines, but with barriers to overcome | |

Figure 8. The analysis followed steps of condensation and abstraction. The main theme represents interpretation of the underlying meaning of interview data. The main theme was derived from three sub-themes which were composed by categories on a lower level of abstraction. Abbreviations: DH, Dental hygienist

To Initiate Behavioral Change by Listening More and Talking Less – Changing the Expert Role

To work in accordance with the test intervention was initially experienced as challenging to the DHs. They felt as partly stepping into another role. Using open-ended questions and to dare being silent made room for the adolescents to be more engaged in conversation, which generated a more enjoyable relationship than previously experienced. This approach allowed the DH to explore the adolescent's perspectives and hence, tailor the information to the individual. Some DHs said, however, that the new way of communicating elicited uncertainty since they were used to provide more information. In addition, visualization of plaque and bleeding was considered to improve the adolescents' understanding about the disease.

Using scales to explore willingness and self-efficacy beliefs for behavioral change contributed to reflections and positive statements about change on part of the adolescents. Some DHs, however, faced challenges integrating scales naturally in the conversation.

Incorporating personal goal setting was expressed as contributing to a changed and more person-centered focus in treatment, greater participation in care and enhanced motivation. In addition, the plan formulated by the adolescents was perceived, by the DHs, as contributing to a serious commitment to the goals. If the adolescents' personal goals were perceived as too divergent from professional goals this could, however, generate a feeling of frustration on part of the DHs.

To Encourage Continued Efforts by Acknowledging Success and Being Supportive

The test intervention comprised three initial sessions. Most DHs expressed that they seldom met adolescents at several follow-up visits in daily practice. They

were, however, positive about putting in more effort in the initial treatment phase to achieve a behavioral change and recognized it as an investment.

The DHs noticed that the diary for self-monitoring was not always used by the adolescents as intended and expressed some doubts about whether they had sufficiently justified the purpose of the diary. They suggested that the diary might have been used more if it had been a smartphone-application.

The DHs expressed that it was important for the adolescents to see and acknowledge own success, which encouraged them to keep up with behavioral efforts. Still, the DHs found it difficult to share the sense of achievement if the behavioral change did not align with their professional treatment goals.

Most of the DHs expressed that the clinical results improved to the 6-month evaluation. Even so, some DHs had expected even better results considering the time spent on the intervention. The DHs also acknowledged difficulties for the adolescents in maintaining new oral hygiene behaviors in the long-term. However, some DHs expressed skepticism towards providing more visits to the dental clinic than already offered. In addition, the DHs expressed diverging opinions on how to continue with adolescents considered as non-adherent.

To Take Responsibility in Changing Established Work Routines, but with Barriers to Overcome

The DHs stressed the importance of adequate education and training to perform the test intervention. Participating in the field study had shifted their mindsets about behavioral interventions, especially to engage patients more in treatment.

Nonetheless, the DHs emphasized several prerequisites and barriers to consider if the intervention were to be implemented in daily practice. A key barrier that was emphasized by the DHs was the expenditure of time since children and adolescents are not allowed too much treatment time due to economic restraints. The dental organization was described, by the DHs, to increasingly resemble a “factory”, prioritizing economy over quality of care.

The DHs also highlighted the prerequisite of consensus among colleagues about establishing new ways of working due to expected resistance towards change. Furthermore, to have the management's support in implementing new working routines was considered as particularly important. However, in the light of the organizational prerequisites and barriers, the DHs reflected on their own responsibility for preventive care as well as their responsibility to influence preconditions to provide good quality care.

Main Findings

- ◇ The person-centered, theory-based, behavioral intervention (test) and conventional information/instruction (control) resulted in improvements in bleeding and plaque scores, with greater improvements for the test intervention. Adolescents in the test group brushed their teeth and used interdental cleaning aids more frequently compared with adolescents in the control group at 6 months (Study I).
- ◇ Adolescents in the test group were more satisfied with the education and communication during therapy. They also reported to a higher extent that they were much more careful with their oral hygiene habits after treatment and reported higher confidence (self-efficacy) about keeping up healthy gingival conditions, compared with the control group (Study II).
- ◇ The adolescents experienced the test intervention as a challenging journey and elucidated the importance of a person-centered approach in treatment. To gain personal insight about importance of improved oral hygiene was fundamental for a behavioral change. To plan and monitor oral hygiene behavior, with guidance and support by the DH, facilitated behavioral change and encouraged further behavioral efforts. However, individual needs of reminders and support should be acknowledged (Study III).
- ◇ The DHs experienced that working in accordance with the test intervention meant a changed professional approach, going from experts to partners, which was considered as challenging but more enjoyable. Prerequisites for implementing such an intervention in general dental practice were adequate knowledge and skills, own interest and willingness for a change and supportive work environment. The expenditure of time needed in relation to economic demands were seen as main barriers (Study IV).

Concluding Remarks

To address the aims of this thesis, quantitative and qualitative approaches were employed. The data collected and analyzed comprised both clinical outcomes and patient-reported experiences and outcomes of the interventions. Exploration of the adolescents' and DHs' experiences of and views on the person-centered, theory-based, behavioral intervention contributed to the understanding of how the intervention exert its effects, as well as with suggestions on further development of the intervention and on prerequisites and barriers to consider for implementation in daily practice.

A Person-Centered, Theory-Based, Behavioral Intervention - Clinical and Patient-Reported Outcomes (Studies I & II)

Study I revealed that both the person-centered, theory-based, behavioral intervention (test) and conventional information/instruction (control) resulted in improved clinical outcomes at 6 months, with greater improvements in the test group. In addition, at 6 months, a higher proportion in the test group reported that they brushed their teeth at least twice daily and cleaned interdentally at least 3 times a week.

The results of Study I are in line with the conclusions drawn from systematic reviews indicating that educational interventions guided by social cognitive constructs and with dental professionals using a collaborative communicative approach (like MI), have the potential to reinforce adherence to beneficial oral hygiene behaviors in adults with periodontal disease (Carra et al., 2020; Newton & Asimakopoulou, 2015; Vilar Doceda et al., 2023; Werner et al., 2016). In addition, the current findings support the results of previous studies suggesting the beneficial effects of using BCTs such as goal setting, planning and self-monitoring of behaviors in interventions to improve oral hygiene among adults with periodontal disease (Newton & Asimakopoulou, 2015; Vilar Doceda et al., 2023). To compare the current

intervention with other studies directed at adolescents in a dental setting is not straightforward due to the limited number of studies and the heterogeneity in study designs (see Table 2). However, studies performed in school-based settings have demonstrated that BCTs such as goal setting, planning and self-monitoring are associated with positive effects on self-reported oral hygiene behavior in young individuals (Gholami et al., 2015; Schwarzer et al., 2015; Schüz et al., 2009; Sniehotta et al., 2007; Zhou et al., 2015).

The combination of clinical assessments and patient-reported measures contribute to a more comprehensive evaluation of the interventions (Mercieca-Bebber et al., 2018). The results of Study II, with focus on patient-reported experiences and outcomes, further illustrate the beneficial effects of the test intervention. Hence, adolescents in the test group were more satisfied with the education provided and communication with the DH which indicates the benefits of a person-centered communicative approach in treatment. The current results could be seen in relation to previously reported findings emphasizing that adolescents considered dental professionals to often lack time for proper communication and personalized information/instruction (Östberg, 2005). The multiple regression analyses, performed in Study II, further support the importance of communication in treatment and as a factor significantly associated with positive self-reported behavioral outcomes. A higher proportion of adolescents in the test group reported themselves to be much more careful regarding their oral hygiene habits after treatment and reported higher confidence about keeping up healthy gingival conditions going forward. Satisfaction with own performance is closely related to self-efficacy, which in turn can contribute to a firmer commitment to goals and persistent behavioral efforts (Bandura, 1977, 2004; Ogden, 2019). Worth noticing is that the proportion of adolescents in the control group who reported taking good care of their daily oral hygiene declined from baseline to 6 months (Study II), aligning with their quite unchanged self-reported oral hygiene behavior (Study

I). Furthermore, 19% of the adolescents in the control group reported no difference of oral hygiene habits after treatment or even to be less careful which could be compared with 9% in the test group (Study II).

Based on the study design, it is not possible to identify which component(s) of the intervention that had the greatest impact on behavioral change. When interpreting the results, one should also keep in mind that the adolescents in the test group were in general offered more visits and consequently more time in the initial intervention phase. The fact that most of the adolescents in the control group were only offered one visit probably mirrors what adolescents with poor oral hygiene conditions are usually offered in routine care, or even more given a potential Hawthorne effect of the study.

Regarding clinical significance, a bleeding score of $\leq 20\%$ has been regarded as a high standard of infection control after non-surgical treatment of adult patients with periodontitis (Stenman et al., 2012; Wennström et al., 2005). In Study I, a mean MBI score of 20% was shown at 6 months in the test group compared with 26% in the control, with significantly greater improvement in the former (-20% vs -11%, small to medium effect size). Further, a higher proportion of adolescents in the test group reached a MBI score of $\leq 20\%$ (58% vs 42%), while 36% and 17% in the test and control groups, respectively, reached a MBI score $< 10\%$ and could thus be considered as periodontally healthy (Chapple et al., 2018; Tonetti & Sanz, 2019). Additionally, the statistically significant differences observed between study groups regarding self-reported experiences and outcomes (Study II) could most probably be interpreted to be of clinical significance as supported by the clinical outcome results.

Adolescents' Experiences of a Person-Centered, Theory-Based, Behavioral Intervention (Study III)

In Study III, the main theme illustrated that the adolescents had experienced the test intervention as a challenging journey which reflects a process of behavioral change. To gain personal insight into own oral health problem was explained as important in the beginning of the behavioral process. This was facilitated by the person-centered educational approach where the DHs listened to the adolescents and took the time to explain properly. From a health psychological point of view, insight into health benefits and risks creates the precondition for behavioral change (Bandura, 2004; Ogden, 2019). However, a fundamental part of interventions guided by social cognitive constructs is to strengthen self-efficacy to carry out the behavior in question. Self-efficacy can be affected by self-perceived success or failure regarding one's own performance (Bandura, 1977, 2004). Hence, initially, the adolescents expressed good intentions about changing behavior due to their newly gained personal insight into the importance of improved oral hygiene. However, they did also mention feelings of doubt regarding their ability to succeed which were often related to previous experiences of failure. Dental professionals should be aware of the possible imbalance between willingness to change behavior and self-efficacy to carry out the behavior in question. To learn and practice a person-centered and collaborative communicative approach, like MI, can facilitate exploration of such ambivalent feelings and thus, give guidance to the professional about aspects that need to be strengthened or elaborated on during the behavioral intervention (Miller & Rollnick, 2013).

The adolescents perceived goal setting, planning and self-monitoring of behavior as positive components of the intervention which made treatment more personal. To set own realistic goals and to plan how to achieve them increased the chance of succeeding, even though goal setting initially was perceived as somewhat difficult and unfamiliar. To succeed with a task can, as

described above, have a positive impact on self-efficacy (Bandura, 1977, 2004). This impact was strengthened by the adolescents' statements highlighting how witnessing own progress encouraged continued behavioral efforts. Nevertheless, the adolescents suggested that a digital version of the written diary for self-monitoring would have been easier to use. Considering the frequent use of smartphones among adolescents (Alexandersson, 2019; Andersson et al., 2023), this suggestion should be acknowledged in the development of the test intervention. There is a growing interest in using digital means, such as smartphone-applications, in health behavioral interventions (Patil et al., 2021; Virella Pérez et al., 2019; Väyrynen et al., 2023; Whitehead & Seaton, 2016).

The adolescents had experienced a more personal relationship with their DHs than previously experienced in dental care. The relationship was strengthened by meeting the same DH at multiple occasions and feedback from the DH encouraged further efforts. These results are in line with a recent interview study by Wallbing et al. (2023), exploring adolescents' experiences of a person-centered intervention for stress and pain management, delivered by school nurses. In that study, the findings emphasized that the person-centered approach had enhanced a trustful relationship with the school nurse which the adolescents explained as essential to promote a positive outcome. Meeting the school nurse at multiple occasions also fostered the relationship and was important to make progress visible, encouraging further efforts (Wallbing et al., 2023). The connection between a person-centered approach in communication and treatment alliance have been highlighted in a previous systematic review by Pinto et al. (2012), with positive impact on treatment outcome.

The adolescents' experiences of how the test intervention and its various components exert their effects (Study III) supported the significance of the results generated in Studies I & II. Still, the adolescents expressed that maintaining new oral hygiene routines after the initial intervention phase could

be challenging without further support by their DH. They expressed that adolescents might be in special need of reminders and support to keep up beneficial health behaviors over time, which has been suggested before by young individuals (Bregnballe et al., 2011; Fägerstad et al., 2019; Lindqvist et al., 2012; Östberg et al., 2002).

DHs' Views on a Person-Centered, Theory-Based, Behavioral Intervention (Study IV)

In Study IV, the main theme illustrated that working in accordance with the test intervention meant changing direction from a disease-centered towards a person-centered approach. The findings indicated that the DHs conventionally used a more directive way of communicating with adolescents, providing standard information about disease and treatment. This is partly in contrast with findings generated in previous interview studies among Swedish dental professionals who expressed the importance of communication and a person-centered approach in dental care (Shmarina et al., 2023; Stenman et al., 2010). The contrasting findings might be explained by the results of another interview study. Hence, according to Liss et al. (2020), Swedish DHs are well aware of how to provide high quality care but this awareness does not always reflect what is actually done in their daily practice. The DHs in the current study described that the person-centered communicative approach had created greater opportunity to explore the adolescents' perspectives and involve them in decision-making, fostering a more enjoyable relationship than previously experienced. This description aligns with fundamental aspects in person-centered care (Ekman et al., 2011). Even though the DHs in general experienced the test intervention as positive, the movement towards a person-centered approach was also challenging. This included a changed professional approach, from being the evident expert to encouraging partnership in treatment. Similar findings have been elucidated in previous interview studies

in health care (Andersson et al., 2015; Wigert et al., 2021). Hence, Andersson et al. (2015) explored nurses' experiences of supporting learning by using a person-centered approach directed at patients with long-term illness. The nurses emphasized a challenging shift, from providing conventional information about disease and treatment to focus on a genuine dialogue and daring to listen sincerely to their patients' perspectives (Andersson et al., 2015). In addition, Wigert et al. (2021) interviewed school nurses about their experiences of using a person-centered approach, directed at adolescents, to manage stress and pain. The school nurses had experienced a comparable transition from traditional knowledge transfer (monologue) towards a dialogue. They had listened more to the adolescents' perspectives and engaged them as partners in care. Furthermore, the school nurses felt that time and resources were saved long term, despite that the person-centered approach initially required more time which they thought could be seen as negative by the school administration (Wigert et al., 2021). Time and resources were also discussed by the DHs in the current study. Hence, they stressed the importance of time and follow-up visits for a desirable treatment outcome and mentioned it as an investment. Still, the expenditure of time in relation to the financial framework for dental care were identified as main barriers for implementation in daily practice. Time as a key barrier to implementation could be discussed in relation to Johansson et al. (2023), emphasizing the importance of that professionals and patients spend their limited time together focusing on what is most important for the patient i.e. on effective interventions (Johansson et al., 2023). Still, the DHs acknowledged adolescents' individual needs of reminders and support after the initial intervention phase. However, they expressed skepticism about providing even more visits to the dental clinic. Instead, they suggested digital meetings as an alternative.

The DHs also provided valuable insight about prerequisites for implementation of a person-centered, theory-based, behavioral intervention in

daily practice. Besides a supportive work environment and personal interest and willingness, the DHs highlighted the importance of adequate knowledge and skills to carry out the intervention. The DHs received a brief education and training before the start of the clinical field study but the need of more in-depth knowledge was raised. The findings are partly in line with findings from interviews with physical therapists on their experiences of performing a similar theory-based behavioral change intervention directed at adolescents in pain (Frygner-Holm et al., 2021). They highlighted the importance of adequate education before study start, but also that close supervision during the learning process was very important (Frygner-Holm et al., 2021). Such close supervision was not offered to the DHs who worked in accordance with the test intervention in the current clinical field study.

Methodological Considerations

Conducting the clinical field study in general dental care, intertwined in the DHs everyday treatment schedule, is unique and a strength of the study. The field study did contribute with warranted knowledge about effectiveness of the behavioral interventions tested (National Board of Health and Welfare, 2011, 2022; Werner et al., 2016). To collect and analyze both objective and subjective outcomes of the interventions is also a strength and contributes to a broad perspective on the effectiveness of the interventions. In addition, various strategies were applied to secure data quality and treatment fidelity (Borrelli, 2011; Perepletchikova & Kazdin, 2005). The low internal dropout in questionnaires indicates that the questions were understandable and worth answering. Strategies were implemented to reduce the risk of social desirability bias regarding the questionnaires (Streiner et al., 2015). Another strength is the sensitivity analysis on the primary clinical outcome (MBI), showing consistent findings with the per protocol analysis verifying the robustness of the findings (De Souza et al., 2016). Nevertheless, some limitations should be considered.

There was no blinding due to study design. All clinical assessments throughout the study were performed by the same DH who also performed the intervention, potentially resulting in biased outcomes. However, the same conditions applied for both treatment groups. The 12% attrition rate could be considered as low when compared with attrition rates of about 20% at 6 months in other studies on behavioral interventions among adolescents (Karlson & Rapoff, 2009). An attrition rate of about 20% was also shown in a recent field study conducted in the Public Dental Service, Region Västra Götaland, on the effectiveness of non-surgical therapy of periodontitis (Liss et al., 2021; Tomasi et al., 2022). A higher attrition rate was, however, observed in the test group, consistent with findings from a systematic review (Crutzen et al., 2015). The authors found no association between drop-out and potential moderating factors, such as amount of human contact in delivery.

The vast majority of Swedish adolescents are regularly recalled to the Public Dental Service. The field study being conducted at 17 clinics representing various sociodemographic characteristics within Region Västra Götaland, one of the largest regions in Sweden with both urban and rural areas, contributes to the generalizability of the results.

The qualitative interview studies (Studies III & IV) were conducted in accordance with established routines and guidelines to ensure high quality in data collection and analysis as well as to strengthen trustworthiness and reduce risk of researcher bias (Graneheim et al., 2017; Graneheim & Lundman, 2004; Krueger & Casey, 2015; Lindgren et al., 2020). The interviewer (SLD) had no personal relationship with the adolescents but had been involved in the education of DHs and served as the study monitor during the field study. This could have influenced the DHs' answers (Brinkmann & Kvale, 2015). Even though focus group interviews and individual interviews could generate somewhat different data, the combination of methods could contribute to enhance data richness (Lambert & Loiselle, 2008).

The informants in Studies III & IV represented a selected group of adolescents and DHs which needs to be considered when interpreting the transferability of the findings. However, as discussed above, the current findings are in line with previous studies in health care which indicates that the studies add knowledge that could be shared outside the specific study setting.

Ethical Reflections

The treatment protocols were not judged to entail an increased risk for the adolescents. Participation did not affect otherwise required dental treatment. The test intervention was based on the adolescent's autonomy and participation in treatment. Adolescents in the control group received treatment in accordance with "business as usual", thus similar to what they would have been offered if not participating in the study. However, the additional time spent at the dental clinic, e.g. to complete questionnaires, might have caused some inconvenience.

Informants in the interview studies were assured of the value of their personal views and were reminded of the importance of confidentiality in focus groups. All interviews aimed for a relaxed atmosphere and no observer was present during individual interviews to minimize power asymmetry (Barbour, 2013; Brinkmann & Kvale, 2015).

Significance and Clinical Implications

The findings from this thesis add relevant knowledge about the effectiveness of educational interventions guided by theory of health behavior. In addition, the findings may contribute to the development of efficient educational interventions directed at adolescents in general dental care. This is of significance given the importance of promoting periodontal health early in life to prevent progression of periodontal disease. The findings may also hold value for other areas in dental and health care that strive to elicit and strengthen motivation for a beneficial health behavioral change.

To work in accordance with a person-centered, theory-based, behavioral intervention (test) can more effectively improve oral hygiene in adolescents compared with conventional information/instruction. Hence, the test intervention seems to be more beneficial for the young individual and to a greater extent fulfill adolescents' desire to feel respected as persons and to make own health behavioral decisions. However, for the maintenance of beneficial oral hygiene behavioral changes, individual needs of reminders and support should be acknowledged.

To implement such an intervention in general dental practice, dental professionals need adequate knowledge and skills to address the complexity of human behavior. Moreover, on an organizational level, prerequisites as well as barriers need to be addressed.

Future Directions

- ◇ The next step of the clinical field study will focus on the analysis of health-economic aspects of the interventions as well as on long-term outcomes (18-month follow-up).
- ◇ Future studies within the project will focus on the development and evaluation of a smartphone-application as a mean for self-monitoring in person-centered, theory-based, behavioral interventions. In addition, based on adolescents' personal needs, offering digital meetings with the DH after the initial intervention phase will be tested and evaluated for the potential to encourage maintenance of new oral hygiene routines.
- ◇ An area for forthcoming study is implementation research, addressing the prerequisites and barriers highlighted by the DHs and the effective transfer of evidence-based knowledge to clinical practice.
- ◇ It would also be interesting to test the person-centered, theory-based, behavioral intervention among individuals with other oral disease conditions, such as caries.
- ◇ In general, there is a need for further studies on interventions that are guided by theory of health behavior and directed at adolescents due to the low body of evidence currently available.

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