Healthy teeth: all aboard!

Verlinden, Ashley

DOI:
10.33612/diss.951852361

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Prevention of dental caries through collaboration of well-child care and oral health care

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Deborah Ashley Verlinden

COLOFON

This research was supported by the Netherlands Organisation for Health Research and Development (ZonMw,) grant 200199501. This research was conducted within the Research Institute SHARE of the Graduate School of Medical Sciences, University Medical Center Groningen, University of Groningen and under auspices of the research program Public Health Research (PHR).

The printing of this thesis was financially supported by the Graduate School of Medical Sciences, Research Institute SHARE, University Medical Center Groningen, and the University of Groningen.

Cover design: Ridderprint
Graphic design: Ashley Verlinden
Printing: Ridderprint

rijksuniversiteit groningen

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Proefschrift

ter verkrijging van de graad van doctor aan de
Rijksuniversiteit Groningen
op gezag van de
rector magnificus prof. dr. ir. J.M.A. Scherpen
en volgens besluit van het College voor Promoties.

De openbare verdediging zal plaatsvinden op

woensdag 17 april 2024 om 14:30 uur

door

Deborah Ashley Verlinden

geboren op 1 augustus 1987

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CHAPTER 1

GENERAL INTRODUCTION

The general aim of this thesis was to improve community-based oral health care for children by adding evidence on targeting, effectiveness and performance. This aim involves three components. First, it provides information on caries prevalence and the socioeconomic differences related to this prevalence among young children (Part I). Second, it assesses the effects of two innovations in oral health care: oral health promotion for young children and their parents, through collaboration between oral health professionals and well-child care professionals (Part II). Finally, it assesses the implementation of interprofessional collaboration in oral health care (Part III).

This general introduction first presents a description of oral health in children, followed by an overview of various initiatives to promote oral health. Then it describes different practical and financial ways of organizing oral health care. It subsequently addresses how early dental visits and collaboration between Well Child Care (WCC) and dental professionals can help to prevent dental caries in children, and concludes with the research questions of this thesis.

1.1 Child oral health

Early childhood caries can be defined as the "presence of one or more decayed, missing, or filled primary teeth (dmft) in children aged 5 years or younger". Dental caries is the localized destruction of susceptible dental hard tissues by acidic by-products from bacterial fermentation of dietary carbohydrates (1). Caries is the most common non-communicable disease (NCD) in children worldwide (2). A recent study, following the World Health Organization (WHO) criteria, reports that early childhood caries affects 48% of all preschool children, and its distribution is global, with geographical variations (3). In 2017, 24% of 5-year-olds in The Netherlands had experienced caries, already with statistically significant and clinically relevant differences between low and high socioeconomic status (SES) groups, the low SES groups being severely disadvantaged (4). In this study, it was found that in low SES 5-year-olds, the average number of decayed, missing, or filled surfaces (dmfs) were 1.4 (SD=3.7), vs. 0.9 (SD=2.8) among Dutch high SES 5-year-olds.

Early childhood caries may lead to pain, inflammation and complications, including sepsis. It can also affect general health, body weight, growth, quality of life,

social functioning, and school performance (5-8). Caries has an impact not only on the children themselves, but also on their families and society (9). Furthermore, literature shows an association between child maltreatment and children with caries experience (10). One study reported that a dysfunctional family situation, and a lack of follow-up in dental care were associated with recurrence of severe caries experience in children (11). Governments are focusing increasingly on access to dental care for low SES groups. Because of the relatively high out-of-pocket payments for dental treatment, low SES groups may visit dental practices less frequently. The US agency Centers for Disease Control and Prevention stated that the limited capacity of the current dental system inhibits further implementation of early preventive oral health interventions, meaning that they must compete with the existing restorative treatments for children with severe caries experience (12).

Dental caries can largely be avoided, as several of its causes are preventable. Fisher-Owens and colleagues proposed a multifactorial model of putative determinants of childhood caries, with five key domains of determinants: genetic and biological factors, the social environment, the physical environment, health behaviors, dental and medical care (13). The aspect of time has also been included. The next paragraph will further describe the determinants, involving the domains social environment, health behaviors, and dental and medical care.

Regarding the social environment, socio-economic status (SES) and ethnicity were found to be relevant risk indicators of caries, leading to social inequalities in oral health (14-16). These socioeconomic differences in oral health may be related to the larger, worldwide problem of differences in health, linked to social determinants (14). These findings confirm a statement of the WHO Commission regarding socioeconomic differences as determinants of health: “The poor health of the poor, the social gradient in health within countries, and the marked health inequities between countries are caused by the unequal distribution of power, income, goods, and services, globally and nationally, the consequent unfairness in the immediate, visible circumstances of people’s lives – their access to health care, schools, and education, their conditions of work and leisure, their homes, communities, towns, or cities – and their chances of

leading a flourishing life. It is the result of a toxic combination of poor social policies and programmes, unfair economic arrangements, and bad politics. Together, the structural determinants and conditions of daily life constitute the social determinants of health and are responsible for a major part of health inequities between and within countries" (14; p.5).

Behavioral factors include poor oral hygiene (lack of twice-daily tooth brushing with fluoride toothpaste) and poor dietary habits (the number of occasions upon which cariogenic food or beverages are consumed) (1,17,18). In general, the daily use of fluoride is an effective way to prevent caries and to arrest existing caries lesions (19,20). Over the last generations, toothbrushing with fluoridated toothpaste has been the main reason for the reduction in caries prevalence and experience, especially in high-income countries (21). Nevertheless, despite a significant decline, early childhood caries remains a problem (22).

The relation between consumption of cariogenic food and beverages and caries has been widely recognized in the literature (23-25). The consumption patterns of the youngest children, toddlers to preschoolers, are of particular concern. Almost half (44%) of toddlers of 1.5 to 2 years old, consume a sugar sweetened beverage (SSB) on any given day (26). That proportion rises to 70% of 2- to 5-year-olds consuming a SSB on a typical day (27).

Previous research has identified several causes for non-compliance with dental health advice: "the causes of the causes" (18,28,29). Parents of young children play a key role, since they are responsible for the daily oral hygiene routines of their child. They need to be informed of the relevant recommendations, and need to have the skills to put oral hygiene recommendations into practice. Vermaire and co-workers described Dutch parental attitudes toward oral health in their children that may explain unfavorable dental health behavior (30). They reported that a considerable proportion of parents generally assume that the responsibility for the oral health of children lies with the dental professional (an external locus of control) rather than being the responsible themselves (internal locus of control). This is, of course, a misconception: by far the most important element in keeping teeth healthy is daily care of the teeth by the

individuals concerned. This includes brushing teeth with fluoride toothpaste, and eating and drinking less often per day.

1.2 Oral health promotion for children and their parents

The core of oral health promotion emphasizes a positive change of the preventable and modifiable determinants of caries experience in children. Interventions aimed at reaching an adequate level of oral health in children preferably start at the moment of eruption of a child's first tooth, or earlier. Oral health professionals play an important role in oral health promotion by providing good information, encouragement (motivational interviewing), assistance during decision-making processes, and instruction about adequate oral care. The American Academy of Pediatric Dentistry (AAPD) recommends establishing a 'dental home' (i.e., a dental practice where the child is patient) no later than twelve months of age (31). Public health interventions to reduce consumption of sugar-sweetened beverages and foods among (young) children are, apart from prevention of obesity and type 2 diabetes mellitus, also advantageous for caries prevention (32).

Furthermore, oral health promotion can be provided via the internet. Web-based interventions like websites and apps play an increasingly important role in oral health promotion. Via the internet, parents can easily access preventive interventions at any time, and on various devices like their smartphone or tablet. This advantage makes implementation of web-based interventions relatively easy and inexpensive. A good example is use of a web-based instructional film to demonstrate parents appropriate oral health behaviors for their children.

1.3 Oral health care systems: organization and financing of oral health care for children

Oral health care for children can be delivered by dentists, dental hygienists or dental (prevention-) assistants, and it can be provided in public dental health organizations, hospitals or private dental practices. In 2019, within European countries, individuals had an average of 1.3 consultation appointments with a dentist (33). However, this dropped

by 15% in 2020, during the first year of the corona pandemic.

Dental expenditures currently account for the third highest proportion of health expenditures in the European Union (2,34). Large global differences exist in payment fees of individuals or vulnerable groups for dental care (33, 35). In general, dental coverage for low-income countries (LICs) and middle-income countries (MICs) is usually lower than in high-income counties (HICs), with median estimates ranging from 35% in LICs to 82% in HICs (36). Over 7% of citizens in Latvia, Portugal and Greece reported unmet needs for dental care in 2020 as a result of financial limitations (33).

Because health-care decisions often involve a compromise between a realistic level of effectiveness and available financial resources it is necessary to identify the most cost-effective approaches (37). Vermaire and colleagues evaluated the cost effectiveness of the Non Operative Caries Treatment Program (NOCTP) approach among 6- to 9-year olds; they reported that, from a societal perspective (all relevant costs included), preventing an additional 1 DMFS would cost 100 EUR (38). Two cost-effectiveness studies of the Atraumatic Restorative Treatment (ART) approach considered it a cost-effective approach for children (39,40).

Dental care for children can be provided in a similar way as dental care for adults. However, specific programs aiming at this age group have also been developed, to reach this group more effectively. A structured program in dentistry to offer preventive oral care to children is the NOCTP approach, mentioned above (41). Research has revealed that considerable oral health improvement can be achieved if parents are taught how good oral health can be achieved and maintained by participating in the NOCTP. This protocol is used by dental professionals, and targets young children. The method was developed in Denmark and has been successfully applied internationally (38,42-44). NOCTP focuses on individual caries prevention, using a risk assessment per person. For the Netherlands, when this approach was studied in a population of 6 to 12-year-olds, it showed a significant improvement of oral health at acceptable costs (38,44). Another well-known approach to manage dental caries in children is the ART approach, also mentioned above.

The ART approach is also considered to be a minimally invasive approach for the management of dental caries (45).

1.4 Early initiation and collaboration of well-child care and oral health care

The importance of early initiation with oral health promotion is beyond dispute (46). Pine and Harris (29) have pointed out that "a major reason for the lack of success of many oral health programmes is the fact that they operate in isolation, separate from the general health care structure. An approach in which different health care workers are involved is needed." Gussy suggested that primary care health professionals, such as general medical practitioners and child health care workers who have frequent contacts with children well before the age of the first dental visit, may be well placed to offer advice about reducing the incidence of early childhood caries (47). Such interprofessional collaboration between oral health professionals, well-child care (WCC) professionals, general practitioners, preschool and daycare teachers and social workers to promote oral health is supported by several studies (48,49). Collaboration with WCC clinics is particularly desirable because of their extensive reach.

A way to reach the population of very young children may be the instrument of WCC, which offers preventive pediatric care from birth until the age of 18 or 21 years in many countries, including the USA and the Netherlands. At WCC clinics, children receive scheduled immunizations, and their growth and development figures are monitored. The WCC also detects early potential health problems such as growth disorders, obesity, motor skills- and language/speech disorders. Care for children aged 0-4 years is supplied by the WCC through well-baby clinics. WCC professionals promote health behaviors and provide care where necessary. Furthermore, parents can always talk with the physician or nurse regarding their concerns about parenting and the health of their child. In the US it was shown that the 2-, 4-, and 6-month visits were the most frequently attended WCC visits (63% to 90%), whereas the 15- and 18-month visits (41%–75%) and the 4-year visit (19%–49%) were the least frequently attended (50, 51). Information about oral health is part of the package of basic tasks (care and supervision provided by the system), albeit not a mandatory element. It is as yet unknown to what extent individual YHC doctors or

nurses provide individual education to parents of young children about oral health (52).

Considering the impressive reach of WCC, an intervention that utilizes WCC with an approach involving preventive individual referral to a dental clinic may be promising to achieve early initiation of dental visits for parents of newborns. A recent Dutch study of perspectives of professionals, including WCC professionals, concluded that a broad child-, parental-, and societal-centered educational communication strategy can be promising, and that interdisciplinary collaboration requires a better understanding of a family's oral health needs, as well as the needs of professionals working within and outside the oral health care setting (49).

A new caries prevention intervention, combining an existing population approach for all children and an individual approach for children at risk of poor oral health, would be valuable. Referral by well-child care for a first preventive dental visit can be considered part of a population approach, whereby the individual approach is operationalized by following the NOCTP approach in dental practices. For this new integrated intervention, further described in Chapter 4 and 5, two existing systems were combined for optimal effectiveness.

1.5 The context of the current study: the Netherlands

This section presents a description of WCC in The Netherlands, and then outlines the organization of dental healthcare in The Netherlands. Regarding WCC, in the Dutch system children attend well-baby clinics from birth, at no cost (53). These clinics reach 92% of all parents and children from birth until the age of 4 years, including groups with low socioeconomic status and diverse ethnicities (54, 55). A manual for WCC exists, called "Focus areas for preventive oral care in 0-19-year-olds in child health care", but this is not obligatory for professionals and was published many years ago (56).

In the Netherlands, dental care for children aged 0-18 years old is covered through the (mandatory) basic health insurance package. In 2021 the costs related to dental care for this group were reported to be 818.5 million euros, and costs continue to rise (57). In the Netherlands, dental care is executed by dentists and dental hygienists (in this thesis further called "dental professionals"), most of whom are employed in solo or

group practices; a minority of dental health professionals work in a hospital. In 2013, the recommended age for the first dental visit changed from 2 years to 6 months of age (58). The recent 'Clinical practice guideline dental and oral care for kids and adolescents' for dental professionals also recommends the first dental visit of the child around the eruption of the first tooth (59). In 2021, 7.9% of Dutch 1-year-olds and 64.6% of 2- and 3-year-olds had visited a dentist; this indicates that children's first dental visits are relatively late even though dental care is free of charge for the parents (60).

On 1 November 2022, the Dutch parliament voted on a motion to place a dental hygienist at WCC clinics to improve the oral health care of children from high-risk groups (61). The Dutch Minister of Health,Welfare and Sport (MinVWS) agreed with the motion, which would include providing parents with oral hygiene advice at the WCC clinic. Further evidence is needed regarding the cost-effectiveness of this proposal. Meanwhile, the cabinet is exploring how to start with the activities of the oral health coaches at WCC clinics in deprived neighborhoods.

For the 'Healthy teeth: all aboard!' (HTAA) intervention study described in Chapter 4 and 5, East Groningen and The Hague were selected as intervention regions. In East Groningen, 30% of the population fall under the low SES group. The Hague has large numbers (48%) of children from ethnic backgrounds other than Dutch. Both low SES and a migrant background have been proven to be strong risk indicators for dental caries. In The Hague a Youth Dental Care organization (YDC) is available, and East Groningen has private group- and solo dental practices.

An important issue that affected the HTAA intervention study was the COVID-19 pandemic, which had a large impact on performing research studies. As declared by the WHO on the 11th of March 2020, the transmission of the "severe acute respiratory syndrome coronavirus 2" (SARS-CoV-2) was the beginning of the COVID-19 pandemic (62). To control the pandemic, governments in many countries applied firm measures, including lockdown periods during which children and adolescents received online education at home, mandatory teleworking/homeworking for 'non-crucial' employees, and closure of dental healthcare clinics.

1.6 Aim, research questions and outline of the thesis

The general aim of this thesis is to provide insight into caries prevalence and socioeconomic differences among young children (Part I), to assess the effects of two innovations in oral health care, i.e. oral health promotion for young children and their parents and collaboration between oral health professionals and well-child care professionals (Part II) and into the implementation of interprofessional collaboration in oral health care (Part III). By doing so, this thesis may contribute to improve the oral health of young children. The general aim has been translated to several research questions (RQ). The outline of this thesis is as follows:

Part I Oral health of young children

Chapter 2 discusses a cross-sectional study assessing differences in caries experience related to socioeconomic status in a health care system offering full coverage of dental costs for children up to the age of 18.

- RQ1: What differences in caries experience, related to socio-economic status (SES), exist in a health-care system with full coverage of dental costs for children up to the age of 18?

Chapter 3 assesses whether the COVID-19 lockdown affected routine parental oral care for their children.

- RQ2: In which ways did restrictive measures during the corona pandemic affect family structure and parental oral health behavior?

Part II The effectiveness of oral health promotion for young children and their parents, and of collaboration of oral health professionals and well-child care (WCC) professionals

Chapter 4 reports whether active or passive referral of parents of babies for a first preventive dental visit by a well-child clinic physician leads to earlier initiation of dental care.

- RQ3: Does referral of parents of babies for a first preventive dental visit by a well-child clinic physician lead to earlier initiation of dental care, and does this differ for active vs. passive referral?

Chapter 5 discusses whether referral of parents of newborns by a well-child care (WCC) clinic doctor for an early first dental visit, combined with the Non Operative Caries Treatment program (NOCTP) approach in dental practices, is effective to promote timely first dental visits and to decrease caries experience in children.

- RQ4: Does referral of parents of newborns by a well-child clinic physician for an early first dental visit, combined with the Non-Operative Caries Treatment Programme (NOCTP) approach in dental practices, decrease caries experience in children by the age of five years?

Based on a non-blinded quasi-experimental study, chapter 6 evaluates the effectiveness of an 8.5 minute web-based film about oral health, provided by well-child care.

- RQ5: What is the 6-month effectiveness of an 8.5-minute web-based film about oral health routines in well-child care aimed at improving parental knowledge about oral health?

Part III Implementation of interprofessional collaboration in oral health care

Chapter 7 describes how a collaboration between well-baby clinics and oral health care can be formalized to reach all young children and their parents earlier for (preventive) dental care.

- RQ6: How can the collaboration between well-baby clinics and oral health care be formalized to reach all young children and their parents earlier for (preventive) dental care?

Chapter 8 assesses the validity of: a) patients' self-report (PS) and routine electronic patient records (EPR) regarding time spent per visit, and b) PS regarding types of treatment and type of dental professionals involved.

- RQ7: What is the validity of a) patients' self-report and routine electronic patient records regarding time spent per visit, and b) patients' self-report regarding type of treatment and type of dental professionals involved?

Finally, Chapter 9 contains the general discussion and presents recommendations for oral health promotion policy and research. Chapter 10 summarizes the findings and conclusions of this thesis. Figure 1.1 illustrates the relationship between the research questions of this thesis.

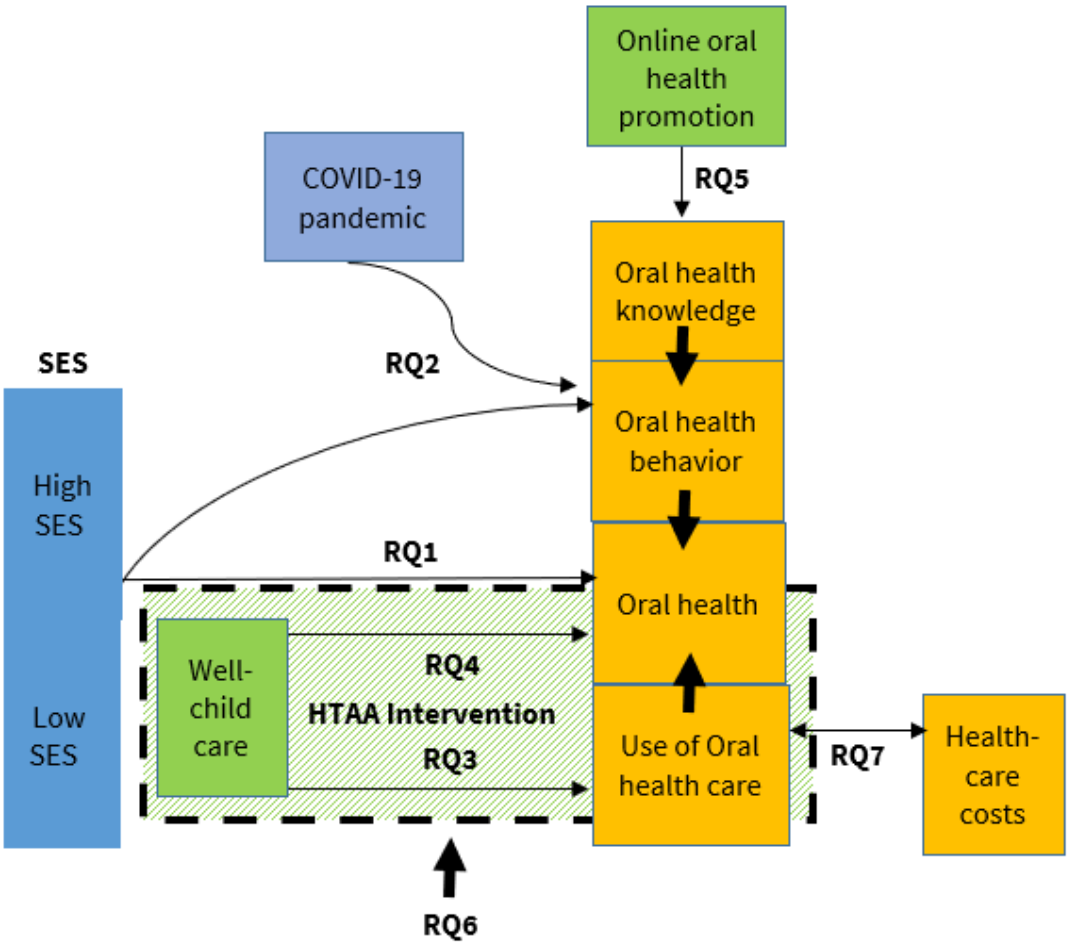

Figure 1. Conceptual model of this thesis and how the research questions (RQ) are related.

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PART I

CARIES PREVALENCE AND SOCIOECONOMIC DIFFERENCES AMONG YOUNG CHILDREN

CHAPTER 2

SOCIOECONOMIC INEQUALITY IN ORAL HEALTH IN CHILDHOOD TO YOUNG ADULTHOOD, DESPITE FULL DENTAL COVERAGE

Published as: Verlinden DA, Reijneveld SA, Lanting CI, van Wouwe JP, Schuller AA. Socio-economic inequality in oral health in childhood to young adulthood, despite full dental coverage. *Eur J Oral Sci.* 2019; 127: 248-253.

Abstract

The aim of this cross-sectional study was to assess differences in caries experience by socioeconomic status (SES) in a health care system with full coverage of dental costs for children up to the age of 18. In 2011 and 2014, by performing hurdle negative binomial models, data were obtained on 3,022 children and young adults aged 5, 8, 11, 14, 17, 20 and 23 years, living in four cities in the Netherlands. At all ages between 5 and 23 years, the percentages of children with caries-free dentitions were lower and mean caries experience were higher in low-SES than in high-SES participants. In 5-year-olds with dmft>0, mean caries experience was 3.6 in low-SES and 2.3 in high-SES children. In 23-year-olds, these estimates were 6.8 and 4.4, respectively ($p<0.05$). Low-SES children have a greater risk of more caries experience than high-SES children. Thus, in a system with full free paediatric dental coverage, socioeconomic inequality in caries experience still exists. Dental health professionals, well-child care doctors and nurses, general practitioners, and elementary school teachers should collaborate to promote oral health at community level, with a specific targeting of low-SES families. We further need policy measures to curtail at community level the increasing availability and consumption of highly processed, carbohydrate-rich foods, with particular attention for low-SES families as well.

Introduction

Disparities in child health by socioeconomic status (SES) are often reported. Youth in high-SES families generally experience better health than youth in low-SES families (1). Children and young adolescents experiencing socioeconomic disadvantages encounter a wide range of health risk factors and adverse outcomes in adulthood (2), including increased risks of injury, asthma, elevated blood pressure, as well as involvement in risky health behaviours such as smoking and physical inactivity (2,3).

Dental caries experience is reportedly a strong indicator of socioeconomic inequality in both children and adults (4-11). It is the most common paediatric disease (12). Among 5- to 17-year-olds in the United States, dental caries is over five times more common than asthma and seven times more common than hay fever (13). The term "dental caries" refers to decay on any surface of a tooth (14). It is characterised by a continuum of disease states, ranging from subclinical lesions to cavitated lesions that extend into dentine or even into the pulp. If left untreated, caries may lead to pain, discomfort, infections or tooth loss. Dental caries, and poor oral health in general, has a major impact on children's overall health, growth and development. It not only affects the ability to chew and eat properly, but can also result in lost school hours and affect a child's overall wellness and self-esteem (15, 16).

Prevention of caries in children regards adequate oral hygiene and a healthy diet with limited cariogenic foods, as well as starting young with dental check-ups and regular dental visits. Risk factors, on the other hand, include brushing teeth less than two times a day, frequent consumption of cariogenic foods, skipping breakfast, and lower parental educational level and income (12, 17, 18, 19, 20). Individuals of low SES have been found to be more likely to have inadequate preventive oral health behaviour (21, 22).

Availability of full financial coverage for costs of dental care may also affect whether children receive dental care, and the occurrence of dental caries (23). However, other factors may contribute, such as low parental oral health literacy and limited parental language proficiency (23, 24). Moreover, care-related barriers may add to this, e.g. inadequate preventive services, care that is not culturally well adapted, and services

that do not fully take into account low levels of oral health literacy (23, 24).

In the Netherlands, dental care for youth is included in the mandatory health insurance, and free of charge for children up to 18 years of age. Research in this setting can clarify to which degree factors other than the costs of dental care contribute to socioeconomic differences in caries experience. The research question for this study was therefore: In a health care system with full coverage of dental costs for children up to the age of 18, does a socioeconomic difference in caries experience exist, based on SES? Our hypothesis was that between socioeconomic groups in children up to 18 years of age, all of whom have free access to dental services, no differences in oral health would exist.

Material and Methods

Study population

During the study period from 2011 through 2014, children and young adults aged 5 to 23 years who were living in four medium-sized cities in the Netherlands were eligible to participate. These four cities (Gouda, Alphen aan den Rijn, Breda and Den Bosch) are typical of the Dutch population in age, gender, ethnicity, and marital status (25). Random samples were drawn from the municipal population records of each city and stratified by age, to reach similar numbers per city per age category. Sample sizes were determined based on the potential to detect relative differences of 30% in mean caries experience, from earlier estimates from 2005 and 2009, at an alpha of 0.05 with a power of 80%. This led to a required sample size of about 450 children per age category (26, 27).

In total, 13,961 children and young adults aged 5 to 23 years (and their parents) received invitations to participate, including information about the purpose of the study. Trained interviewers personally attempted to contact individuals who had not responded, to emphasize the importance of the study. If the initial contact attempt failed, the interviewer made a maximum of three additional attempts. Individuals who refused to participate were asked to fill out a nonresponse questionnaire with questions about gender, SES and oral health behaviour. Of the 13,961 children and young adults and their parents invited to take part in the study, 3,022 (23%) participated.

Ethics statement

The Central Committee on Research Involving Human Subjects concluded that no ethical considerations were involved, as the clinical proceedings were harmless and the questions not sensitive in nature. The study met all the requirements of the Personal Data Protection Act (number m1383077 for 2011 and number m1556571 for 2014).

Procedure and measures.

Data were gathered via clinical oral examinations and a questionnaire. The questionnaire was completed by a parent for the 5-, 8- and 11-year-olds and by the 14-, 17-, 20- and 23-year-olds themselves. In this study, SES was operationalized as the highest level of education completed by the mother of the children aged 5, 8 and 11 years or by the adolescent/young adult (14, 17, 20 and 23 years of age). A total of ten or fewer years of education was coded as low SES, whereas a total of more than ten years of education was coded as high-SES. This decision was in accordance with the International Standard Classification for Education 2011 (28).

The total score of the decayed, missing and restored teeth (DMFT) index was used to indicate level of caries experience (29). The DMFT score represents caries experience in permanent teeth, whereas the dmft score represents that of deciduous teeth. Caries-free dentitions are defined in our paper as those with dmft=0 or DMFT=0. Caries experience was observed during a clinical oral examination that comprised visual inspection of the teeth with documentation of caries lesions and any subsequent treatment (i.e., restoration or extraction). Participants in urgent need of treatment were advised to visit their dental professional.

Clinical examinations were performed by four dentists in a mobile oral health facility. During the clinical assessment, both permanent and deciduous teeth were evaluated, depending upon the age of the participant. For children aged 5 years, only caries in deciduous teeth was included. For children aged 8 years, caries in both deciduous and permanent teeth was included. For children aged 11 or more years, permanent teeth were evaluated, with the exclusion of wisdom teeth.

To assess the quality of the clinical examinations, we determined the inter-

examiner agreement for 304 participants in 2011 and 137 participants in 2014. We calculated overall Pearson correlations and intraclass correlations between the two examiners, and mean outcomes of each examiner for dmft and DMFT. The intraclass correlation coefficients were 0.92 and 0.95, respectively. Differences between the two examiners in mean caries experience were clinically negligible (i.e. at maximum 0.2 dmft and DMFT).

Data analysis

First, we calculated descriptive statistics for gender, SES, ethnicity, tooth brushing frequency and dental attendance for the 5-, 8-,11-,14-,17-, 20- and 23-year-olds in the sample. Second, we assessed mean caries experience for low-SES and high-SES children. We used Student's t-tests or Mann-Whitney U tests to assess statistical significance, depending upon the frequency distribution. Crosstabs and chi-square tests were used for categorical variables. Third, we assessed differences in caries experience by SES and age, using hurdle modelling. Hurdle models have the advantage of estimating two separate parameters to accommodate many zero counts: one estimate for the dichotomization of zero versus non-zero (i.e. caries-free or not) and one for caries experience in cases of not-caries-free. Since the count part had a negative binomial distribution, we used a negative binomial hurdle model (30). Hurdle analyses yield odds ratios for the probability of having any caries, and, in the case of those with caries, rate ratios comparing the greater caries experience of low-SES than that of high-SES groups (30). We made one hurdle model for caries experience in the deciduous teeth and another for caries experience in the permanent teeth. Models were adjusted for age and age-squared because the relation between age and caries experience for the count part was not linear. We performed bivariate analyses using SPSS 22.0, and negative binomial hurdle models in R, version 3.3.2.

Results

Table 1 shows the characteristics of the participants. Of all participants, 46% were male and 39% had a low-SES.

Table 1. Characteristics of participants by age category

		Age (in years)						
		5	8	11	14	17	20	23
	n	302	363	453	619	434	438	413
Background characteristics								
Male gender	%	54.9	54.0	49.8	46.5	43.3	39.3	35.7
Low SES	%	40.3	38.8	40.8	41.0	38.8	34.7	36.9
Mother with Dutch ethnicity	%	83.1	87.8	88.9	85.0	82.4	85.3	83.7
Oral health behaviour								
Tooth brushing 2x/day	%	73.9	85.4	82.1	80.6	71.3	73.3	72.6
Dental check-up 2x/year	%	78.2	87.1	89.7	84.0	82.9	67.1	65.6

Table 2 shows caries experience in deciduous and permanent teeth, and mean caries experience according to age and SES. For all ages except 11 years the percentages of children with caries-free teeth were lower for low-SES children than high-SES children (P<0.05). We observed mean dmft (or DMFT) scores to be higher in low-SES children than high-SES children.

Table 3 shows odds ratios and rate ratios for the association of SES and age with caries experience in children aged 5 and 8 years and children 14 years and older. Low-SES children had higher odds of dmft>0 or DMFT>0 than high-SES children. Low-SES children with dmft>0 or DMFT>0 had (on average) more caries experience than high-SES children, teens and young adults. Older children had higher odds of dmft>0 or DMFT>0 than younger children. Older children with dmft>0 or DMFT>0 had more caries experience than younger children. We found no statistically significant interaction of SES with age.

Table 2. Percentages of Dutch children and young adults with caries experience in deciduous or permanent teeth, and mean caries experience (SD) of them, according to age and SES (2011-2014).

	Age category (yrs) and tooth type						
	n						
Variable	5[a]	8[b]	11	14	17	20	23
	295	363	448	619	420	438	401
dmft>0 or DMFT>0 (%)							
Low SES	42.9 *	56.7 *	26 *	21.3	53.5 *	66.9 *	75.0 *	89.2 *
High SES	29.5	48.6	14	18.9	38.1	52.9	70.3	77.9
Mean caries experience (SD) when dmft>0 or DMFT>0							
Low SES	3.6 (2.6) *	4.3 (2.6) *	1.7 (0.8)	2.0 (1.2)	3.3 (2.8) *	4.1 (3.6)	5.4 (4.3) *	6.8 (5.4) *
High SES	2.3 (1.7)	3.1 (2.1)	1.8 (0.9)	1.7 (1.1)	2.3 (1.6)	3.3 (2.6)	4.4 (3.9)	4.4 (3.2)

[a] In this age group, caries experience in the 20 deciduous teeth only.

[b] In this age group, caries experience in deciduous and permanent teeth as present.

***** Statistically significant different from high SES group (p<0.05).

Table 3. Odds ratios (OR) for dmft>0 and DMFT>0, and rate ratios (RR) for caries experience in deciduous and permanent teeth of children and young adults, according to SES and age: findings of Hurdle models.

	Deciduous teeth		Permanent teeth[a]	
	OR for dmft>0 (95% CI)	RR for caries experience (95% CI)	OR for DMFT>0 (95% CI)	RR for caries experience (95% CI)
SES	1.66**	1.55***	1.75***	1.47***
(Low vs. High)	(1.13 - 2.14)	(1.32 - 2.08)	(1.41 – 2.16)	(1.29 – 1.68)
Centered age	1.15 ***	1.31*	1.22***	1.11***
(per year)	(1.14 – 1.51)	(1.02 - 1.29)	(1.18 – 1.27)	(1.08 - 1.15)
Centered age^{2} [a]			1.00	0.99*
			(0.98 – 1.01)	(0.98 – 1.00)
Centered age x SES	0.93	0.92	0.99	1.01
	(0.74 – 1.14)	(0.79 - 1.09)	(0.93 – 1.06)	(0.97 - 1.04)

CI = Confidence interval * p < 0.05, ** p < 0.01, ***p<0.001.

[a.] We included a quadratic term for centered age to reach a better fit of the data with the model.

Discussion

At all ages between 5 and 23 years low-SES children were less likely to have caries-free teeth and had at average more caries experiences. The absolute difference in caries experience between low-SES and high-SES children was greatest among 23-year-olds. Low-SES children and older children had higher odds for dmft>0 or DMFT>0 than high-SES and younger children. Also, when having caries, low-SES children and older children had at average more caries experiences than high-SES children and younger children, respectively.

We found a difference in caries experience by SES in a health care system with full coverage of dental costs for children up to the age of 18. Epidemiological research in the

Netherlands reported dental check-up rates of around 95% for low-SES and high-SES children from ages 4 to 16 years (31). Moreover, in our sample, we also found that most participants in all age groups visited dental professionals yearly. Nevertheless, socioeconomic differences in caries experience existed, which may be explained in several ways: by client-related factors, by professional-related factors or by the organisation of care.

With respect to client-related factors, children from low SES groups have been shown to have a greater risk of unfavourable preventive oral health behaviour than their high SES counterparts, resulting in the gradient found in caries experience (21, 22, 32-34). Low-SES households consume more highly processed carbohydrate-rich foods, because these foods are more affordable (35). Adequate regulation of availability and prices of such junk food and sugar-sweetened beverages lacks. There is a lack of regulation and prices for production and prices of junkfood and sugar-sweetened beverages. Another client-related factor is that low SES parents may have lower oral health literacy than high SES parents, and because of that a limited potential to train their children in optimal dental care. In the matter of professional-related factors, not all dental professionals may have the skills to promote oral health behaviour effectively among low-SES parents, nor to solve the challenges associated with lower levels of oral health literacy (36, 37). Concerning factors related to the organisation of care, clear guidelines for oral health promotion and prevention are not yet available. Without guidelines, dental professionals may be insufficiently informed about the recommendation to train parents and their children to keep their children‘s teeth healthy, and the methods to reach this.

Our findings of differences in caries experience between low-SES and high- SES participants are in line with those of studies completed in Switzerland, Brazil, Denmark, Australia, Los Angeles County (USA), Norway and southern China (4-8, 10, 11, 38). These findings indicate the socioeconomic inequality in oral health in children in multiple countries, despite different dental coverage systems.

In a Dutch system with full dental coverage we found inequalities in caries experience by SES from the ages of 5 years through 23 years. In Denmark,

socioeconomic inequality was still found to exist in dental health even though almost all children and adolescents attended a free public dental service (6). Moreover, according to DARMAWIKARTA et al., among urban Canadian children who had been to a dentist, children in low-income families were more likely to have dental caries (39). Findings from a study conducted in North Carolina showed that low-income children with extended dental coverage had less dental caries experience than children in Medicaid (40). These findings indicate that although free dental services are important for children, socioeconomic differences in caries experience may persist nonetheless (Figure 1).

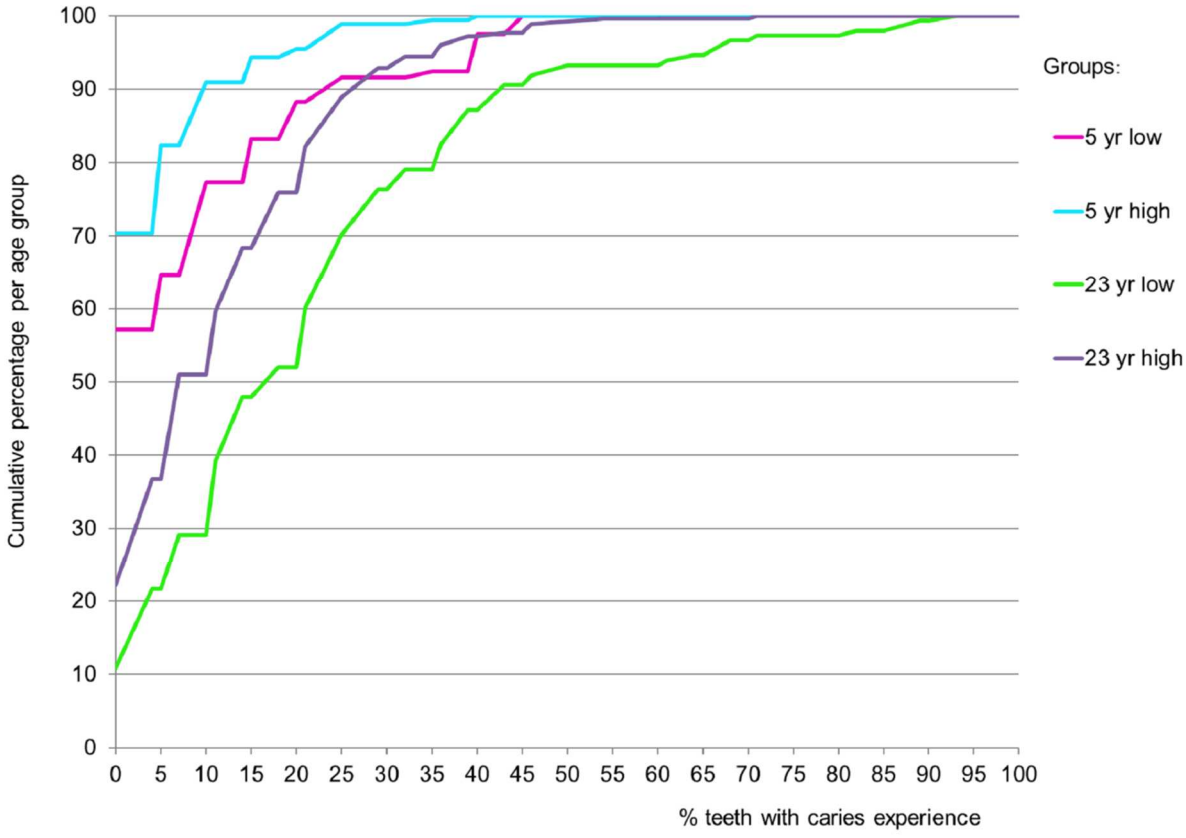

Figure 1. Cumulative percentages per group for percentages teeth with caries.

One hundred percent teeth with caries experience is for age five years, twenty teeth with caries experience, and for twenty-three years, twenty-eight teeth with caries experience.

The findings of this study should be considered in light of its strengths and limitations. The strengths include the large sample of children and young adults shown

to be representative of the Dutch population of 5- to 23-year-olds with respect to background variables (26, 41). Moreover, the dental examinations were carried out by trained professionals with satisfactory inter-examiner agreement. There are also some limitations. Given the low response rate of 23% selection bias may have affected our findings. In our study, the inclusion of participants stopped when the required number was reached, slightly increasing non-response rates, but less likely causing bias. Non-response analyses indicated why people were unwilling to participate. The most frequent reasons were lack of interest, lack of time, and anxiety, with in particular the latter reason potentially giving some bias. Moreover, selection bias is less likely as the demographic characteristics of the sample were very similar to those of the general population . A second limitation may be that we assessed SES only by educational level and not by other measures such as income or occupation. Asking about educational level has the advantage of high response, particularly in contrast to asking about income; moreover, in the Netherlands, educational level has been found to be the most sensitive indicator of SES (42).

Our finding of large absolute differences by SES in all age groups in a country with a system of full dental coverage suggests a need for additional preventive efforts. The disease of dental caries is preventable (43). One way to prevent it is to change unfavourable oral health behaviour like tooth brushing less than twice a day and frequent consumption of cariogenic food and drinks. Interventions to reach children to prevent caries experience may include enhancing oral health literacy, as well as improving parental knowledge, skills and self-efficacy in relation to preventive oral health behaviour, both early in life and thereafter.

In this study, differences in mean caries experience between low-SES and high-SES children were already present in 5-year-olds, despite full dental coverage. One could hypothesize that children receive preventive dental care too late. To minimize socioeconomic differences, community-based interventions aimed at improving the oral health of children and young adults should start early in life, as early as the age of 6 months when the first tooth erupts (44, 45). To reach all children, better integration of preventive dental care in well-child care, paediatric primary care and elementary school

programs could improve caries prevention.

Another challenge to decrease the socioeconomic gap is the growing problem of a higher intake of highly processed foods with added sugars in low-SES households, mainly because these low quality foods are more affordable (35) . The cariogenic and obesogenic environment is especially a problem in more deprived areas. Better regulation policies for production, pricing and provision of highly processed foods with fermentable carbohydrates are needed. Furthermore, dental health professionals, well-child care doctors and nurses, and general practitioners should collaborate at community level, to motivate parents for healthy food choices. Such community-level interventions are for instance integrated preventive dental care by dental hygienists at well-child clinics or routine referral of children to a dental clinic by the well-child clinic paediatrician. Both interventions are researched for (cost)effectiveness now in the Netherlands. Dental professionals participating in these interventions perform the Non-Operative Caries Treatment Program while caring for children's teeth (46, 47).

Conclusion

In conclusion, low SES is associated with a lower prevalence of caries-free teeth and more caries experience at the ages of 5 to 23 years, even in a system with full dental coverage. Remaining socio-economic differences indicate that other factors than only access contribute to these differences. Low SES children may be at a higher risk of unfavourable preventive oral health behaviour than their high SES counterparts. Dental professionals may not have the skills to promote oral health behaviour effectively, often with challenges for lower levels of oral health literacy. Furthermore, clear guidelines lack for preventive dental care for children. Community-based interventions to decrease the socioeconomic differences and to improve oral health may include enhancing oral health literacy and improving parental knowledge, skills and self-efficacy in relation to preventive oral health behaviour. Better collaboration of paediatric primary care, elementary schools and preventive dental care may help to motivate parents to brush their child's teeth twice a day, to let their child drink water, and to limit their child's consumption of highly processed carbohydrate-rich foods. Moreover, we need policy

measures to curtail at community level the increasing availability and consumption of highly processed, carbohydrate-rich foods, which in particular affects low-SES families. Further research is needed on the effectiveness of such interventions and on the degree to which they reach low-SES children. This may reduce child dental morbidity in a major way.

Acknowledgments **–** I wish to thank Dr. Paula van Dommelen for her contribution to the statistical analyses, Ineke van Kempen for her skilled assistance during the data collection and Dr. Erik Vermaire for his useful suggestions.

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CHAPTER 3

IMPACT OF CORONA LOCKDOWN ON THE DAILY ORAL HEALTH BEHAVIOR OF YOUNG CHILDREN

Published as: Verlinden DA, Vermaire JH, Reijneveld SA, Schuller AA. Impact van coronacrisis op gedrag van ouders met betrekking tot de mondgezondheid van het kind. *Ned Tijdschr Tandheelkd.* 2020; 127: 639-643 (In Dutch).

Abstract

Aim**:** The aim of this study was to assess the effects of the corona lockdown on oral health behavior in Dutch families, and whether these effects varied according to parental educational level. This particularly concerned the period of the lockdown during the first wave of corona infections.

Materials and Methods: A total of 120 parents of children aged 4 to 5 years completed a digital questionnaire about their behavior with regard to their child's oral health.

Results: The results showed that during the corona lockdown 26% of parents more often skipped toothbrushing of their child in the morning, 44% more often offered their child sugary snacks, and 19% more often offered their child sweetened drinks. In addition, more highly educated parents more often skipped toothbrushing in the morning than parents with lower education, whereas lower educated parents more often skipped toothbrushing in the evening.

Conclusion: The results of this study suggest that the corona lockdown negatively affected the daily oral care of young children by their parents.

Introduction

The COVID-19 pandemic has had major social consequences on health, economy, employment, and well-being of people all over the world, particularly because of the so-called lockdown (intermezzo 1). The first articles on the effects of this “corona lockdown” on psychosocial health point to an increase in feelings of anxiety and stress in society (1-3). Due to the closure of schools and childcare, children remained at home for weeks, and education took place - as good as possible - with the help of parents or carers at home. For parents working at home was a major challenge to find balance between helping children with their school work and/or keeping very young children out of school entertained, and executing their own work and/or household activities. The normal daily routines of going to school, and possibly going to work, were disrupted.

Young children are (completely) dependent on their parents for their daily oral care. Brushing a child’s teeth twice a day, limiting the times of drinking and eating per day (with the exception of water and tea without sugar), and visiting a dental professional are behavioral factors that contribute significantly to good oral health. As a result, responsibility for the oral health of young children rests with the parents (4,5). Due to the lockdown period during the coronavirus pandemic, parents were found to experience more stress (6). However, it is as yet unknown how this extraordinary corona pandemic has affected behavior related to oral care as part of the daily structure of the family.

In 2014 the project “Healthy teeth: all aboard!” (HTAA) was started with the aim of improving the oral health of young children. This entailed that -from the moment that the child’s first tooth has erupted- the well-baby clinic refers the child to a dental professional who offers dental care in accordance with the Non Operative Caries Treatment Program (NOCTP). The first corona lockdown in March and April of 2020 may have had an impact on family routines and behaviors related to oral health (brushing the children’s teeth, limiting the number of sugary snacks and drinks) potentially affecting children's oral health over time. The aim of the present study was to gain insight into how the first corona lockdown may have affected the daily structure and behavior of families regarding oral care. We also examined to what extent the effects of

the corona lockdown on oral health behavior differed according to the educational level of the parents.

Intermezzo 1. The outbreak of SARS-CoV-2 in the Netherlands

In December 2019, the SARS-CoV-2 virus (coronavirus), which causes the disease COVID-19, was first discovered in the Wuhan region of China. In the Netherlands, the first patient with this virus was diagnosed on February 27, 2020. This was followed by various measures to keep the number of infections low:

March 9, 2020: 321 people tested positive for corona and 3 deaths from COVID-19 were reported. The first public measures: no more shaking hands, sneezing and coughing in the elbow, wash your hands regularly with soap and water, and use paper tissues.

March 12, 2020: Work from home as much as possible; no more group meetings of > 100 people.

March 15, 2020: Schools and childcare centers closed, except for children of parents in so-called crucial professions, or children from vulnerable home situations. Catering establishments and sports clubs were closed, contact professions discontinued. Social distancing (1.5 meters away from other people) was introduced.

March 16, 2020: Advice KNMT, ANT, NVM and ONT to close oral care practices and to perform emergency treatments only on non-infected patients.

March 31, 2020: The measures were extended until April 28.

April 21, 2020: The measures were extended again, until May 20.

March 25, 2020: A national network was set up with 11 Corona Centers Acute Oral Care (CAM) for patients with (or highly suspected of having) corona infection by the KNMT and the Regional Consultation Acute Care.

April 22, 2020: Oral care practices open again, on condition that one follow the Guideline Oral Care Corona.

April 29, 2020: Sports clubs resume training youth, up to and including 18 years.

May 11, 2020: Schools and childcare opened up to 50%

June 2, 2020: Secondary education again fully open

June 8, 2020: Primary schools again fully open

At the time of writing (May 31, 2020), the situation in the Netherlands was: 46,442 patients tested positive for coronavirus; 11,735 patients (have been) hospitalized for COVID-19; and 5,965 deaths due to COVID-19.

Materials and methods

The current study was carried out within HTAA research (intermezzo 2.) Parents of children (4 and 5 years) who participated in the HTAA research were sent a short digital questionnaire with questions to compare oral health behavior and structure during the corona lockdown with behavior before the corona lockdown started.

Intermezzo 2. HTAA Research

The HTAA Intervention and research project aims to improve children's oral health and reduce socio-economic differences. This project has been carried out by TNO, the University of Groningen, and the Erasmus University of Rotterdam since 2015 and will continue until 2022. The research population of HTAA (n = 1341) consists of an intervention and control group in both East Groningen and the Schildersbuurt in The Hague. The intervention group receives the HTAA Intervention and the control group oral care as usual. The intervention consists of advice by the pediatrician of the consultation office to parents with a child of 6 months old to make a first appointment for the child at one of several dental practices. In these dental practices, the Gewoon Gaaf method (Non Operative Caries Treatment Program, NOCTP) is applied (for more information see https://www.gewoon-gaaf.nl or the QR code). The HTAA research is funded by ZonMw.

Procedure

Of the HTAA participants, 47 percent had shared their e-mail address (n = 639). On April 24, 2020, these parents were invited by email to participate in the HTAA corona lockdown study. They were given access to the digital questionnaire using a link in the e-mail. A reminder email was sent on April 30th. The digital questionnaire was closed on May 10th.

Questionnaire

The questionnaire consisted of 9 statements about the effect of the lockdown on behavior of parents with regard to the oral care of their child, and to family structure. On a 4-point scale, parents could indicate to what extent they agreed (completely) or (completely) disagreed with the statement (see table 1 for statements). In addition, parents were asked whether the child had been to school in the past month (answer categories “Daily”, “Occasionally” or “Not at all”), whether the parent was living with a partner, and whether the work situation of the parent and any partner had changed due to the corona lockdown. Finally, parents who completed the questionnaire were asked about their own educational level. Educational level was dichotomized into high and middle-low (hereafter referred to as “low”); high was defined as completed HBO or university education and all other education as middle-low.

Analysis

Characteristics of the study population and the answers to the statements were described using frequency distributions and histograms. Answers were dichotomized into (completely) agree versus (completely) disagree. Differences between parents with low- and high education were tested with chi-square tests. Parents whose educational level was unknown were excluded from this comparison. Differences with a p value of <0.05 were considered statistically significant. All analyses were performed in IBM SPSS version 25.

Results

Characteristics of the sample

A total of 120 of the 639 approached parents (19%) completed the online questionnaire. Of these, 89% were Dutch and 11% non-Dutch, and 47% had received low- and 53% high education. The majority (92%) of the parents lived with a partner. Of the working parents, 39% had worked at home during the weeks in lockdown; 41% of the partners also worked at home. Of parents with high education, the parent and/or the partner

more often worked at home than was the case of parents with low education (69% versus 22%, p <0.01).

Effects of the corona lockdown

Effects of the corona lockdown reported by parents were mainly that children did not go to school, had less daily routine and more often watched online videos (Table 1).

Table 1. The nine statements, and the percentages of parents who (completely) agreed with a statement (n = 120). Parents filled out their answers using a 4-point scale ranging from completely agree to completely disagree.

Statement	(Completely) agreed %
1. In this corona period, brushing my child's teeth in the evening is more often forgotten than before corona.	4.2
2. During this corona period, brushing my child 's teeth is more often forgotten in the morning than before corona.	26.1
3. During this corona time my child gets sugar-snacks more often than before corona.	44.1
4. During this corona time, my child gets more lemonade, juice or soda than before corona.	18.5
5. In this corona time my child more often plays outside than before corona.	57.5
6. In this corona time my child watches more TV/movies/tablet than before corona.	67.2
7. In this corona time, my child goes to bed later than before corona.	42.5
8. In this corona time my child misses his/her school.	77.0
9. During this corona time we maintain a fixed daily routine at home.	83.2

In recent weeks, 67% of the children had not attended school at all, 14% occasionally, and 19% daily. Of children of 'high' educated parents, 77% did not attend school, versus 51% of children of 'low' educated parents (p <0.01).

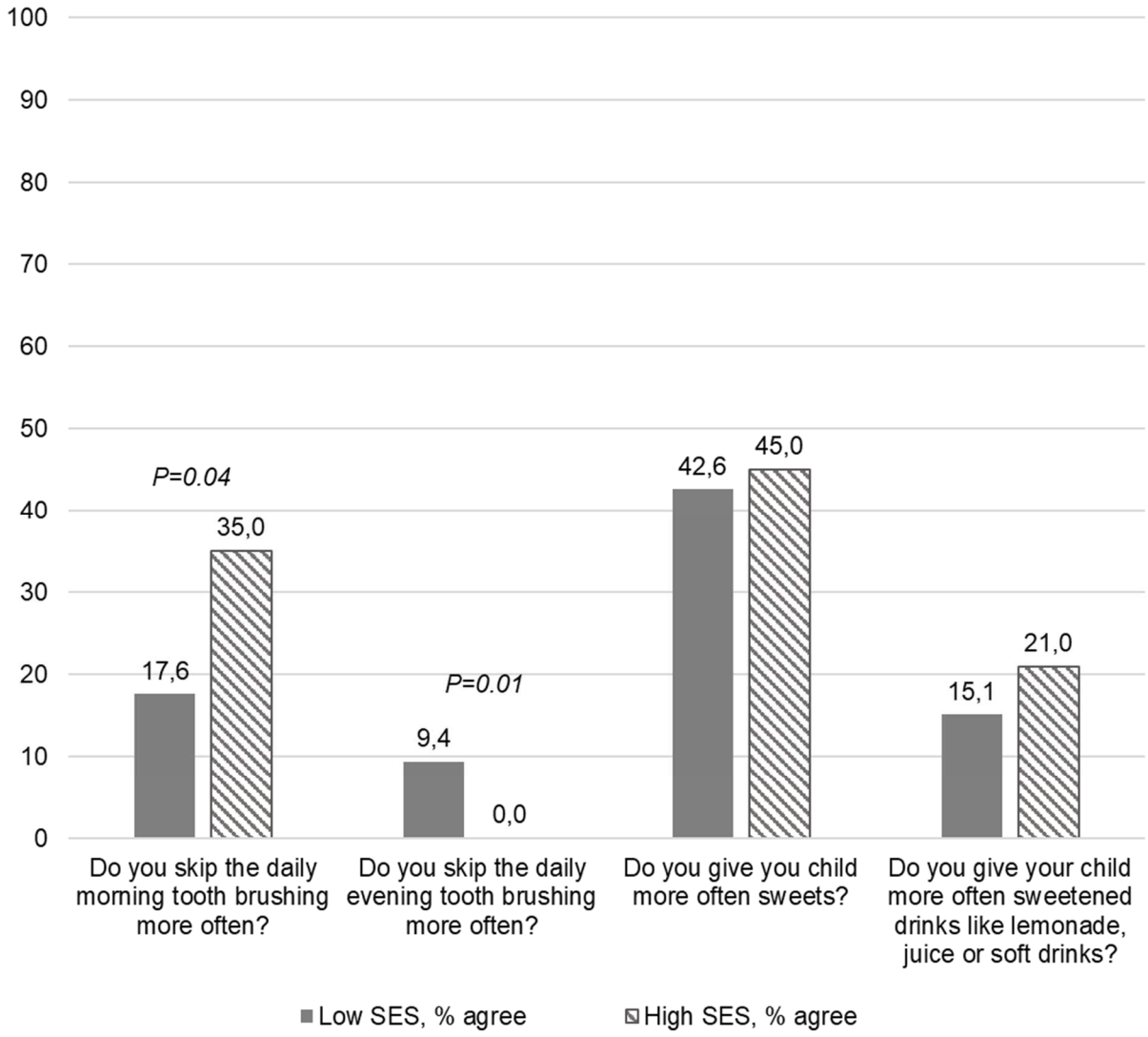

Figure 1. Percentages parents' agreement with the statements.

Figure 1 shows the percentages "(completely) agree" of the statements relating to oral care behavior, stratified by the educational level of the parents. Regarding allowing children sugar snacks more often during the corona lockdown, parents with both high and low education levels had similar percentages (43% versus 45%). Of all parents, 4% indicated that toothbrushing had been skipped more often in the evening, and 25% that it had been the case in the morning (Table 1). Less well-educated parents more often

indicated that they skipped toothbrushing their child's teeth in the evening compared to highly educated parents (9% versus 0%, p = 0.01). In contrast, highly educated parents reported that they skipped toothbrushing in the morning more often than parents with low education (35% versus 18%, p = 0.04) (Figure 1).

Discussion

To our knowledge, this is the first study to explore the impact of the corona lockdown on daily oral care of young children by their parents. The results show that some parents indicated that during the period of the corona lockdown they had skipped toothbrushing more often in the morning, that their children had been allowed to eat sugary-snacks more often and drink sweetened drinks more often (March-April 2020). In addition, the results show that parents with a low education more often skipped toothbrushing in the evening than parents with a high education. This was the other way around for toothbrushing in the morning during the corona lockdown: parents with a high education were more likely to skip toothbrushing in the morning than parents with a low education.

Twenty-six percent of the parents indicated that they more often skipped toothbrushing in the morning. This may be explained by the fact that during the lockdown children did not have to leave the house in the morning. Changes in the daily routine of "waking up, getting washed and dressed, having breakfast, brushing teeth and going to school" made it more likely that parents would forget the toothbrushing. Another explanation could be the pressure on parents to work from home while simultaneously performing multiple tasks like teaching their child(ren) themselves and caring for them. For some professions the pressure was greater than usual, increasing the likelihood that toothbrushing would be forgotten.

The fact that parents with a high education more often indicated that they skipped brushing their child's teeth in the morning than parents with a low education may partly be explained by the fact that the former more often worked from home than the latter (69% versus 22%). Moreover, as the children of parents with a higher education more often stayed home from school than the children of less well educated

parents, this may have changed their daily routines. Another explanation may be that in families of parents with a lower education, toothbrushing was already less frequent in the morning (5), so there was nothing to be skipped.

Parents with a low educational level more often indicated that they skipped brushing their child's teeth in the evening than parents with a high educational level. This difference may be explained by the fact that children of less well educated parents are more likely to go to bed later than children of parents with a high educational level. Later bedtime probably increases the likelihood that toothbrushing will be skipped before going to bed.

Forty-four percent of all parents indicated that their child was allowed to sugar-snack more often, and 19% indicated that their child was allowed to drink sweetened drinks more often. This negative effect of the corona lockdown on parents' rules about sugar-snack behavior and the consumption of sweetened drinks may have been caused by parents' desire to please the children. With children spending a lot of time at home and missing their friends from school, parents possibly wanted to make their lives more pleasant by giving them candy or sweetened drinks. Candy may have been used as a literal 'sweetener' to compensate for the sad situation of the lockdown. Another explanation could be that parents were too distracted by work or multiple tasks to enforce rules as strictly as usual.

Because no one could have foreseen the corona lockdown, no pre-measurements could be carried out for the current study. However, with the questionnaire an attempt was made to acquire the best possible picture of changes in oral health behavior before and during the corona lockdown. A few points must be considered when evaluating the results. We had e-mail addresses for fewer than half of the HTAA participants. We did not know whether the people whose email addresses we had differed in characteristics from those whose email addresses were missing. Fifty-three percent of the respondents had a high educational level and 47 percent had a low or moderate educational level. This percentage corresponded well with national figures. These figures showed that 49% of the 25-45 year olds (according to the age group of our study population) were highly educated and 51% had a low or moderate educational

level (7). Response to the questionnaire (19%) was relatively low. It is expected that parents with the highest pressure or stress at home responded less frequently to the questionnaire. Therefore, some selection bias cannot be ruled out, and the results may be a bit too positive; the effects of the corona lockdown on oral health behavior may be even greater than indicated by our results. In addition, because parents themselves reported their behavior, some answers may have biased by social desirability.

Conclusion

The results of this study suggest that the corona lockdown did affect the daily oral care of children by their parents, as well as the daily structure in the family. This means that dental professionals have reason to be extra vigilant about the oral care of children when a new lockdown occurs (see Intermezzo 3).

Intermezzo 3. Alternative consultations

Possibilities for telephone or digital consultations can be considered when parents cannot, are not allowed, or do not wish to come to the dental practice with their child. In this way, children can still be accompanied.

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PART II

THE EFFECTIVENESS OF ORAL HEALTH PROMOTION FOR YOUNG CHILDREN AND THEIR PARENTS, AND OF COLLABORATION OF ORAL HEALTH PROFESSIONALS AND WELL-CHILD CARE (WCC) PROFESSIONALS

CHAPTER 4

REFERRAL FROM WELL-CHILD CARE CLINICS TO DENTAL CLINICS LEADS TO EARLIER INITIATION OF PREVENTIVE DENTAL VISITS: A QUASI-EXPERIMENTAL STUDY

Published as: Verlinden DA, Schuller AA, Vermaire, JH, Reijneveld SA. The effectiveness of early referral of children by well-child clinics for their first dental visit. *Int J of Pediatr Dent.* 2024; 34: 190-197.

Abstract

Aim: To evaluate whether active or passive referral by a well-child care (WCC) physician of babies for a first preventive dental visit leads to earlier initiation of dental care.

Design: From WCC clinics in two Dutch regions, 629 parents of babies participated. Parents received an active referral from a WCC physician for a dental visit for their babies (n = 204) or received care as usual (CAU) (n = 136) in one region and a passive referral (n = 143) or CAU (n = 146) in the other region. Active referral involved parents receiving a scheduled appointment at the dental practice, and passive referral involved parents making an appointment themselves. During the WCC visit, parents completed a baseline questionnaire. At age 2.5 years, parents received a follow-up questionnaire about dental attendance.

Results: Of the active referral intervention group, 59.3% had their first preventive dental visit in their first year compared with 3.7% in the CAU group ($p < .001$); for the passive referral group, 46.9% compared with 9.6% ($p < .001$).

Conclusion: Referral of babies by WCC for their first preventive dental visit leads to earlier initiation of dental care. An active referral had a larger effect than passive referral.

Introduction

The Global Burden of Diseases study reported that dental caries of the primary teeth was the 12th most prevalent disease in all ages combined (1). Carious lesions form through a complex interaction over time between acid-producing microorganisms and fermentable carbohydrates and are affected by exposure to fluoride, consumption of dietary sugars, and preventive behaviors (2,3). Before the age of 10, most children's manual and intellectual skills are not developed sufficiently to reach an effective level of oral hygiene, and parents play a significant role in imparting knowledge, attitude, and practice of their oral health care (4). Parents of children with an adequate level of oral health behaviors more often have a high socioeconomic status and adequate oral health behavior themselves (5).

Interventions that promote reaching an adequate level of oral health in children can improve oral health considerably if occurring from the eruption of a child's first tooth. A study in North Carolina showed that the age at the first preventive dental visit had a significant positive effect on dentally related expenditures, with the average dentally related costs being less for children who received earlier preventive care (6). The American Academy of Paediatric Dentistry (AAPD) and the British Society of Paediatric Dentistry both recommend establishing a “dental home” for the child no later than 12 months of age (7,8).

In the Netherlands, the advice on the age of the first dental visit changed in 2013 from 2 years of age to 6 months (9). Despite these recommendations, in 2019 only 44% of Dutch 2- and 3-year-olds had visited a dentist/oral health practitioner at least once (10).

A population approach to oral health promotion is reported to be the most promising for children, potentially leading to decreased caries experience in several “at-risk” subpopulations (11). A way to reach very young children may be through well-child care (WCC) clinics, offering preventive paediatric care from birth until the age of 18 or 21 years in many countries, including the United States and the Netherlands.

At the WCC clinics, the growth and development of children is monitored, and they receive scheduled immunizations. WCC staff promotes healthy behaviors and

provide care; parents may also discuss parenting concerns or their child's health with the staff. Oral health education is not an obligatory part of their work. In the United States, it was reported that the 2-, 4-, and 6-month planned visits to a WCC were attended by 63%–90% of parents of young children (12). In the Netherlands, 92% of all parents of newborns (age 0–4 years) visited the WCC clinic regularly in 2019 (13). Considering the reach of the WCC, an intervention that utilizes WCC access with an individualized preventive referral to a dental clinic may be promising to promote early initiation of dental visits for parents of newborns. We therefore conducted a study (Healthy Teeth All Aboard [HTAA]) in which 4- to 11-month-old children were referred from the WCC to a dental clinic. At the dental clinic, oral health care professionals treated the children according to the Non Operative Caries Treatment Program (14,15). The aim of HTAA was to improve oral health among young children and to reduce oral health inequalities currently present at 5 years of age. This paper is the first paper related to this HTAA project and aims to evaluate whether referral (both active or passive) of parents of babies for a first preventive dental visit by WCC staff leads to earlier initiation of dental care than care as usual (CAU).

Materials and Methods

Ethics approval

The Medical Ethics Committee of the University Medical Center Groningen provided a waiver for full assessment and further required the study to be performed in accordance with the Helsinki Declaration (Ref. METc2014.175). The study was part of the HTAA study and was registered in 2015 (Trial NL4174). It follows the CONSORT guidelines (16).

The HTAA study was conducted as a quasi-experimental trial with a premeasurement at baseline before the intervention and a postmeasurement at 2 years after the intervention (first follow-up) and at 5 years after intervention (second follow-up). In this paper, we used data from the baseline measurement and the first follow-up.

Study setting and participants

Inclusion criteria were children: (1) living in the municipality of the WCC clinic they were

visiting; (2) aged between 1 and 12 months at baseline; and (3) who had not been to the dentist or oral health practitioner yet. In this paper, we used data from parents who completed the first follow-up questionnaire (n = 629) (Figure 1).

Intervention

The intervention consisted of a preventive referral for children aged 4–11 months from the WCC clinic to a dental practice. The WCC physicians and nurses were trained during a 2-h workshop given by an author (Deborah Ashley Verlinden) regarding preventive oral health information for parents and how to communicate and clarify the advice for the first dental visit to parents.

At the WCC clinic, active and passive referrals were given for this first dental visit for children by one of the physicians during the appointment at 4, 6, or 11 months of age. WCC physicians referred parents to local dental practices participating in this trial. In one region (The Hague), an active referral was given because this referral method was preferred by both the WCC clinic and the dental practice. Active referral parents were asked for permission to share their contact details at the WCC clinic so that dental practices could call parents to make the first appointment. In the other region (Northern Netherlands), a passive referral method was preferred by the participating organizations. In that case, parents were asked to make an appointment themselves for the first preventive dental visit of their child by contacting the dental practice whose details were provided.

Parents were informed by the WCC physician about child dental development, the importance of caries prevention, and dental insurance coverage in the Netherlands. Information included the importance of caring for teeth from the eruption of the first tooth at around 6 months, and the benefits of visiting a dental practitioner regularly from early in life. In addition, the physicians emphasized that dental care up to 18 years of age is fully covered in the basic health insurance package in the Netherlands.

Care as usual

Parents in the CAU group (with no referral to the dental practitioner) received

CAU in the WCC clinic. Usual child oral health education, however, was offered if this was part of their routine.

Procedure

Parents in both the intervention group and the CAU group were asked to complete a baseline questionnaire at the WCC clinic when their child was 4–9 months of age. Questions regarded background variables such as child's gender and age, ethnicity (Dutch, Non-Dutch born), educational level of the mother (ISCED level 0–4 = low, ISCED 5–8 = high) (17), and the number of children in the household.

After 2 years, parents received a mailed follow-up questionnaire; if they had not responded within 3 weeks, an email reminder was sent with a link to an online version of the questionnaire. If necessary, a reminder by telephone followed when the digital questionnaire was not completed within 4 weeks (18).

Primary outcomes

The primary outcome was whether the child had the first dental visit within the first year of life, or not (reported by parents at the first follow-up).

Sample size

The sample size was determined based on the primary outcome of the clinical part of the main HTAA project, which was caries experience (number of decayed, missing and filled primary teeth; dmft) at the age of 5 years. A power calculation was performed for alpha = 0.05, beta = 0.80, and a clinically relevant differences between intervention and CAU of 0.25 dmft (39%) and 12% fewer children with dmft = 0 than in the CAU group. This showed a required sample size of 250 children in both the intervention and CAU groups with complete datasets. This number was sufficient to detect a difference of 8.4% between the groups in visiting a dental professional in the first year with a power of 80% at alpha 0.05, a contact rate of 0% at baseline, and a follow-up contact rate of 8.7% in CAU (19).

Allocation

Participants were allocated to the WCC clinic in the "active" (A) region and in the "passive" (P) region. Region A had approximately 500 000 citizens of whom fewer than 50% had Dutch ethnicity and Region P had approximately 120 000 citizens of whom more than 80% had Dutch ethnicity. The assignment of WCC clinics for control or intervention conditions was made randomly, and the management or the practitioners of WCC clinics could not choose which condition they preferred. In Region A, four WCC clinics participated: Two were assigned to the intervention group and two to the control group. For Region P, three intervention clinics were included, in addition to three control clinics.

Statistical analyses

First, we determined the participants' flowchart. Second, we assessed background characteristics of the intervention and CAU groups at baseline for the parents who filled out the follow-up questionnaire. Third, we compared the rates of children having their first dental visit in their first 12 months between the intervention and the CAU group, for Regions P and A based on parental report in the follow-up questionnaire. Fourth, multilevel logistic regression model analyses for the outcome dental visit in the first year were used, accounted for clustering by WCC clinic and adjusted for educational level of the mother (22-24) for Region P and Region A separately and for the total group.
The IBM SPSS Statistics (version 22; IBM Corp., NY, USA) program was used for all analyses.

Results

Flow of participants

There was a total of 1347 participants (Figure 1) of whom 722 were allocated to the intervention group and 625 to the CAU group. The response rate for the 2-year follow-up was 46.7% (n = 629) (intervention group n = 347; CAU group n = 282).

Background characteristics

Table 1 shows the characteristics of parents that were not in follow-up vs. parents in

follow-up in the intervention (I) and CAU groups. Percentages of children of low-educated mothers and non-Dutch mothers are higher in the children that were not in follow-up than children in the follow-up. This difference is relatively larger in the CAU group than in the intervention group. In 2021, the mean percentage for low education was 52%, and 22% of 35- to 45-year-olds had a non-Dutch ethnicity. Percentages for low educational level and non-Dutch mothers in the follow-up group are quite similar to the national percentages for adults in the Netherlands. For parental oral health behavior, no significant differences were found between the intervention and CAU groups. The background characteristics of parents who completed the follow-up questionnaire are shown in Table 2. The two groups differed in educational level and ethnicity of the mother in Region A and gender of the child in Region P.

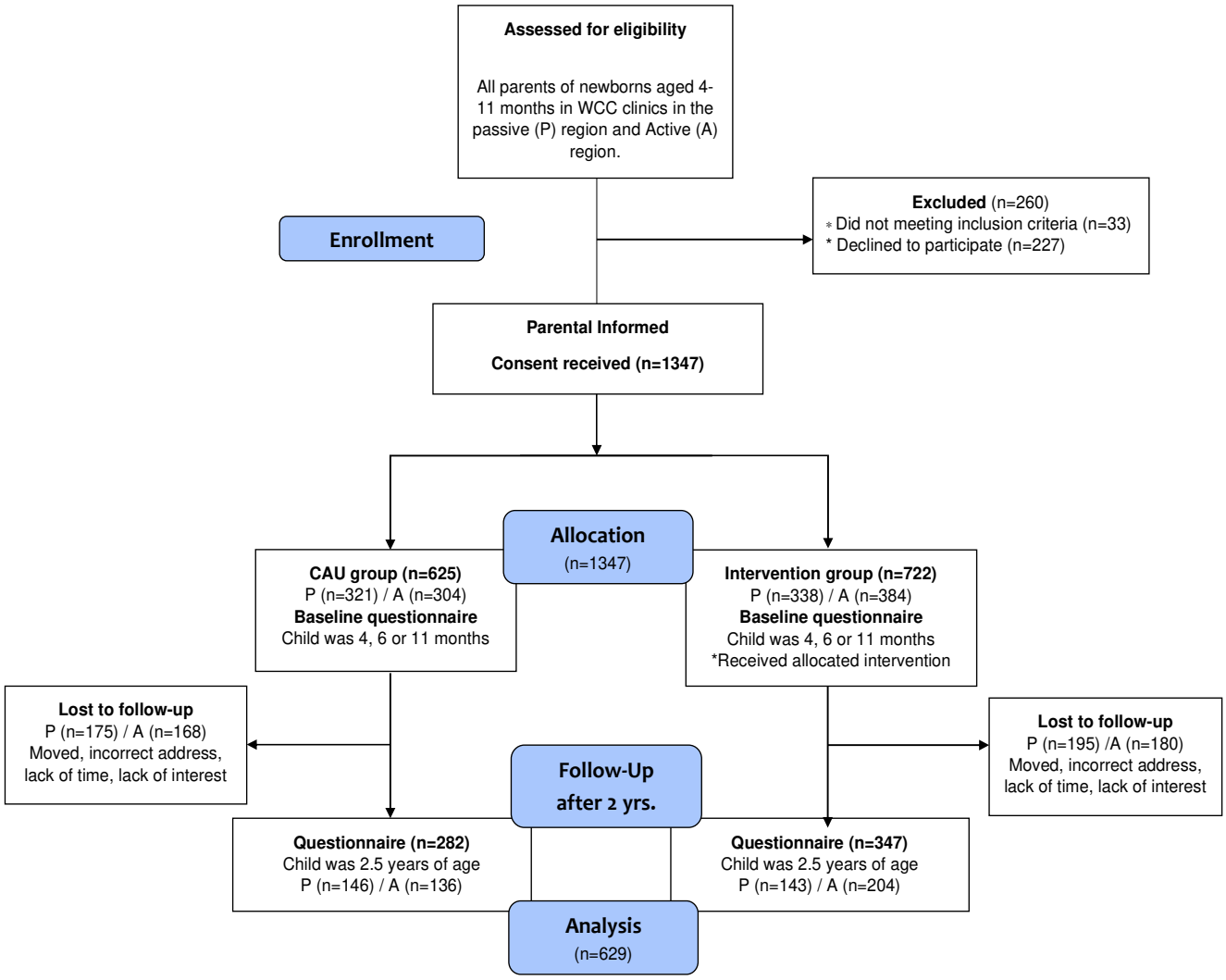

Figure 1. Study Flowchart

Table 1. Characteristics of participants not in follow-up vs. in follow-up in Intervention (I) and CAU groups.

	Not in follow-up			**In follow-up**		
Baseline characteristics of Mother	I n=375	CAU n=343	*P*	I n=347	CAU n=282	*P*
Non-Dutch (%)	37	37	0.97	23	7	<0.001
Low educated (%)	71	65	0.09	62	46	<0.001
Toothbrushing < 2x/day (%)	16	17	0.68	19	15	0.20
Last dental visit more than 1 year ago (%)	19	18	0.74	14	12	0.32

Initial dental visit in the child's first year of life

The proportions of children having their first dental visit in their first year in Regions A and P are shown in Table . Children who received an active referral had an odds ratio (OR) of 34.2 for having a first dental visit in their first year versus children in the CAU group (95% confidence interval [CI]: 14.5–80.5). Children who received a passive referral had an OR of 6.0 for having a first dental visit in their first year versus children in the CAU group (95% CI: 1.6–22.8). In the intervention group, 54.2% compared with 6.7% in the CAU group had their first dental visit in their first year of life, representing an OR of 16.5 for the intervention group compared with the CAU group (95% CI: 7.2–38.1).

Table 2. Background characteristics of the participating children in the intervention group and CAU in region A and in region P.

	Region A			Region P		
	Active referral (n=204) (%)	CAU (n=136) (%)	*p*	Passive referral (n=143) (%)	CAU (n=146) (%)	*p*
Male gender of child	51.5	47.1	0.36	59.4	43.8	<.01
Mother Dutch born	62.7	87.5	<.001	97.2	97.9	0.56
Low educational level of the mother	58.8	28.7	<.001	62.9	60.3	0.68
Age child in months (SD)	28.8 (4.7)	29.2 (5.4)	0.52	27.4 (3.4)	27.3 (3.3)	0.83
One child in family	43.6	34.6	0.09	43.3	37.7	0.17

Table 3. Rates of having a first dental visit in the first twelve months and odds ratios and adjusted odds ratios of rates for the intervention group vs the CAU group.

Active referral	Intervention (n=204)	CAU (n=136)	OR (95% CI)	Adjusted OR (95 %CI) †
Age dental visit ≤12 months	59.3% (121)	3.7% (5)	27.3 (12.0-61.9)***	34.2 (14.5-80.5)***
Age dental visit >12 months	40.7% (83)	96.3% (131)		
Passive referral	Intervention (n=143)	CAU (n=146)	OR (95% CI)	Adjusted OR (95% CI) †
Age dental visit ≤12 months	46.9% (67)	9.6% (14)	5.9 (1.6-22.3)***	6.0 (1.6-22.8)***
Age dental visit >12 months	53.1% (76)	90.4% (132)		
Total group	Intervention (n=347)	CAU (n=282)	OR (95% CI)	Adjusted OR (95% CI) †
Age dental visit ≤12 months	54.2% (188)	6.7% (19)	15.7 (7.0-35.3)***	16.5 (7.2-38.1)***
Age dental visit >12 months	45.8 %(159)	93.3 (263)		

† Adjusted for educational level of the mother, and for clustering on the level of WCC clinics, the intracluster correlation coefficient (ICC) for the model for the total group=0.09. *p<0.05, *** p <0.001

Discussion

To the best of our knowledge, this is the first study to assess whether referral by a WCC clinic physician of parents of babies for a first preventive dental visit leads to earlier initiation of preventive dental care for their child. Such a referral led to a statistically and clinically significant earlier initiation of preventive dental care, with an active referral having a larger effect than a passive referral.

Comparison with previous data is not possible, as no similar data are available. Other studies mainly reported descriptive percentages of WCC clinic physicians or primary care physicians who referred children with poor oral health to a dentist or they described preventive programs that were provided by paediatricians, family physicians, or providers in community health clinics (25). Results from the program “Into the Mouths of Babes” demonstrated that nondental professionals could integrate preventive dental services into their practices. Even though the program had increased access to preventive dental services for young Medicaid children whose access to dentists was restricted, the promotion of an adequate level of oral health behavior for parents of newborns preferably should be performed by oral health professionals in dental clinics as it allows familiarization of the dental environment for the child (6,26). Evidently, the present findings suggest that referral to the dental practitioner through WCC can improve early initiation of dental care.

We found an overall effect of referring children for their first preventive dental visit of 54%, with the effects being largest for active referral. This large effect could be explained by the trust of parents in the WCC physicians' and nurses' advice, also reflected by the high attendance rates at these clinics (13). Furthermore, it reflects parental understanding of the importance of early preventive dental care. The explanation of the importance of oral health by the WCC physician or nurse is central to parental understanding regarding why they should make an initial appointment for their child. The even larger effect of active referral further suggests that stronger facilitation in care setting provides larger effects. This may, in particular, be effective in case of very deprived or low-health literate families (27).

Despite 54% of the total intervention group having their initial dental visit in the

first year of life, 46% still did not have a dental visit, identifying an opportunity to further improve effectiveness via recalls and the method of referral. One option to improve effectiveness is to ask parents at the following appointment whether they have been to the dental practice with their child. In the current study, there was a one-time referral, indicating that the lesser the action required from the parent, the higher the effectiveness of the referral.

Strengths and limitations

The main strengths of this study were that it was undertaken in WCC clinics with access to 92% of all parents and children in the Netherlands, increasing the generalizability (13). The second strength was that we reached risk groups, less well-educated and migrant families, which can be a challenge for many intervention studies with a long-term follow-up.

Our study also had some limitations. First, a relatively high drop-out rate, which may have led to the inclusion of more motivated parents. This is, however, unlikely to affect the difference between intervention and CAU, since the drop-out rates regarding mothers with a low educational level or a non-Dutch ethnicity were larger for the CAU group than for the intervention group. One paper about nonparticipation in a clinical oral health trial in children reported that the presumption that nonparticipating children show less favorable clinical outcomes was not supported (28). Furthermore, when one of the parents could not read Dutch or English, they were excluded because questionnaires were only available in those two languages. Inferences are thus formally limited to parents speaking these two languages. Another limitation was that the educational level of the mother was lower, and there were fewer Dutch mothers in the intervention group than in the CAU group of Region A, putatively underestimating the real effect, and therefore, logistic regression analyses were corrected for educational level and ethnicity. Finally, the age at the first dental visit was based on parental report, which could sometimes cover a recall of the first appointment of 1.5 years ago and thus could be less accurate.

These recall effects, however, affected both the intervention and control groups, adding random error to effect estimates and thus probably leading to some underestimation of the real effects.

Implications

Referral from the WCC clinic to the dental practice was an effective method to encourage child preventive dental care from an early age. Further research is needed to promote early visit also even further among low-educated mothers. This may, for instance, be reached by additional actions to make dental care better accessible for underprivileged groups or parents, for example, by small rewards or extension of coverage of dental care for underprivileged parents. The next very important question is whether the early referral actually has a positive effect on the child's oral health and what strategies in dental clinics are most effective in promoting oral health in young children. We are currently collecting data to determine the effect of early referral on clinical oral health outcomes. If a positive effect is found, the implementation can be rolled out nationally. This implementation could also be guided by experiences of similar interventions that have been implemented in other countries, such as “Dental Check by One” (8) of the British Society of Paediatric Dentistry and “Childsmile” in Scotland (29), for which our findings also provide support.

Referral by a WCC clinic physician or nurse of parents of babies for a first preventive dental visit leads to earlier initiation of preventive dental care. An active referral method, when parents are contacted by the dental clinic, is more effective than passive referral. Collaboration between WCC and dental care in guiding parents of young children with oral health behavior could promote improved oral health in children.

Acknowledgements

We thank Professor David Manton for his constructive comments in the writing process.

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CHAPTER 5

LONG-TERM EFFECTS OF A COMMUNITY-BASED ORAL HEALTH INTERVENTION FOR YOUNG CHILDREN IN THE NETHERLANDS: A 5-YEAR FOLLOW-UP

Published as: Verlinden DA, Schuller AA, Vermaire JH, Reijneveld SA. *Community Dent Oral Epidemiol.* 2023; doi:10.1111/cdoe.12935. Epub ahead of print.

Abstract

Objectives: The aim of this study was to assess whether referral of parents of 6 months old children by a well-child care (WCC) clinic medical practitioner for an early first dental visit combined with the Non Operative Caries Treatment and Prevention (NOCTP) approach in dental practices was effective to maintain oral health in children.

Methods: The study was conducted as a quasi-experimental comparative pre-post trial with a baseline measurement before the intervention. In total 1347 children were allocated at the age of 6 months and 306 children (intervention group: n = 166; care as usual (CAU) group: n =140) underwent an oral examination at 5 years-of-age and their parents completed a questionnaire. Nonparametric tests and Hurdle models were used to determine differences in caries experience between the intervention and CAU groups.

Results: Children in the intervention group had significantly lower caries experience ($d_{1,2,3}$mfs) than children in the CAU group (Median = 2 vs. 5, r = 0.15, p < .01). Children in the intervention group had significantly fewer inactive caries lesions compared with children in the CAU group (Median = 2 vs. 3, r = 0.18, p < .001). No differences were found for dentin caries experience and also no differences for active caries lesions.

Conclusions: Referral of parents of newborns for a preventive first dental visit by a WCC medical practitioner combined with NOCTP in dental practices may offer a new opportunity to reduce enamel caries lesions in young children.

Introduction

Dental caries is one of the most prevalent health problems in children worldwide, even though it is largely preventable by changing parental oral health behaviours (1-6). A shift towards an adequate level of dental hygiene (by removing dental plaque with a toothbrush and by using fluoridated toothpaste at least twice a day) and a reduction of daily intake in fermentable carbohydrates, may considerably reduce the development and progression of caries lesions (7,8). Parents should be supported to reach this desired level of oral health behaviours as children rely completely on their parents/caregivers until approximately the age of 7 (9). Until then, both their manual and intellectual skills have not yet developed sufficiently to be able to execute this daily task.

Interventions that promote timely preventive dental care, that is starting around an age of 6 months, can prevent the deterioration of young children's oral health (10). A recent study reported that 2.7% of Chinese children had their first dental visit in the first year, and 30% of the mothers were willing to plan the first dental visit in the next 3 months (11). An other study in Turkish children aged 0-5 years showed a mean age at first dental visit of 3.6 years and 2.9% had their first dental visit in their first year (12). In 2014, 34% of Dutch 0-4 year-olds had visited a dentist, showing that children's first dental visit is relatively late, even though this care is free of costs for Dutch parents (13). Dutch guidelines as other international guidelines entail a first visit to a dental practice when the first tooth of the child erupts (10).

Of the Dutch 5-year-olds, 76% had no cavitated lesions in which the dentine can be visually observed ($d_3mfs = 0$) (14). The overall mean among 5-year-olds was 1.1 d_3mfs. Of the Dutch 5-year-olds with a low socioeconomic position (SEP), 30% had no cavitated lesions ($d_{1,2,3}mfs = 0$) and for the 5-year-olds with a high SEP this was 41%. The mean $d_{1,2,3}mfs$ were 1.8 for children with a low SEP and 1.9 for children with a high SEP, respectively.

Well Child Care (WCC) clinics are a promising route for infant oral health promotion; for example, in the Netherlands 92% of all parents and children visit these clinics from birth until children are 4 years old, including groups with a low socioeconomic position and diverse ethnicities (15). However, the encouragement of

adequate oral health behaviour is not part of routine WCC.

An effective way to offer preventive dental care to young children is the non-operative caries treatment and prevention (NOCTP) approach (16). Danish and Russian studies showed long-term positive effects for oral health using the NOCTP approach implemented to care for groups of children in Nexø and in Moscow (17,18). One Dutch randomized controlled trial (RCT) study on the three and six year effectiveness of the NOCTP approach in 9- and 12-year-olds showed a lower caries increment in the NOCTP group than the control group with regular dental check-ups twice a year (19,20).

Evidence is lacking on whether a combination of referral by WCC to dental clinics working according to the NOCTP approach leads to better child oral health. Therefore, the aim of this study was to assess whether a combination of a referral of parents of newborns by a WCC medical practitioner for an early first dental visit and NOCTP in dental practice is effective to maintain oral health in children.

Methods

Study design

The study was conducted as a quasi-experimental comparative pre-post trial with a baseline measurement before the intervention. The protocol of this study has been registered as NTR5587. In the current paper the *clinical primary outcome* caries experience only was reported. The study is reported following the CONSORT guidelines (21).

Study setting and participants

The study included 1347 children, aged 4-11 months and their parents, in 2015/2016 from four deprived regions of the Netherlands, with one intervention and one care as usual (CAU) region being urban (The Hague) and one intervention and one CAU region being rural (Northern Netherlands). The city of the Hague has half a million citizens of whom nearly 50% with a Dutch ethnicity and the Northern Netherlands region has approximately 120.000 residents of whom more than 80% with a Dutch ethnicity. These areas were chosen taking into account that families with low educational levels and

families with different ethnicities also could be reached. Inclusion criteria were as follows: (1) children lived in the municipality covered by the WCC they were visiting; and (2) a valid email address, home address or phone number was available. Analyses were restricted to children who were aged 4.5- 6 years at the clinical oral examination.

Sample size

The required sample size was determined based on the primary outcome caries experience at the age of 5 years. A difference of 0.25 dmft between children in the intervention group and children in the CAU group was considered to be clinically relevant at alpha = 0.05 and power = 0.80. The difference of 0.25 dmft was based on the level of $d_3$mft caries lesions in 2011. For 5-year olds the mean $d_3$mft for 5-year-olds in the Netherlands was 1.6. So, at that time 0.25 $d_3$mft was a difference of 15%; which was considered to be clinically relevant in a consensus meeting with Dutch dentists as the inception of the study preparation.

Ethical approval

The Medical Ethics Committee of the University Medical Center Groningen provided a waiver for ethical permission because it was not considered to be medical scientific research with humans (METc2014.175). Performance was in accordance with the Helsinki Declaration. Participating parents signed informed consent at inclusion.

Allocation

Participants were allocated per WCC clinic in the city of the Hague and the Northern Netherlands region. In city of the Hague four WCC clinics participated: two were assigned to the intervention group and two to the CAU group. For Northern Netherlands, three intervention WCC were included, as well as three CAU WCC.

Intervention

The intervention, named ‘Healthy teeth: all aboard!’ (HTAA), regarded timely (i.e. before or at the age of 12 months) referral from the well-baby clinic to a dental clinic for

preventive care, that is with individually determined recall intervals. In more detail, Table 1 illustrates the procedure of the intervention.

Table 1. Contents of the procedure of the HTAA intervention.

The HTAA intervention consisted of two parts, a WCC part and a dental clinic part. The WCC part entailed a referral for a timely first dental visit of children by the doctor of the WCC clinic during the appointment at 6 months, i.e. when the first tooth erupts, or at 11 months when the 6 month's appointment was missed. WCC practitioners referred parents to local dental clinics that participated in this trial. Practitioners emphasized that dental care of children is covered in the basic health insurance package in The Netherlands until the age of 18 years. The *dental visit* part regarded the following. At the first dental visit, parents and children received a dental preventive program based on the Non-Operative Caries Treatment Programme (NOCTP) of Ekstrand & Christiansen (16,17). NOCTP (also known as "the Nexø method") is an effective oral health program which focusses on the active involvement of the parent/caregiver from the eruption of the first primary tooth (16-20). Several preventive messages such as brushing teeth with fluoridated toothpaste twice a day, brushing/additional brushing by parents/caregivers until the age of 7 years, and a reduction of daily intake of fermentable carbohydrates, were educated to parents. For every child an individual return interval was established.

Medical practitioners and nurses from the WCC's were trained during a 2-hour workshop given by the first author (DAV) about preventive oral health messages for parents and how to communicate and clarify the advice for the first dental visit to parents. Medical practitioners and nurses of the WCC received flyers on oral health messages for parents and postcards for parents with all the information for the first dental visit. Another postcard for parents contained a QR-code for an educational web-based oral health film in Dutch for parents.

Oral health professionals were trained in the NOCTP strategy by authors JHV and DAV. The training consisted of a plenary one-day workshop about the theory of NOCTP

and an on-site visit to practice their skills at their own dental clinic. All participating dental practices received documentation with illustrative photographs and symbols to clarify the preventive messages, especially for parents who did not *speak* Dutch or had a low level of health literacy. The NOCTP intervention was based largely on oral advice provided by the whole dental team, including dentists, dental hygienists and dental nurses. Also, a flyer was handed out to parents with all important child oral health guidelines. The duration of the NOCTP intervention was approximately 4.5 years with an average of eight dental appointments per child.

Care as Usual

Parents in the Care as usual group (CAU) received standard WCC visits (no specific oral health interventions in the WCC) and standard dental care. In the Netherlands, a first dental visit was at start of the study advised at 2 years of age followed by regular preventive visits twice a year (22).

Procedure

First, all parents in the intervention and CAU groups completed a questionnaire at their first visit to WCC clinic at about child age 6 months (T0) on socio-demographic characteristics, respectively. Second, at the child's age of 5 years parents received an invitation for an oral examination for their child at the dental clinic. These oral examinations were performed by three trained research dentists visiting local dental practices. The three examiners were calibrated, and the ICC was 0.95 for dmfs for a similar research project that was running simultaneously. These examiners were blinded to intervention allocation. Caries experience was observed during a clinical oral examination that comprised visual inspection of the teeth with documentation of caries lesions and any subsequent treatment (i.e., restoration or extraction).

Clinical primary outcomes

In the current paper the clinical primary outcomes are reported. These clinical primary outcomes are caries experience, measured by the dmfs (the total number of decayed,

missing and filled surfaces in the primary teeth). The d-component was both measured on the $d_{1,2}$ level (enamel) and d_3 level (dentine) (23). Nyvad criteria scores were used to categorize the activity of the caries lesions. Active caries lesions regarded Nyvad criteria scores 1-3 and 8; inactive caries lesions regarded Nyvad criteria scores 4-6 and 9 (Table S1); sound surfaces regarded Nyvad criteria score 0; and filled surfaces regarded Nyvad criteria score 7 (24).

Socio-demographic characteristics

Socio-demographic characteristics of the study were gender of the child, age of the child, ethnicity of the mother (dichotomized Dutch, Non-Dutch) and educational level of the mother (dichotomized Low, High). Educational level was operationalized as the highest level of education completed by the mother of the child, categorized following the International Standard Classification for Education (ISCED, 2011) as low (ISCED levels 0-4), or high (ISCED 5-8) (25).

Statistical analyses

First, the participants' flow was determined. Second, socio-demographic characteristics of the Intervention and CAU groups were assessed. Third, whether this intervention decreased caries experience in children was assessed. Differences using nonparametric independent samples Mann-Whitney U tests for caries experience were tested and effect sizes r were calculated (26). Furthermore, differences in caries experience, inactive and active caries lesions between the intervention and CAU group were assessed using Hurdle models adjusted for ethnicity and SES (27). Hurdle models have the advantage of estimating two separate parameters to accommodate many zero counts: one estimate for the dichotomization of zero versus non-zero (i.e. dmft=0 or not) and one for caries experience in cases of not-caries-free (25). Since the count part had a negative binomial distribution, a negative binomial hurdle model was used. Hurdle analyses yield odds ratios for the probability of having any caries lesions, and, in the case of those with caries lesions (dmft>0), rate ratios comparing the greater caries experience of children in the intervention group than that of children in the CAU group. Bivariate analyses were

performed using SPSS Statistics for Windows, version 28.0, (IBM, Armonk, NY, USA),, and negative binomial hurdle models using R version 3.3.2 (R Core Team, 2020), and RStudio Server (RStudio Team, 2020). A p-value < .05 was considered statistically significant.

Results

Flow of participants

In total, 1347 children (and their parents) were contacted by the research team. Of these, 306 children participated in the oral examination, see Figure 1, that is. 23%. Table 2 shows the baseline characteristics of the mother at baseline and of those who participated in the oral examination 5 year follow-up after baseline. At baseline the proportion of non-Dutch mothers and of low educated mothers at baseline were statistically significantly larger in the intervention group than in the CAU group. Retention rates at follow up did not statistically significantly differ for the socio-demographic characteristics maternal education, ethnicity and maternal oral health behaviours at baseline (own tooth brushing and visit of dentist) between the intervention and CAU group. More specifically, the retention rates were (intervention vs CAU) regarding non-Dutch respondents 21% and 19%; regarding low educational level 21% and 21%; regarding maternal tooth-brushing ≥2 times a day at baseline 23% and 24%; and regarding recent dental visit in the last year at baseline 25% and 26%, respectively.

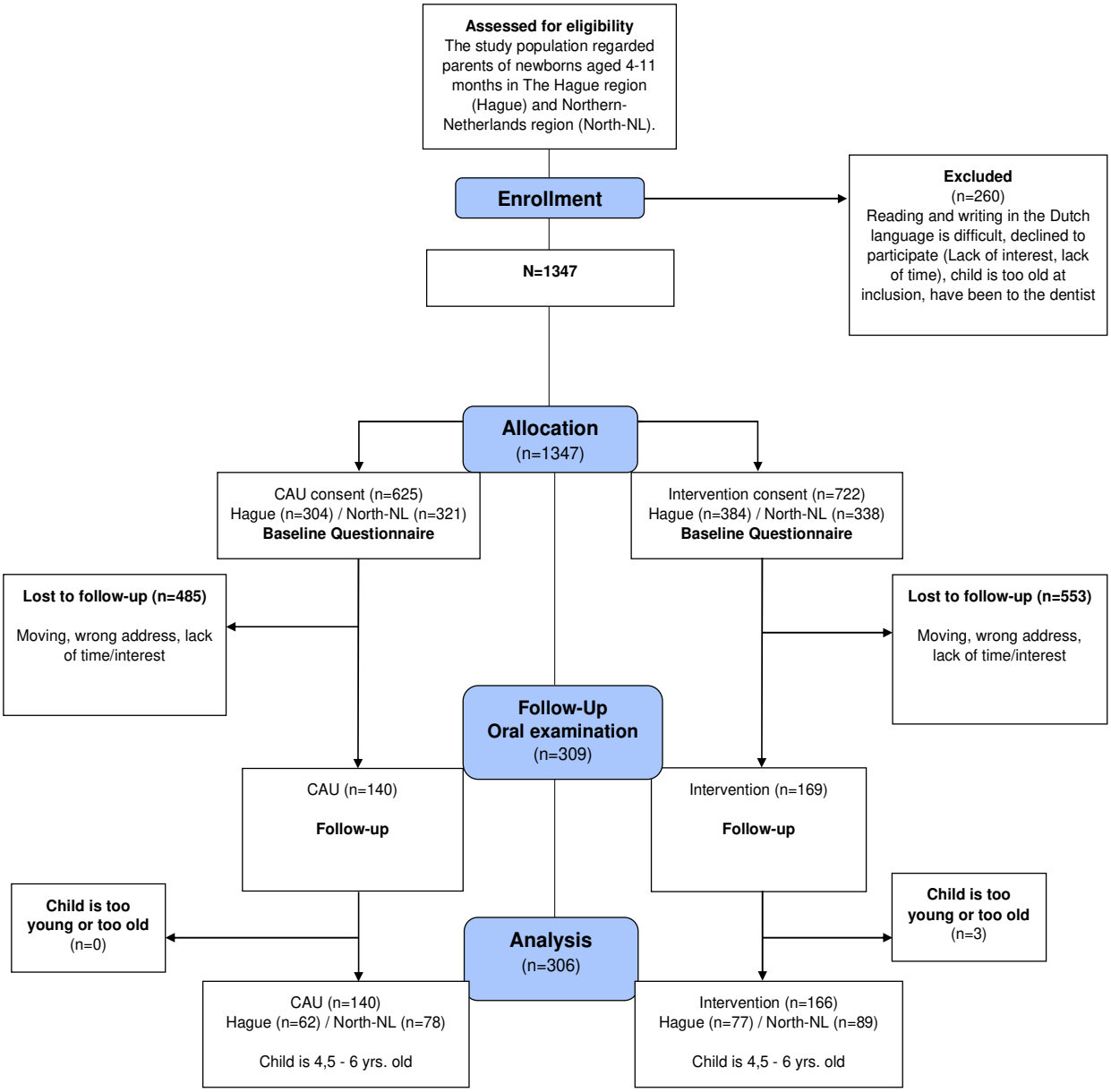

Figure 1. Flow chart of the HTAA study population.

Table 2. Baseline characteristics of participants in CAU and Intervention (I) groups.

Baseline characteristics of Mother	Baseline			Follow-up		
	CAU	I		CAU	I	
	n = 625	n = 722	p	n = 140	n = 166	p
Non-Dutch (%)	23	30	0.007	19	26	ns
Low educated (%)	56	66	<0.001	51	60	ns
Toothbrushing 2x/day or more (%)	84	83	ns	85	81	ns
Last dental visit in the last year (%)	85	83	ns	91	85	ns

Table 3. Background characteristics of the participating children in the intervention and CAU groups.

	Intervention	**CAU**	**p**
	n = 166	n = 140	
	%	%	
Male gender of child	49	42	ns
Dutch ethnicity of mother	74	81	ns
Educational level of mother			ns
Low	60	51	ns
High	40	49	
Mean age of child in months (Tukey's Hinges 25th and 75th Percentile)	65.37 (62.32-68.47)	63.70 (61.34-66.02)	p<0.01

Socio-demographic characteristics

Table 3 shows socio-demographic characteristics of parents who completed both the first questionnaire and the dental examination.

Effects on primary outcome: caries experience

Children in the intervention group had lower caries experience in enamel ($d_{1,2}$) (median = 2, 25th -75th percentile = 0-4) compared to the CAU group (median = 3, 25th -75th percentile = 1-7, $p < .01$). Figure 2 shows the cumulative distribution of enamel caries lesions for 5-year-olds in the intervention group and the CAU group. It clearly shows that until the 98% of enamel caries in the group is reached, children in the intervention group had fewer enamel caries lesions, than children in the CAU group.

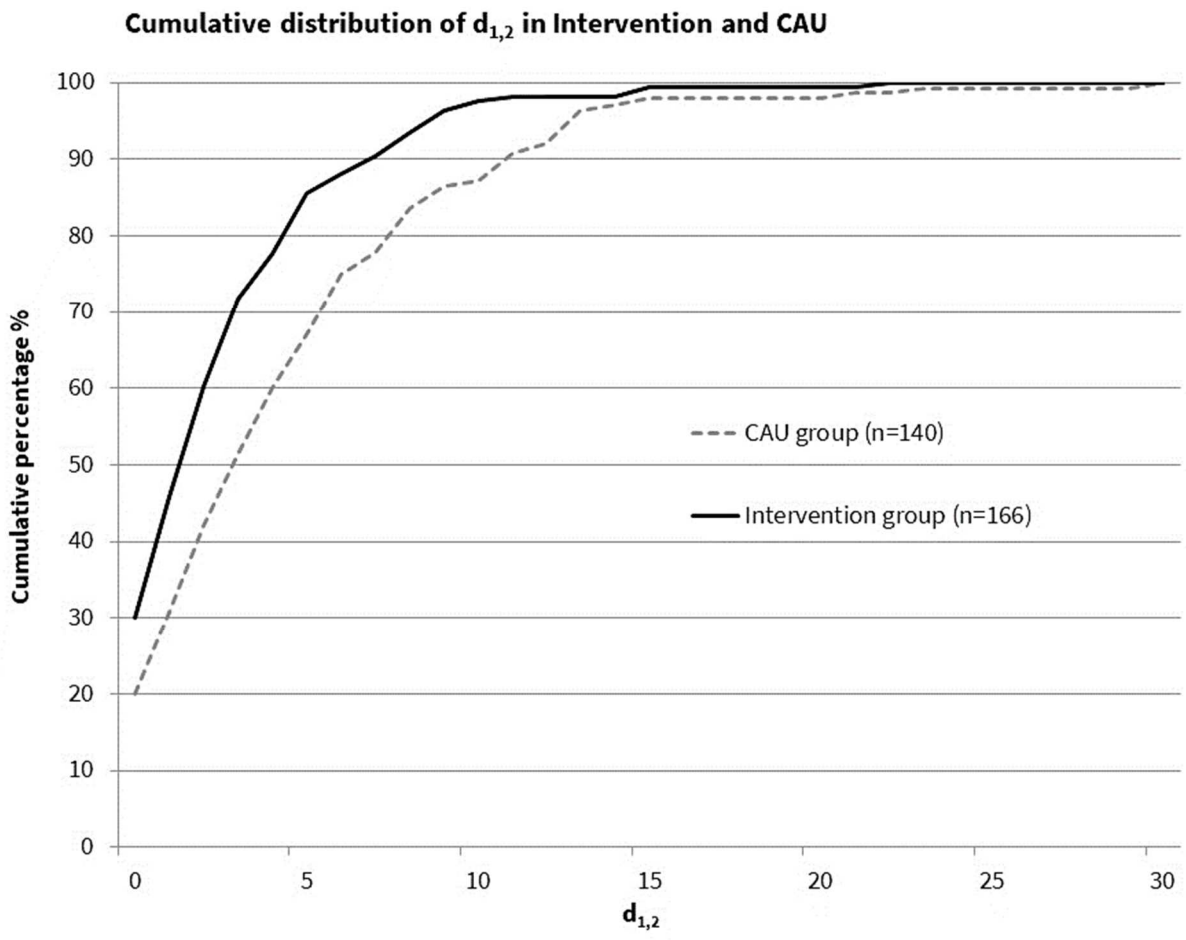

Figure 2. Cumulative distribution of $d_{1,2}$ of children in the intervention group and CAU group.

Regarding *caries experience*, in the intervention group 26.6% of the children had no enamel or dentin caries experience ($d_{1,2,3}$mfs) vs. 19.3% of the children in the CAU group. For no dentin caries experience ($d_3$mfs), this regarded 69.4% of children in the

intervention group vs. 72.1% of the children in the CAU group, p>.05. Children in the intervention group had significantly lower $d_{1,2,3}$mfs than children in the CAU group, p < .01 (median 2 versus 5) (Table 4). Children in the intervention group had significantly lower levels of inactive caries lesions compared to children in the CAU group (median 2 versus 3), p < .01. The effect sizes r for caries experience in enamel and dentin ($d_{1,2,3}$ mfs) was 0.15 and for inactive caries lesions it was 0.18.

For the 5-year-olds with caries experience ($d_{1,2,3}$mfs >0), the caries experience for those in the intervention group was 26% lower than for children in the CAU group (RR = 0.74 (95%CI = 0.54-0.99, p < .05). No statistically significant differences were found between the intervention and CAU groups for their dentin caries experience ($d_3$mfs).

Discussion

The effectiveness on oral health at the age of 5-years of referral of parents and their newborns for a first dental visit by a well-baby clinic medical practitioner combined with the NOCTP approch in dental practices was assessed. Children who were offered early preventive dental care using an individualized approach with parents had lower enamel caries experience at 5 years of age, than children in the CAU group. The differences regarded the enamel and not the dentin lesions. That the lesions were only incipient is possibly related to the still young age of the child. Furthermore children in the intervention group showed fewer inactive caries lesions than children in the CAU group. The effect sizes regarding enamel lesions and inactive lesion were small, that is below 0.2. These effects are small but they regard all children, and small effects in large populations may still have a considerable population impact.

Table 4. Odds ratios (OR) and Rate ratios (RR) on primary outcomes dentin caries experience ($d_3$mfs), enamel and dentin caries experience ($d_{1,2,3}$mfs), active and inactive caries in deciduous teeth in children in the intervention (I) and CAU group according to group.

	Median (Tukey's Hinges 25th-75th percentile)			Crude Hurdle Model (I vs C)		Adjusted[a] Hurdle Model (I vs C)	
	I	CAU	Effect	OR	RR	OR	RR
	n = 166	n = 140	size r	95% CI	95% CI	95% CI	95% CI
$d_{1,2,3}$mfs	2 (0-7)	5 (1-10)	0.15**	0.71 (0.41-1.22)	0.83 (0.60-1.13)	0.62 (0.35-1.08)	0.74* (0.54-0.99)
$d_3$mfs	0 (0-2)	0 (0-2)	0.04	1.18 (0.72-1.94)	1.15 (0.67-1.97)	0.99 (0.59-1.66)	0.99 (0.58-1.68)
Active caries	0 (0-1)	0 (0-1)	0.06	0.84 (0.51-1.40)	0.62 (0.30-1.27)	0.71 (0.42-1.20)	0.51 (0.23-1.11)
Inactive caries	2 (0-4)	3 (1-6)	0.18***	0.51 (0.30-0.85) **	0.84 (0.65-1.08)	0.45 (0.27-0.77)**	0.82 (0.63-1.05)

CI = Confidence Interval, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] Adjusted models were adjusted for SES and ethnicity.

In the current study at age 5 we found that children in the intervention group showed less enamel and dentin caries experiences and fewer inactive caries lesions than children in the CAU group, suggesting a positive though relatively small effect of this intervention. As this is the first study to asses the effects of such a combined intervention of early referral and NOCTP, it is hard to compare with previous findings. Our finding that including oral health promotion in WCC seems promising to prevent some of the enamel lesions in young children differs somewhat from findings of a study in Belgium (28). That study assessed the effectiveness of an oral health education program that was added to a standard preventive care program in WCC during the first 3 years of life. The researchers reported limited to no effects on caries experience at the age of 5 years. The difference regarding enamel lesions between these studies might be explained by the fact that the intervention in the Belgian study did not include collaboration with and referral by WCC for dental care.

Next, the small positive effects regard a combined intervention which leaves to decide which component adds most. On the one hand, its effects on earlier first visits is evident. Referral of parents of babies by the WCC for their first preventive dental visit leads to earlier initiation of preventive dental care for those children. Overall 54% in the referral intervention group versus 7% in the control group had their first preventive dental visit in their first year of life (29). Furthemore, strong evidence supports the effectiveness of NOCTP in dental practice to improve oral health of children, albeit mostly at older ages (16-20). In short, this combined intervention may add to prevention of enamel caries lesions at age 5, with probably both the WCC early referral and the NOCTP parts adding to that.

No differences for dentin caries experience or active caries lesions were found between children in the intervention and children in the CAU group. This might be explained by the fact that the children in the study group were only 5 years old during the oral examinations and in The Netherlands, the group with dentin caries experience or active caries lesions at this age is rather small (14). This limits the power to detect differences between the groups. However, these differences can be expected to become bigger when the children are growing older. A second explanation could be that the

intervention group was slightly more disadvantaged given its composition regarding SES and etnicity of the mother, leading to an underestimation of the intervention effect. In sum, the effects as found may underestimate full effects. A third possible explanation that there was no difference found for dentin caries experience or active caries experience might be the fact that the intervention was not effective in the highest risk groups of children. Finally, the outcomes were based on clinical examinations whereas radiographs might have been more sensitive. However, ethical regulations do not allow its use for research purposes in the Netherlands.

Strengths and limitations

The main strength of the current study was that its prospective design with a follow-up of five years. The second strength is the inclusion of groups at increased risk of poor oral health, for example, low educated families and families with migration backgrounds. Finally, this study is performed in collaboration with several WCC clinics and dental practices, showing its feasibility in routine practice.

The current study had some limitations as well. First, the current study had a quasi-experimental design having as risk that effect estimated are influenced by confounding due to differences in the composition of the intervention and CAU group. However, adjustment for differences in important determinants of the outcomes such as educational level and ethnicity of the mother yielded quite similar estimates, suggesting the impact of this to be limited. Moreover, the baseline differences that occurred, all regarded higher prevalences of factors favourable for the development of child dental health in the CAU group (that is parents in the CAU groups more often were higher educated and more often had a Dutch background, Table 2). So, if leading to bias, this will probably have led to an underestimation of the real effects. Furthermore, this study had a relatively high drop-out, which may have led to including the more involved parents. The retention rate was rather low partly explained by the fact that the clinical examination was performed in 2021 when the covid pandemic prevailed. The retention rates were however similar in both groups, i.e. 23% in the intervention group and 22% in the CAU group, and were similar regarding the socio-demographic characteristics most

likely affecting the clinial primary outcomes, suggesting the impact of a selective retention to be limited. Third, an underestimation of the intervention effect is possible because of incomplete delivery of NOCTP, in particular due to COVID-challenges. Fourth, a multilevel clustering effect in the sample size calculation was not accounted for because the likelihood of such an effect was assumed to be small. Post hoc the intracluster correlation coefficient (ICC) at WCC level for d_{123}mfs as outcome was found to be small indeed, 0.04, and non-significant. Fifth, socio-demographic characteristics like socioeconomic position were dichotomized to obtain sufficient numbers across the categories for socio-demographic characteristics. In this, we adhered to the cut-offs used by Statistics Netherlands but it may have led to some residual confounding (30). However, given the quasi-experimental design of our study, this potential bias is considered to be small.

Conclusion

In conclusion, the results of the study suggest that early dental visits combined with NOCTP leads to a small reduction in less enamel caries experience and less inactive decayed lesions in children in the intervention group. Collaboration of WCC professionals and oral health professionals may offer a new opportunity for prevention of enamel lesions among young children and their parents.

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Supplementary Table 1. Classification of Nyvad criteria

Nyvad criteria	Category
0	Sound
1	Active caries (intact surface)
2	Active caries (surface discontinuity)
3	Active caries (cavity)
4	Inactive caries (intact surface)
5	Inactive caries (surface discontinuity)
6	Inactive caries (cavity)
7	Filling (sound surface)
8	Filling + active caries
9	Filling + inactive caries

CHAPTER 6

EFFECTIVENESS OF A SHORT WEB-BASED FILM TARGETING PARENTAL ORAL HEALTH KNOWLEDGE IN A WELL-CHILD CARE SETTING

Published as: Verlinden DA, Schuller AA, Verrips GHW, Reijneveld SA. Effectiveness of a short web-based film targeting parental oral health knowledge in a well-child care setting. *Eur J Oral Sci.* 2020; 128: 226–232.

Abstract

Young children rely on their parents with respect to oral health routines. However, parental knowledge on this is often insufficient. Well-child care may be an excellent route to reach parents because almost all attend. To evaluate the effectiveness of a 8.5 minute web-based film about oral health, provided by well-child care, a non-blinded quasi-experimental study was performed. Parents attending well-child care clinics in the Netherlands were assigned to an intervention (n=88) or control group (n=41). The control group received care as usual. We measured parental knowledge of oral health with a questionnaire (range of scores 1-12) before and directly after the intervention, and six months later, and assessed differences between the intervention and the control group. Parental oral health knowledge improved after watching the film: the intervention group mean score of 11.1 (SD, 1.3) was greater than the mean score of 7.1 (SD, 2.0) of the control group (Cohen's d=2.64). Scores remained higher in the intervention group six months after watching the film (mean, 9.1, SD, 1.3) than before (Cohen's d=1.25). A web-based educational film delivered in a well-child care setting can be an effective way to address oral health and to improve parental knowledge.

Introduction

Children rely on their parents with respect to oral health routines, and parental knowledge on this is often insufficient, particularly for young children. These routines are not always adequately performed by parents, especially those of low socioeconomic status (1-4).

Well-child care may be an excellent route to reach such parents, since most parents visit well-child clinics. Well-child care covers preventive pediatric care from birth until 18 or 21 yr, depending on the country where it is delivered. At the well-child care clinic, children receive scheduled immunizations, growth and development are monitored, and children and parents receive care to promote the child health and development. The routine health check-ups and immunization are an essential part of well-child care visits. Topics such as child behavior, eating and sleeping are discussed during a well-child visit. However, because there are so many important health issues that have to be discussed, some remain unaddressed during the well-child care visits (5). Caring for children's teeth and dental caries are frequently unaddressed topics, despite caries being the most common pediatric disease (6, 7).

Dental caries has a known etiology that implies routines for prevention since it depends on behavioral factors such as twice-daily tooth brushing with fluoride toothpaste and frequency of sugars intake (8, 9). The consequences of advanced caries (such as pain, discomfort, infections and tooth loss) can have a major impact on children's general health, growth and development. Caries affects the ability to chew and eat properly, and it can lead to lost school hours and affect children's quality of life, overall wellness and self-esteem (1, 10). Total costs for dental care for children up to 18 yr old were 443.5 million Euro in 2018 in the Netherlands (11).

In the Netherlands in 2011 43% of low-SES 5-yr-olds and 30% of high-SES 5-yr-olds had experienced caries (12). The Dutch routine policy is to arrange for a first oral check and advice at a dental practice when a child reaches the age of 2 to 2.5 yr, but not all parents visit a dentist with their child at that time. Oral health promotion should preferably be initiated at the age of six months, when the first tooth erupts. Well-child care clinics are an excellent route for infant oral health promotion, since the clinics are

in contact with 99% of parents and children from birth, including disadvantaged groups, such as those of low socioeconomic status or ethnic minorities (13).

Having adequate and correct knowledge is essential for appropriate health behaviors. Films have been shown to improve parental knowledge about oral health and the associated behaviors, and those with a web-based approach are relatively inexpensive. Alsada et al. reported an increase of 32% in knowledge of infant oral health in young mothers and early childhood educators after oral health information was given in a film (14). Rothe reported improved oral health knowledge among parents in Nebraska after watching a PowerPoint and film presentation (15). Bates & Riedy (2012) reported improvements in knowledge and beliefs on oral health among pregnant women and new mothers after the women had watched an oral health commercial on a website (16). However, none of these studies had a control group and or explored whether the effects were sustained. The advantages of supplying information in a film are, first, that knowledge is transferred and, second, that the desirable behavior is modelled by actors as role models (16-18).

Evidence-based and structured interventions for oral health promotion in 0-5-yr-olds are not standard in well-child clinics, and the encouragement of adequate oral health knowledge is not part of routine care. Electronic health (e-health) offers new routes for health promotion (19-21). Since 94% of parents in the Netherlands have access to the internet, a web-based intervention could increase the scale and sustainability of implementation (22). Via the internet, parents can access preventive interventions easily at any time via various devices, making implementation relatively inexpensive. A web-based film that demonstrates appropriate oral health behaviors to parents delivered in well-child care could therefore be an effective way of informing parents.

The aims of this study were: (1) to assess whether a web-based film about oral health routines in well-child care improved parental knowledge of oral health; and (2) to determine whether the film had an effect over the longer term.

Materials and Methods

Study design

This was a non-blinded quasi-experimental study. The intervention group had three measurements: (1) baseline; (2) post-intervention measurement, immediately after watching the film; and (3) a follow-up measurement 6 months after watching the film. The control group had one measurement, simultaneous with the post-intervention measurement of the intervention group, at which they were also offered the opportunity to watch the web-based film. To obtain a group of controls with a similar motivation for watching the film as in the intervention group, the control group included only those who had watched the film. In this way, we could prevent selection bias. We then assessed the effects of the intervention by comparing the differences in oral health knowledge scores between the intervention and the control group at the post-intervention measurement. We further assessed the increase in oral health knowledge scores of parents in the intervention group by comparing the post-intervention and the follow-up measurements of this group with their baseline measurements.

Study setting and participants

Included in the study were parents of 0-5-yr-olds living in urban or rural areas in the Netherlands, and parents who attended well-baby clinics in municipalities in the provinces of Zeeland, South Holland and Flevoland (Fig. 1). Parents who were not able to read Dutch, English, Moroccan or Turkish were excluded. The study took place in routine well-child care settings, with all parents from any given clinic being allocated to either the control or intervention group. Well-baby clinics for both groups were selected based on comparability of the regions concerned, to minimize the likelihood of selection-bias. Since doctors and nurses in well-child clinics serve entire clinics, five clinics were allocated to the intervention group and five clinics were allocated to the control condition. Thus, parents were assigned to the intervention or control group depending on the specific well-baby clinic they visited. Doctors and nurses at the well-child care clinics invited parents to participate in the study. These doctors and nurses spoke fluent Dutch and moderate levels of English. Informed consent was obtained from

all participants. Data were anonymized to protect the privacy of the responses. The research did not require a full assessment by a medical-ethical committee, based on the Dutch law, but was reviewed and approved by the quality and research ethics board of the Netherlands Organization for Applied Scientific Research TNO and was conducted in accordance with the guidelines of the 1964 Helsinki Declaration.

Intervention

The intervention was the viewing of the 8.5 minute web-based information film, "Healthy teeth for children". This film was designed by oral health promotion professionals working at the Netherlands Organization for Applied Scientific Research TNO and produced by Elan Productions (Elan Productions, Aadorp, the Netherlands). The film aimed to enhance knowledge and attitudes about oral health-related behavior for parents of children aged 0-5 yr. It included standard oral health recommendations about how to care for children's teeth until the age of 5 yr (see Table S1. Advice from the Dutch Dental Advisory board 'Ivoren Kruis'). To be comprehensible for parents of all levels of oral health literacy, the script was developed using plain language. The persons in the film were mothers and a female oral health professional and the narrator was a woman. The film was translated into Moroccan, Turkish and English, the three most commonly spoken foreign languages in the Netherlands (23).

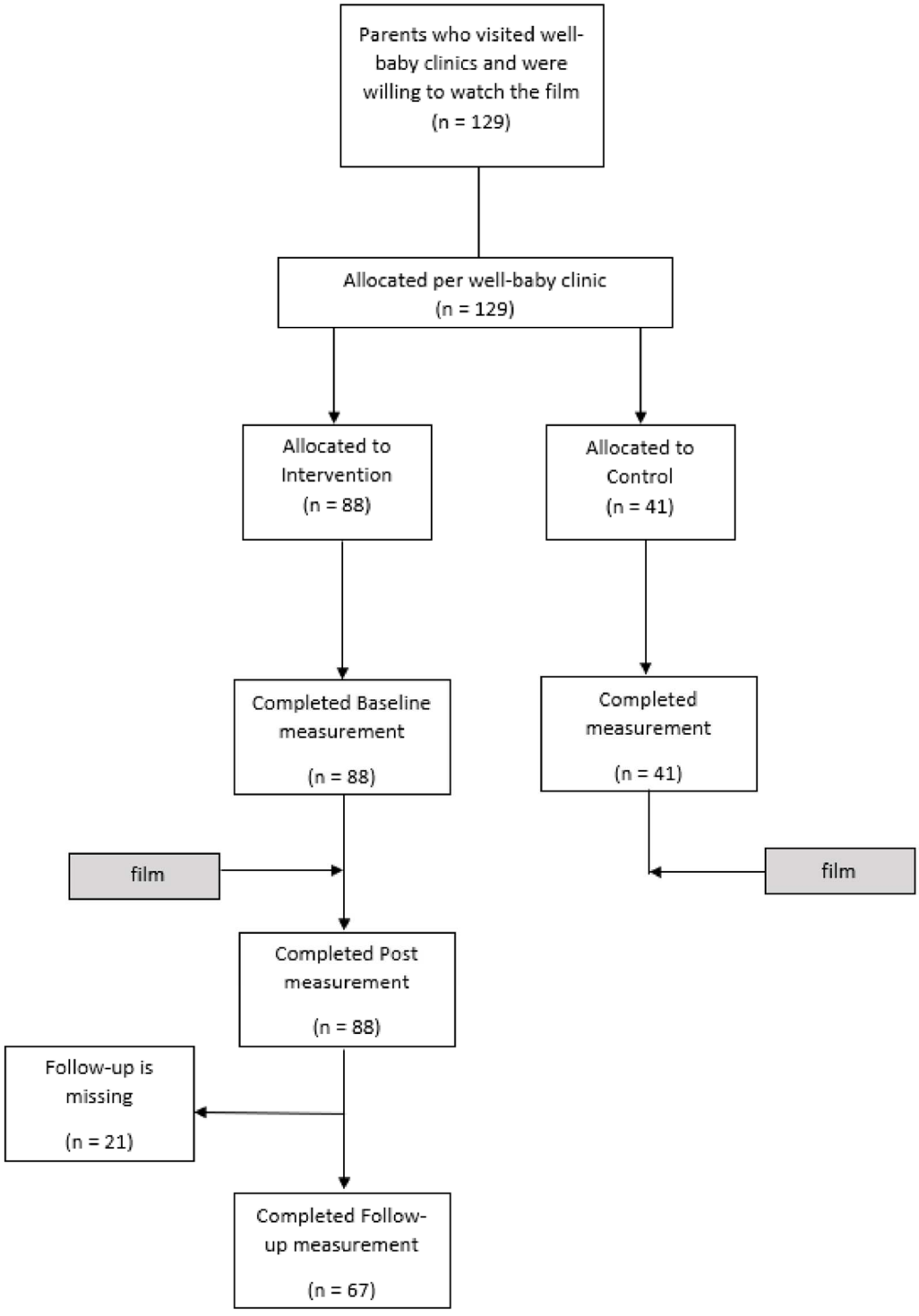

Figure 1. Flowchart of participants

* The control group was restricted to those parents who watched the film after they filled in the questionnaire, to select the parents who were similarly motivated to watch the film as in the intervention group.

The film displayed five challenges in dental prevention in children, using five scenarios. In the first scenario, a 5-yr-old boy and his mother were taught by an oral hygienist how to brush his teeth appropriately with fluoride toothpaste. The second scenario was of a 2-yr-old boy and his mother showing how a caregiver should help a toddler brush his teeth twice a day in the home situation. The next scenario was about food intake and showed that drinking from a cup is preferable to drinking from a bottle. Advice was also given about not drinking anything else than water when lying in bed. The fourth scenario showed a baby drinking lemonade from his bottle while shopping with his mother, and emphasized that water also should be the preferred drink in this case. The last scenario showed a child having its first dental visit, recommended at the age of 6 months (when the first tooth erupts). At the end, the film provides a short summary in text of all guidelines on keeping children's teeth clean and healthy (it can be viewed at www.tno-kindergebit.nl, and is also available on DVD).

The film was piloted among 48 parents visiting well-child care clinics in the province of Zeeland in The Netherlands. All participants in the pilot study thought the film was clear, and 79% of them thought the film duration to be good; the other 21% thought it was too long. Based on this pilot, the film was shortened.

Procedure: Instrument

We developed a 12-item questionnaire on parental oral health knowledge (Table 1). We used this questionnaire to assess the effectiveness of the film. This questionnaire was tested among the 48 parents in the pilot study. The Dutch language questionnaire was translated into Turkish and Moroccan, adhering to international agreed guidelines for securing cultural and semantic equivalence, including forward-backward translations (24).

Procedure: Intervention group

Parents in the intervention group were asked to complete the same questionnaire on three occasions: (1) At baseline; (2) Post-intervention measurement, immediately after the film; and (3) at a follow-up measurement, 6 months after watching the film. First,

they were asked to complete the questionnaire at the well-baby clinic before the intervention. They received a card with the link to the film's website and a personal log-in code and were asked to watch the film online at home. Parents could choose in which language they watched the film.

Table 1. Parental Oral Health Knowledge Questionnaire (every correct answer is 1 point knowledge score, with a maximum score of 12.

Questions	**Answer options**
1. Generally speaking, at what age does a baby get its first tooth?	Open-ended question
2. At what age is the set of baby teeth generally complete?	Open-ended question
3. When do you need to start brushing children's teeth? When a child ….	Can brush his or her own teeth / Is around 2 years old / Has a few teeth / Gets his or her first tooth / I don't know
4. How often should the teeth of a child (aged between 2 and 5) be brushed?	Never / Not every day / …….. times a day / I don't know
5. Up to the age of 5, you need to brush a child's teeth with:	Toothpaste for adults / Toothpaste for toddlers / Only with water / It doesn't make a difference / I don't know
6. Up until what age do you need to brush your children's teeth even if they are brushing also themselves?	This is not necessary / Is .... years old / I don't know
7. Should a child rinse his or her mouth with water after brushing?	Yes / No / It doesn't make a difference / I don't know
8. Can milk be harmful to baby teeth?	Yes / No / I don't know
9. Many children receive 3 meals a day. How many times a day are children allowed to have something else to eat or drink (excluding water or tea without sugar)?	Open-ended question
10. What is better for the baby teeth : drinking from a bottle or drinking from a cup?	Feeding bottle / Cup / It doesn't make a difference / I don't know
11. What can a child still drink before going to bed after brushing his or her teeth?	Milk / Only water or sugar-free tea / I don't know
12. At what age should the first dental check-up be? When a child ….	Has toothache / Is ..... years old / I don't know

Immediately after watching the film online, the participants were asked to complete the post-intervention measurement online. Parents who did not complete the post-intervention measurement were excluded from all analyses. After six months, parents in the intervention group were asked to complete the questionnaire again.

Procedure: Control group

The control group received care as usual (promotion of oral health knowledge is not part of routine care). Parents who were allocated to the control group were asked to complete the same questionnaire at the well-baby clinic as the intervention group. After responding to the questionnaire, parents were offered the opportunity to view the web-based film several weeks after the questionnaire. Analyses for the control group were restricted to those who were willing to watch the film at follow-up (n=41).

Background variables

The educational level of the mother was recorded and categorized [10 yr of education or less was coded as low educational level; more than 10 yr of education was coded as a high educational level]. This decision was made in accordance with the International Standard Classification for Education 2011 (25). Other background variables were the age of the child with an appointment at the well-child clinic, the ethnicity of the mother, and the number of children in the household.

Outcome measures

The primary outcome was parental oral health knowledge. There were twelve questions addressing levels of knowledge. All the questions had one correct answer, so the total score could range between 1 and 12 (Table 1).

Power and sample size

Sample sizes were determined based on the potential to detect an effect size of 0.5 SD in mean oral health-related knowledge score (range of scores 1-12) relative to the control group (knowledge score = 8.1, SD=2.2) at an alpha of 0.05 and with a power of 80%. This led to a required sample size of 63 persons per group.

Statistical analyses

We first described the background characteristics of the two groups before assessing the effects of the intervention on dental knowledge by comparing the intervention post-intervention measurement and the control group measurement using independent-sample t-tests. Cohen's d effect sizes were calculated (25). We then determined the persistence of the effects in the intervention group by comparing the follow-up measurement with the baseline measurement using paired-sample t-tests. Statistical analyses were performed using SPSS 22.0 and a p value < 0.05 was considered statistically significant.

Results

Background characteristics

Eighty-eight parents in the intervention group and 41 parents in the control group enrolled in the study and could be compared (Fig 1). Parents who completed the questionnaire were mainly mothers, in line with mothers often being the caregivers who visited the well-child clinic with their child. The sample was predominantly Dutch. We found a significant difference between the intervention and control groups for mean number of children in the family (intervention group: 1.8, SD=0.9 vs control group: 2.3, SD=1.5; P=0.048) (Table 2). There were differences between the two groups for ethnicity; 9% migrant mothers in the intervention group and 0% in the control group.

Table 2. Background characteristics of the participating parents of children aged 0-4 years.

	Intervention group	**Control group**	
	n=88	n=41	
	%	%	*p* value
Ethnicity of mother			0.06
Dutch	91	100	
Non-Dutch	9	-	
Educational level of mother			0.76
Low	54	51	
High	46	49	
Age child			0.91
0 to 1 years	69	66	
1 to 2 years	21	22	
2 to 4 years	10	12	
Mean number of children in family (SD)	1.8 (0.9)	2.3 (1.5)	0.048

Table 3. Parental oral health knowledge scores at baseline, post-intervention and follow-up measurement in the intervention group and Cohen's d effect sizes.

		Baseline – Post-intervention			Baseline – Follow-up		
	Baseline mean (SD)	Post-intervention mean (SD)	Difference (95% CI)	Cohen's d	Follow-up mean (SD)	Difference (95% CI)	Cohen's d
Intervention (n=88)	6.9 (1.7)	11.1 (1.3)	4.2 (3.8-4.6)	2.82	9.1 (1.3)	1.9 (1.5-2.3)	1.25
Control (n=-41)	n.a.	7.1 (2.0)	n.a.		n.a.	n.a.	
Difference intervention – control (mean, 95% CI)		4.0 (3.3-4.7)					
Cohen's D		2.64					

CI = confidence interval
n.a. = not applicable

Effect of the intervention

Table 3 shows mean levels of parental oral health knowledge scores for baseline, post-intervention and follow-up measurement in the intervention and control groups. Parental oral health knowledge at post-intervention measurement was higher in the intervention group than in the control group (means 11.1 (1.3) vs. 7.1 (2.0), p< 0.001). In the intervention group, parents had higher knowledge scores at post-intervention measurement than at baseline (means 11.1 (1.3) vs. 6.9 (1.7), p< 0.001) and the difference between baseline and post-intervention measurement was large; Cohen's d = 2.82. At follow-up, 67 parents in the intervention group completed the questionnaire, reporting higher knowledge scores than at baseline (9.1 (1.3) and 7.2 (1.7)); Cohen's d = 1.25.

Table 4. Proportion of correct answers on oral health knowledge items of the questionnaire for the intervention (post-intervention measurement) and the control group measurement.

	Intervention	**Control**
	n=88	n=41
	% correct	%correct
Age at which baby's first tooth erupts	93	73
Age at which the set of deciduous teeth is generally complete	71	20
Age at which to start brushing children's teeth	100	95
Advised frequency of toothbrushing per day for children aged 2-5 yrs	94	76
Type of toothpaste until the age of 5 years	100	96
Age until which helping brushing children's teeth is needed	93	15
Rinsing with water after toothbrushing	94	51
Milk harmful for baby teeth	78	44
Maximum frequency of eating or drinking per day	92	10
Recommended way of drinking	100	85
Recommended drink before going to bed	100	95
Recommended age for first dental check-up	99	49

Table 4 shows the proportion of correct answers for parental oral health knowledge per item in the intervention group at post-intervention measurement and in the control group.

There were no differences in parental knowledge scores by child age: mean scores for parents of young children and mean scores for parents of older children were not different at baseline, post-intervention and follow-up measurement. Levels of knowledge to be higher for better educated parents at all measurements. However, there were no differences between the intervention and the control group by parental education, or for the changes from baseline to post-intervention measurement or to follow-up measurement in the intervention group.

Discussion

To the best of our knowledge, this is the first study to assess the 6-month effect of a web-based film about oral health routines in well-child care to improve parental knowledge about oral health. We found that parental knowledge scores increased immediately after watching the film. This improvement persisted after six months, even though parental knowledge scores were lower than immediately after watching. The effect sizes for the immediate effect of the film and the 6-months follow-up effect were both large (26). The longer term effect of the film makes the current study unique (14).

The difference in knowledge between the parents who received the intervention and the parents in the control group was consistent with the results from the currently limited evidence on this topic (14-16). An explanation for the improvement in knowledge could be our use in the film of the concept of modeling. Film modeling can facilitate the transfer of knowledge, reduce anxiety and improve self-care, and have a positive effect on the self-efficacy of parents (16-18; 27). Film or video interventions have been shown to be effective in improving health knowledge in other health settings such as a video intervention about Ebola and a short video for parents about how to help children cope with fearful situations (28, 29).

We also found a longer term effect on oral health knowledge in our study. Previous studies with a film for parents on infant oral hygiene evaluated the

effectiveness on oral health knowledge for the short term only (12-14). Possible explanations for the long term improvements in knowledge found in the current study, might be the use of verbal summaries of recommendations, the use of clear and short messages, showing the consequences of unfavorable parental oral health behavior and the combination of verbal and visual repetition of information in the film (30). The film was also pretested among parents and adjusted based on their comments. The improved film may have captured parents' interest in the film and understanding of the information, and subsequently improved their memory.

Strengths and limitations

A strength of our study was its embedding in routine care and its design to compare a new intervention with routine care. Moreover, we included intervention and control groups, both of which were willing to watch the film and therefore likely to have similar levels of motivation. It is known that parents with lower levels of education are more likely to drop out; they might have lower levels of health literacy and be less healthy than parents with higher levels of education (31, 32). Thus, to minimize selection bias, we analyzed groups with similar motivation to watch the film. The improved knowledge found in this study can therefore genuinely be assigned to watching the film and not to differences in motivation levels.

Our study also has some limitations. First, parents were not randomly assigned to control or intervention but assigned depending on the specific well-baby clinic they visited. Some well-baby clinics were intervention locations and some were control locations; this might have resulted in selection bias. However, we selected well-baby clinics for both groups from comparable regions to minimize that likelihood. The intervention group and control group differed in the proportions of mothers with a migrant background (intervention group 9%, none in control group). Migrant parents have lower levels of dental attendance and knowledge of oral health than the native population, and so mean knowledge scores would have been lower in the intervention group (33). This will presumably have led to an underestimation of the real effect in our study. Finally, the size of the control group was smaller than required by the power

analysis, whereby a sample size of 63 participants was originally determined. Since well-child clinics have to address very many different topics, oral health is seen of less importance. In addition, some of the well-child clinics had to deal with a shortage of (and changes in) workforce. These issues might be reasons for the low number of participants. However, since we found substantial effects on knowledge and a large difference in mean parental oral health knowledge scores between the intervention and control groups (Cohen's d=2.64), we may conclude that the effect is real.

The findings show that a web-based film is a promising method to promote knowledge on oral health among parents. The study opens up a promising avenue for addressing oral health in health settings such as well-child care. Major advantages of this method of oral health promotion are lower costs and a high reach, and that it is straightforward to implement in healthcare settings. Dissemination is probably best left to trusted intermediaries such as well-child care. It is known that educational interventions like a web-based film alone have limited impact on oral health, but nevertheless could be useful for initiating oral health promotion in children. Further research is needed to determine whether the improved oral health knowledge scores can contribute to better oral health outcomes. Accordingly, a web-based film could be used in practice as part of a longer, multicomponent oral health promotion intervention in the well-child care setting. Evaluation of the effectiveness of the film in settings (such as physicians practices, dental practices or pharmacies) should be undertaken. Further research is needed to address the effects of a web-based film on outcomes other than parental knowledge, such as parental self-efficacy, attitude, intentions, and perceived behavioral control, that are important factors for changing parental behavior for the oral health of their children (34 -38).

Acknowledgements

The study received financial support from ZonMw, the Netherlands Organization for Health Research and Development (grant number 156511009).

The financiers had no role at any stage of the project, including the decision to submit the manuscript. I'd like to thank Dr. Erik Vermaire for his suggestions, Elan video

productions for producing the film, Dr. Ernest de Vroome for his assistance with the statistics, and Thijs Vogels for developing and hosting the website. Lastly, the authors like to thank all parents who participated in the study.

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Supplemental file 1

Table S1. Advices from the Dutch Dental Advisory board 'Ivoren Kruis' from 2011 about how to care for your children 's teeth.

1. Start brushing your baby's teeth with fluoride toothpaste as soon as the first deciduous tooth breaks through
2. Use fluoride toothpaste following the guidelines of Advisory board 'Ivoren Kruis'
    a. As soon as the first tooth erupts: once a day in the evening with fluoride toothpaste for toddlers (500-750 parts per million (ppm) fluoride),
    b. As soon as the child turns 2 years of age: 2 times a day with fluoride toothpaste for toddlers (500-750 ppm fluoride)
    c. As soon as the child turns 5 years of age: 2 times a day with fluoride toothpaste for juniors or adults (1000-1500 ppm fluoride)
    d. For all ages: Only extra fluoride supplements when there is an indication after risk assessment
3. Tooth brushing by parent/caregiver until the child is 10 years of age.
4. Maximum of frequency of meals and drinks of 7 times a day
5. First dental check-up at the age of 2

PART III

IMPLEMENTATION OF INTERPROFESSIONAL COLLABORATION IN ORAL HEALTH CARE

CHAPTER 7

COLLABORATION ORAL HEALTH CARE AND YOUTH HEALTH CARE; FOR BETTER DENTAL PREVENTION

Published as: Verlinden DA, Snip M, Vermaire JH, Smit L, Schuller AA. Samenwerking mondzorg en jeugdgezondheidszorg; voor betere tandheelkundige preventie. *Ned Tijdschr Tandheelkd.* 2021; 128: 395-401 *(In Dutch).*

Abstract

The new Dutch Oral Health Care Guideline for Children advises parents to visit the oral health care professional before or from the eruption of the first tooth, because oral health care starts with the first deciduous tooth. However, this is not yet a standard for everyone. Almost all parents of newborns (> 95%) visit well-baby clinics with their newborn. This article describes how a collaboration between well-baby clinics and oral health care can be formalized to reach all young children and their parents earlier for (preventive) dental care. Some projects in which well-child clinics and oral health care collaborate include the "Toddlers' Oral Health" project, the "Healthy teeh: all aboard!" project, and various joint efforts between local well-child clinics and oral health care, such as in the Schalkwijk district in Haarlem.

Introduction

In the Netherlands, dental care for children from 0 to 18 years is fully reimbursed under the basic health insurance. Nevertheless, in 2017, 24% of five-year-olds in the Netherlands had one or more dental caries lesions (1). These figures suggest that children and their parents may not be getting proper and timely preventive advice. Research in Australia showed that starting earlier with dental visits contributes to better oral health among young children (2,3). Children of mothers who received dental guidance from pregnancy had up to 14% less caries at age two, and up to 23% less caries at age three, compared to children whose mothers had not received this guidance.

In the Netherlands, data from Vektis (centre for business intelligence in health care) show that in 2019 41% of two- and three-year-old children made at least one visit to the dentist (4). For the year 2019, CBS reported that 39% of the 0 to 4 age group in the Netherlands had made one or more visits per year to the dentist (5). Until 2013, the advice was to visit the oral health professional regularly from the age of two. However, as of 2013, with the availability of the *Oral Health Care for Youths Guideline*, which recommends preventive education for parents of children aged six to nine months, this advice changed (6). Nevertheless, oral health professionals do not (always) have an overview of all newborn children to be able to invite their parents for preventive dental consultation at six months of age. Since more than 95% of all parents of newborns use Youth Health Care (YHC) resources (7), a collaboration between oral health care providers and the YHC could increase outreach to parents of newborns for preventive dentistry. The purpose of this article is to provide insight into ways in which oral health professionals in the Netherlands can collaborate with YHC professionals to reach young children and their parents for timely (preventive) dental care.

When did the advise for visiting a dental professional change from "at two years" to "after the first tooth has erupted"?

In 2013, the advice to visit the oral health professional twice a year starting at two years of age changed, and the Netherlands was not unique in this. One of the first studies on the effect of preventive consultations at a very young age started in 1992 in Nexø,

Denmark (8). There, children were offered preventive consultations at the age of eight months. In 1995 an article in the *Journal of the American Dental Association* recommended that the first dental visit should occur between the ages of six and 12 months (9). In 2001, in the *American Clinical Guideline for Adolescent Oral Care* the American Academy of Pediatric Dentistry recommended that the child's first preventive dental visit should occur no later than 12 months of age (10). In December 2020, the new '*Clinical practice guideline dental and oral care for kids and adolescents'* was published with the recommendation, "Try to counsel children before or from the time of the eruption of the first teeth. Agree on an interval for periodic oral examinations in consultation with parents. It is recommended to follow the systematics of the Danish Nexø project or the Ivory Cross' (Dutch Association for Oral Health) Gewoon Gaaf project" (11,12).

Importance of early dental visits

The literature reports prevalence rates of caries in children under four years of age of 13% in two-year-olds in Greece, and 8% in 18-month-olds, and 23% in three-year-olds in Australia, (13,14). In the Netherlands, no caries prevalence figures are known for the two- to three-year-old group. What is known is that a quarter of five-year-olds have already (had) caries experience; moreover, among these children a strong link has been found between caries and socioeconomic status (1).

Insight in the child's oral health before the age of two, and the parents' motivation to follow all recommended child oral health advices can help to provide early targeted preventive dental care and stop incipient caries lesions. Teaching healthy behaviors from the beginning is better than having to unlearn inadequate behaviors later (15,16). Consider, for example, education on preventing early childhood caries: one example is to discourage taking drinks (except water) to bed.

For families who require additional support and training appointments for adequate oral care, return intervals of appointments can be individually tailored according to the 'Gewoon Gaaf'' Method (NOCTP, Nexø Method).

Additional benefits of early visits to the oral health professional are that the child

gets used to consultations, and the first experiences will be positive ones.

What does a dental consultation with a six- to 12-month-old child at the oral health clinic involve?

Now that the child's first dental consultation is to take place at the age of six to 12 months, the content of the consultation will not be the same as in the previous situation, when it took place at the age of two years. At this earlier age the child has only one or a few first teeth. A brief clinical inspection can provide an impression of the oral health. However, even more important during a first contact between the oral health professional and the parent(s) is the conversation with the parent(s). In addition to giving advice on toothbrushing and nutrition, getting to know the parent(s) is especially important, as the family situation and context will directly or indirectly influence the oral care, and thus the oral health, of the child. One should also consider the possible presence of mental and/or physical illnesses, diseases, poverty or fear of the dentist in the family.

Based on an impression of what parents consider important when it comes to dental health, a preventive message can be tailored. For example, one parent thinks it is important for the child to have nice white teeth; another parent wants to protect the child from having cavities and pain; and some parents have a firm belief that caries is hereditary, or that deciduous teeth do not matter because they are temporary anyway (17). Parents may also have different opinions and ideas about professional dental care. They may not know that dental care for children up to age 18 is reimbursed from the basic insurance package, or may think that the deductible or co-payment for a dental consultation must be paid.

When talking to parents, it is important that professionals keep the atmosphere open, avoid a top-down approach, and ensure that the parent feels understood and taken seriously. Through motivational interviewing, the professional can work with the parent to develop a plan of action with concrete goals. This approach is described in detail in the new '*Clinical practice guideline dental and oral care for kids and adolescents*'(11).

Advice to parents on nutrition

In the first year of life, a child's feeding pattern changes significantly, from complete breast- or bottle feeding to the introduction of solid foods from around the age of 4 months. Also, around seven months, some parents start giving their child drinks other than breast- or bottle feeding (18). Topics for discussion then include frequency of eating and drinking, and limiting of fermented carbohydrates and sugars. Not all parents know which products contain sugar, and how often and how much sugar their child ingests in a day. Products advertised as "for children" are often high in sugar. Sometimes the text "no added sugars" appears on fruit juices, giving parents the idea that these products are healthy for children, when this is not the case. Publications of the Netherlands Nutrition Centre provide dietary recommendations tailored to age for young children; these are the same as the advice for a good oral health (see also Figure 1).

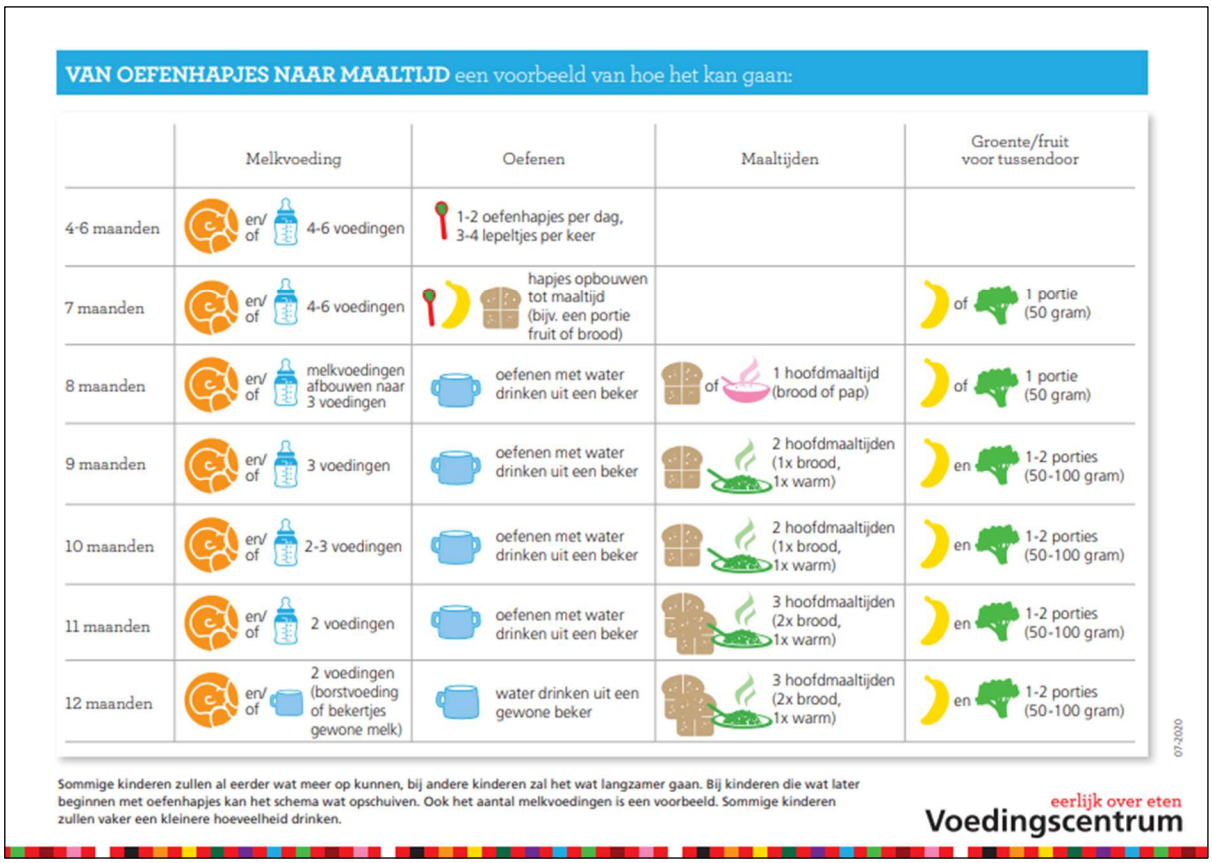


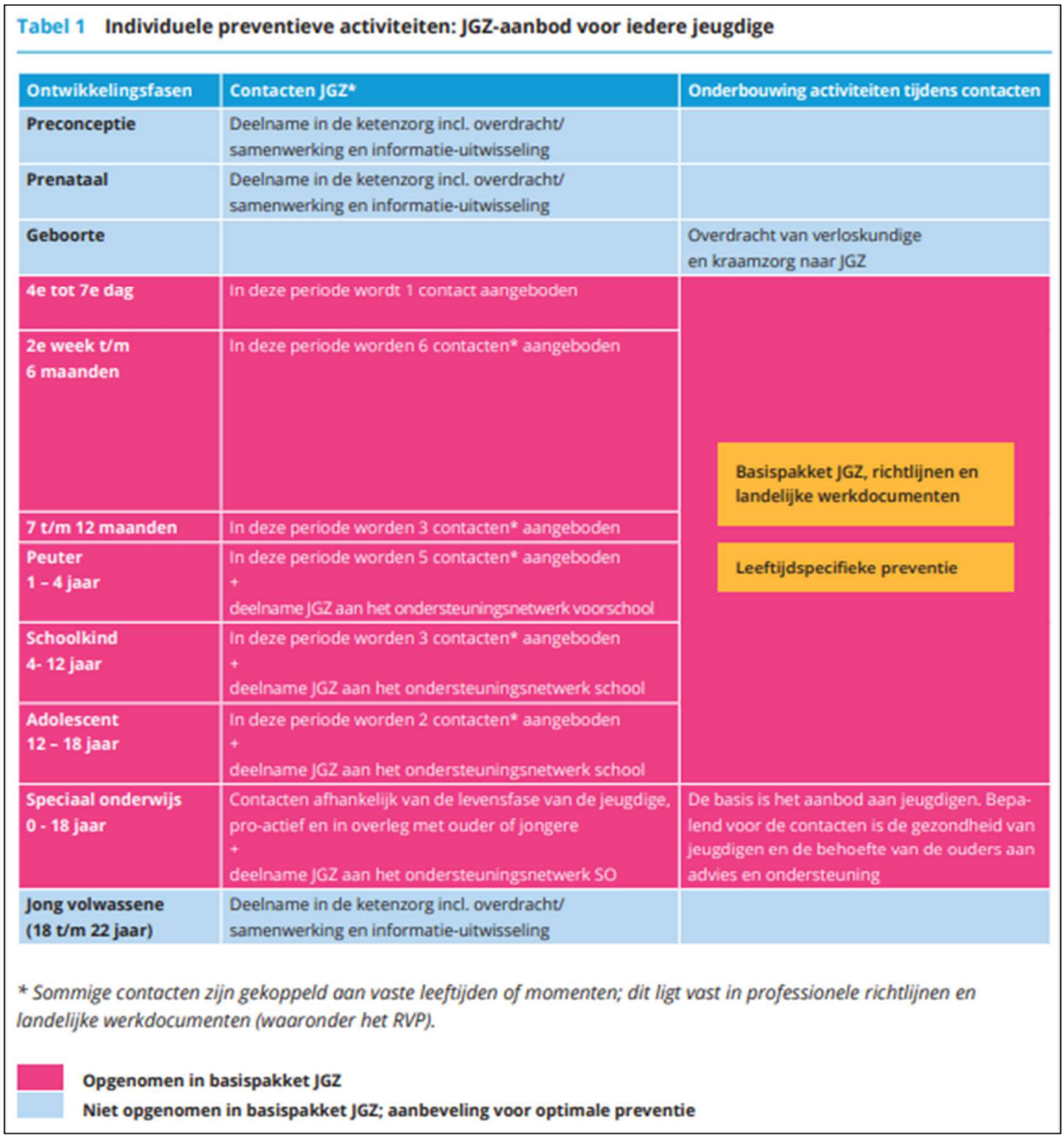
Figure 1. "From practice bites to meals" in Dutch, from: Build-up schedule of practice snacks Nutrition Center.

It is also important to address topics such as how to drink (preferring a cup to a bottle), and the harm caused to early teeth by nighttime drinks (with the exception of water).

Box 1. Youth health care in the Netherlands (YHC)

YHC is a form of care that supports parents in raising and caring for their child. All municipalities in the Netherlands are required to offer their resident children a basic YHC package (see basic YHC package at *www.ncj.nl*). The activities of the YHC are anchored in the Public Health Act (Wpg) and further elaborated in the Public Health Decree (Bpg). The YHC is organized at city and/or district level, and has national coverage. Each counseling office knows the social map of the district, with the working areas of its care providers, general practitioners and medical specialists.

Sometimes contact takes place between expectant parents and YHC professionals at the child's consultation center even before the child is born. At 22 weeks of pregnancy, the mother can receive a vaccine against pertussis at the consultation center. Immediately after birth, the baby receives the heel prick test, and the YHC performs a hearing screening. Then a youth nurse comes to the home for an intake, and explains the role of the YHC. Consultations and home visits are offered and conducted as needed. The YHC is responsible for carrying out the National Vaccination Program (RVP), and regularly receives parents and children at the consultation center. See Figure 2 for an overview of all contact moments offered by the YHC for children aged zero to four years.



Tabel 1 **Individuele preventieve activiteiten: JGZ-aanbod voor iedere jeugdige**

Ontwikkelingsfasen	Contacten JGZ*	Onderbouwing activiteiten tijdens contacten
Preconceptie	Deelname in de ketenzorg incl. overdracht/ samenwerking en informatie-uitwisseling	
Prenataal	Deelname in de ketenzorg incl. overdracht/ samenwerking en informatie-uitwisseling	
Geboorte		Overdracht van verloskundige en kraamzorg naar JGZ
4e tot 7e dag	In deze periode wordt 1 contact aangeboden	
2e week t/m 6 maanden	In deze periode worden 6 contacten* aangeboden	
7 t/m 12 maanden	In deze periode worden 3 contacten* aangeboden	
Peuter 1 – 4 jaar	In deze periode worden 5 contacten* aangeboden + deelname JGZ aan het ondersteuningsnetwerk voorschool	
Schoolkind 4- 12 jaar	In deze periode worden 3 contacten* aangeboden + deelname JGZ aan het ondersteuningsnetwerk school	
Adolescent 12 – 18 jaar	In deze periode worden 2 contacten* aangeboden + deelname JGZ aan het ondersteuningsnetwerk school	
Speciaal onderwijs 0 - 18 jaar	Contacten afhankelijk van de levensfase van de jeugdige, pro-actief en in overleg met ouder of jongere + deelname JGZ aan het ondersteuningsnetwerk SO	De basis is het aanbod aan jeugdigen. Bepalend voor de contacten is de gezondheid van jeugdigen en de behoefte van de ouders aan advies en ondersteuning
Jong volwassene (18 t/m 22 jaar)	Deelname in de ketenzorg incl. overdracht/ samenwerking en informatie-uitwisseling	

** Sommige contacten zijn gekoppeld aan vaste leeftijden of momenten; dit ligt vast in professionele richtlijnen en landelijke werkdocumenten (waaronder het RVP).*

Opgenomen in basispakket JGZ
Niet opgenomen in basispakket JGZ; aanbeveling voor optimale preventie

Figure 2. "Individual preventive activities: YHC offerings for every youth" from: National Professional Framework. Implementing basic youth health care package from the Netherlands Center for Youth Health', 2018 (In Dutch).

During consultations, the YHC focuses on monitoring growth and development, identifying problems, and timely detecting of specific disorders. It also helps parents with questions about parenting, and about the development of their children. The YHC is also responsible for providing preventive education to help children to grow up, as much as possible, in a healthy and loving environment. Article 5 of the Public Health Law

(in Dutch ‘Wet publieke gezondheid’) and Article 6 paragraph 1 of the Public Health Decision (in Dutch ‘Besluit publieke gezondheid’) also emphasize preventive oral and dental care: "The work on providing information, advice, instruction and guidance for adolescents includes individual and group-oriented information, advice, guidance and support aimed at supporting parents and in any case concerns the topics of teeth and dental care."

The YHC professional and child oral care

The YHC professional advises on oral health, including eating and drinking, pacifier and bottle use, and tooth brushing. From the eruption of the first tooth, YHC professionals encourage parents to brush teeth and visit the dentist. Children who do not allow tooth brushing; parents who are indulgent, and give their children bottles of lemonade or milk when putting them to bed; or parents who are themselves afraid of the dentist - all can visit the clinic and can be motivated and equipped by a YHC professional to exhibit more desirable behaviors where necessary.

Cooperation between oral health care and youth health care

Contact between YHC professionals and oral health professionals in the district is not yet obvious. There are various possibilities for developing a partnership between oral health care and YHC, and collaboration can involve the goals described below.

Goal: offer dental consultation

To ensure that all children receive their first consultation with an oral health care provider at the age of six to 12 months, collaboration between the YHC and oral health care professionals is highly desirable. In the Netherlands, two projects involving such collaborations aimed at improving the oral health of young children are currently in the finishing phase of research (19). One project, named "Healthy teeth: all aboard!", is a research project of the University Medical Center Groningen; TNO Child Health and Erasmus School of Health Policy & Management; YHC in The Hague and East Groningen; and several oral health practices in The Hague and East Groningen (20). Participating

six-month-old children were divided into two groups. (Parents of) one group of children received a referral advice from the YHC doctor to attend a check-up visit to the oral care professional. The other group received care as usual, provided by the YHC professionals. This study has been designed to examine whether, by the age of five, oral health will differ between the two groups.

The second project, called "Toddler Oral Health", is a collaboration of the Academic Center for Dentistry Amsterdam; Hogeschool Utrecht, Municipality of Utrecht; GGD Den Bosch and Tilburg; Stichting Amsterdamse Gezondheidscentra and Stichting Thuiszorg en Maatschappelijk Werk Rivierenland; and the Ivoren Kruis, KNMT, NVM oral hygienists - Dutch Society for Children's Dentistry and oral health care practices in the regions of Tilburg, 's Hertogenbosch, Culemborg, Tiel, Utrecht and Amsterdam (21). This project investigates how the use of an oral health coach for parents and children at the WCC clinic affects the oral health of young children. The oral health coach applies the Gewoon Gaaf method and uses the health action process approach behavioral model. Children in the intervention group and in the control group are followed from zero to four years of age, and the children's oral health is measured at two and four years of age.

Goal: providing dental prevention by the YHC

If the YHC's goal in collaborating is to apply more dental prevention in practice, YHC professionals can receive appropriate training for this purpose. Such training has been studied in Peru (22). The study examined the effectiveness of comprehensive training for YHC professionals in the application of preventive oral health care, combined with a collaboration between YHC professionals and dentists trained in the Atraumatic Restorative Treatment (ART) approach (23). Children coached by the trained YHC professionals were followed from zero to three years of age and compared with children coached by YHC professionals who had received only additional written information about oral health care, and with children coached by YHC professionals who had received a single lecture on the importance of oral health care. Children coached by the trained YHC professionals had significantly lower rates of caries and significantly less severe caries at age three than those coached by YHC professionals who had not

received the comprehensive training (22). In the Netherlands, however, YHC professionals actively providing dental prevention has not yet been implemented.

Purpose: addressing pedagogical issues

Collaboration between YHC and oral health care could also focus more on common issues, such as the need for pedagogical support for parents. In daily practice, oral health professionals encounter children who have oral health problems related to pedagogical issues like inadequate oral hygiene and dietary patterns. For these issues, oral health professionals can also refer children to a pediatrician. When oral health professionals see children affected by child neglect or abuse, they report these situations to 'Veilig Thuis' (see also the five steps of the Reporting Code for Child Abuse and Domestic Violence in Box 2 (24). Veilig Thuis is an advice and reporting center for child abuse and domestic violence, also for professionals. The oral health care professional can always contact Veilig Thuis with questions regarding signals of child abuse and/or domestic violence.

Box 2. The five steps of the Reporting Code on Child Abuse and Domestic Violence (23).

Step 1. Map Signs.

Step 2. Seek advice from colleague and/or Veilig Thuis (Acutely unsafe? Contact police or Veilig Thuis immediately).

Step 3. Talk to the patient and/or his/her relatives.

Step 4. Weigh nature, seriousness and risk of the signs.

Step 5. Organize your own help or report to Veilig Thuis (advice and registration center for domestic violence and child abuse, tel. 0800 2000, or www.vooreenveiligthuis.nl.) Record all five steps of the case in a file.

The first step towards collaboration with a local WCC clinic is, for example, to arrange a meeting with the staff doctor, or the location manager of the health care office, to discuss cooperation.

The first results of the collaborative project YHC oral health practices HTAA.
In the HTAA study, (parents of) one group of children (intervention group) aged six months were advised by the youth physician to go to the oral health professional; the other group of children (control group) received care as usual from the YHC. Initial results show that children in the intervention group were 16 times more likely to visit the oral health professional before their first birthday than children in the control group; in the intervention group of the HTAA project, 54% of children visited the oral health clinic before their first birthday, compared to 7% in the control group (20). This is obviously a significant increase in outreach, but one must not lose sight of the fact that 46% of children have not yet visited an oral health professional. Follow-up research will be needed to indicate how the remaining 46% can also be reached.

Case study: 'Oral health generation in Schalkwijk': active referral works!
That cooperation between oral health care professionals and YHC is not always initiated by oral health care professionals is demonstrated by the example below, in which YHC doctors from the Schalkwijk district of Haarlem sought contact with oral health care professionals. Schalkwijk is a neighborhood in Haarlem with many families with a low socioeconomic status and/or a migration background. The YHC doctors noted that in this neighborhood the percentage of children whose teeth are brushed daily and who visit the dentist was low. For this reason, in 2018, YHC Kennemerland, in collaboration with Poetz Jeugdmondzorg (children's oral health care) in Haarlem, launched a collaborative project to connect children earlier and more effectively with oral health care practices. The project was named "Schalkwijk zet de tanden erin!" *('Schalkwijk sets teeth into it'*) (26). All oral care practices in Haarlem were informed by the YHC of the plan to refer children to the dentist earlier, more directly and more quickly.

When each child in this district reached the age of six months, an automatic message, a task 'Toeleiden Mondzorg' (*Leading to Oral Care*), was placed in the YHC's digital file for the YHC professional. The YHC professional who met the parents and child during the next consultation discussed this message with the parents, and advised them to take their child to a dentist from the eruption of the first tooth. In cases of caries or other dental problems, fear of the oral health care provider, lack of a dentist for the family, or a dentist who preferred not to examine children until later in life, a referral to Poetz was offered. Parents were then given an information kit from Poetz and asked to make their own appointment there. The information kit included a letter explaining the first consultation and asking parents to make a first appointment, a leaflet about the Gewoon Gaaf method, and a medical anamnesis. The YHC sent a referral letter to Poetz or, with parental consent, to the family's own dentist, requesting that the child should be invited for a first oral health consultation. If the parent did not contacted Poetz, Poetz itself contacted the parents after some time. Implementation of this strategy resulted in a spectacular increase in the number of children visiting an oral health provider at ages two to three - from 20% in 2017 to 43% in 2019; this number became higher than in the overall YHCK population. A similar increase was seen among three- to four-year-olds, among whom the percentage increased from 39 in 2017 to 59% in 2019. At YHC Kennemerland, the intention is to expand early referral to the own dentist, as in Schalkwijk, where referrals are now successfully being made to the other consultation offices in its working area.

Conclusion

It is very well possible to form a collaboration network between the YHC and the oral health professional in order to reach more young children in the Netherlands and their parents earlier for oral health care. Several examples of collaborations between the YHC and oral health care already exist, such as the Todller Oral Health project, the Healthy teeth; all aboard! project, and several local collaborations of YHC and oral health care, such as in Schalkwijk. The first results of the HTAA study show that as a result of such collaboration, significantly more parents visit the dentist with their child aged six to

twelve months than in the control group without collaboration. However, it is still being investigated which method of collaboration is most effective, and whether a collaboration of YHC and oral health care to reach young children for early dental prevention also has an effect on caries prevalence in children. Moreover, the most suitable collaboration between the YHC and oral health care may vary by region.

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CHAPTER 8

VALIDITY OF DATA COLLECTION METHODS FOR TIME SPENT, PROFESSIONAL INVOLVEMENT AND TREATMENT VOLUME FOR THE PURPOSE OF COST-EFFECTIVENESS STUDIES IN DENTISTRY

Published as: Verlinden DA, Schuller AA, Reijneveld SA, van Dommelen P & Vermaire JH. Validity of data collection methods for time spent, professional involvement and treatment volume for the purpose of cost-effectiveness studies in dentistry. *Acta Odontol Scand.* 2022;80(5):396-400.

Abstract

Objectives: Economic evaluations can support provision of adequate and affordable oral care, requiring valid information on costs. The aim was to assess the validity of a) patients' self-report (PS) and routine electronic patient records (EPR) regarding time spent per visit and b) PS regarding types of treatment and type of dental professionals involved.

Methods: Data were collected in four dental clinics regarding time spent using PS and EPR, on types of treatment and dental professionals involved using PS. As reference standard for time spent, independent research assistants (RA) collected data on time per visit using stopwatches. As reference standard for types of treatment and of dental professionals involved we used the dental clinic's Electronic Patient Files (DEPF). The Two One-Sided Tests (TOST) equivalence procedure for the difference between paired means for time and kappa statistics for treatment and professional were used to assess agreement of data collection methods with the reference standards.

Results: Equivalence and agreement was good between a) PS and RA registration concerning waiting time, appointment time and total time spent and b) EPR and DEPF concerning appointment time. Agreement between PS and DEPF concerning types of treatment was moderate to fair (kappa values between 0.49 - 0.56 for preventive consultation, restoration, radiographs and extractions and between 0.15 -0.26 for fluoride applications and sealants). Agreement between PS and DEPF for dental professional involved was fair (kappa=0.41).

Conclusions: Data collection regarding time using PS and EPR was valid. Data collection via PS on treatment and professionals involved was not sufficiently valid and should occur via DEPF.

Introduction

Healthcare expenditures comprise a considerable share of total national expenditures in most countries worldwide, with oral health being a significant component. In the Netherlands health care expenditures are estimated to be 11,2% of the gross domestic product (GDP) (1). From these health care expenditures was 2,8% related to oral health care (1,2). This is lower compared to the Scandinavian countries. In Norway, healthcare expenditures were 11,3% in 2020 and 4,6 % of total healthcare expenditures represented oral health care expenditures (1,3). Since financial resources are limited, treatment choices must be made (4). Economic evaluations can provide data which these choices can be based on. Since the 1980s, economic evaluation and systematic reviews have been increasingly available in evidence-based dentistry (5).

Countries have different systems of financing dental treatment. For example in the Netherlands all dental procedures have fixed maximum rates. Peadiatric dentistry is fully covered by a national health insurance, adults have to pay dental treatment out-of-pocket or could voluntarily take out an additional dental insurance. Cost-effectiveness analyses (CEA) could help to decide what intervention is the most cost-effective and will help policymakers to select the most cost-effective health policy options (6). The costs in CEA studies are based on time consumption, type of treatment, and type of dental professional performing the treatment. These factors are relevant because time is costly; one treatment may use more expensive materials than another and type of professional matters since hourly rates differ between dentists, other dental healthcare provider such as dental hygienists and dental assistants. In the medical literature, estimates have been established for certain costs and cost factors (7). These estimates have mostly been based on collection of additional data by questionnaires or diaries about utilization of healthcare services (8,9).

Estimates of costs and cost factors of treatments are lacking in dentistry, and evidence is even lacking on the validity of various ways to collect data on cost factors. A likely best method to obtain reliable unbiased data is to use assessors of cost factors that are independent from care. For example, data measuring time spent in a dental clinic could be collected by temporarily providing patients with electronic chips or by

using independent research assistants recording the time spent with a stopwatch. An independent research assistant could in addition observe what kind of care professional is performing the treatment. However, even though these methods would provide valid data, they can be too time consuming and expensive for many research settings.

Alternative, these types of time measures and measures of type of care professional could also be retrieved from electronic software systems for patient records (electronic patient record (EPR)) or by asking patients to report data themselves (patient self-report (PS)). Both alternative methods are less time consuming and less expensive as the previous mentioned methods. Type of treatment could be retrieved from Dental clinic's Electronic software for Patient Files (DEPF). Not all dental practices have EPR yet, as an alternative the time for the treatment booked in the calendar on paper could be used. However, the validity of data collecting by EPR or PS should be confirmed. When any of the methods provides valid data, one could make recommendations about collecting data about costs. Therefore, the aim of the present study was to assess the validity of a) PS and EPR regarding time spent per dental visit and b) PS and DEPF regarding type of treatment and dental healthcare provider involved in treatment.

Materials and methods

Sample

This study was part of the Dutch "Healthy teeth, all aboard" (HTAA) project in which the cost-effectiveness of a new approach to prevent dental caries in young children was compared to 'routine' care (Trial NL4174). Prior to the cost effectiveness analysis, data for the present validation study were collected in four dental clinics participating in the HTAA project.

Ethical Approval

The Medical Ethics Committee of the University Medical Center Groningen provided a waiver for full assessment and further required the study to be performed in accordance with the Helsinki Declaration (Ref: METc2014.175).

Power and sample size

In our equivalence test of means a sample size of 120 achieves 80% power at a 5 % significance level when the true difference between the means is 4 minutes, the standard deviation of the paired differences is 4, and the equivalence limits are -5 and +5 minutes.

Procedure and measures

The validity of data collection methods to determine cost components of dental treatment was assessed. These methods concerned time consumption (waiting time, time spent in the examination room, patients' travel time), type of treatment, and type of dental healthcare provider. The following data sources were used: EPR, DEPF, PS (via a questionnaire), and RA (Independent Research Assistants using stopwatches).

Concerning time measurements, the validity of two different methods of data registration on time spent (EPR and PS) was assessed using RA as reference standard. Concerning type of treatment and dental healthcare provider involved, validity of PS was assessed using DEPF as reference standard. Two RAs participated which were both trained by the researcher. Regarding time consumption, data on the following measures were collected per source:

a. EPR: Electronic patient record (EPR) software typically includes a time-management module that may be used to extract data on time consumption, volumes of treatment, and which dental professional performed the treatment. We measured the scheduled appointment time in EPR minus 5 minutes (which is the estimated time for clinical set-up and cleaning procedures and administrative tasks.
b. PS: Patients were asked to record a) the exact hour when entering the dental clinic, b) the exact hour when entering the dental operatory and c) the exact hour when leaving the dental operatory. PS waiting time (in minutes) was calculated as the difference of between the moment of entering the dental clinic and of entering the dental operatory. The PS appointment time (in minutes) was

calculated as the difference between the moment of entering the operatory and of leaving the operatory. The PS total time spent in the dental clinic (in minutes) was the sum of PS waiting time plus PS appointment time. PS travel time was based on patient self-report, and is typically included in economic evaluations as concentration of care can lead to more time spend on this by the patient, i.e. it makes part of the societal perspective.

c. RA (reference standard time): The RA time measures were regarded as the reference standard for data on time measurements. The RA recorded a) when the patient entered the dental clinic by starting the stopwatch; b) the elapsed time when the patient entered the dental operatory (in minutes and seconds); and c) the elapsed time when the patient left the dental operatory (in minutes and seconds). The RA waiting time (in minutes and seconds) was the time elapsed from the patient entering the dental clinic to entering the operatory. The RA appointment time (in minutes and seconds) was the time elapsed between the patient's entering and leaving the operatory. The RA total time spent in the dental clinic (in minutes and seconds) was the sum of the RA waiting time plus RA appointment time.

Regarding type of dental treatment undertaken, data on the following measures were collected per source:

a. PS: Patients were asked what treatment they had received by selecting prewritten choices (preventive consultation, taking radiographs, fluoride application, placement of a pit or fissure sealant, placement of a restoration, extraction, dental hygiene);
b. DEPF (reference standard treatment): DEPF records were regarded as the reference standard for data on type of treatment performed, as RAs could not observe all treatments due to patient privacy. Out of the patient files, the performed treatment were extracted using identical options as the PS (preventive consultation, X-rays, fluoride application, pit and fissure sealant, restoration, extraction, other).

Regarding type of dental healthcare provider involved, data on the following measures were collected per source:

a. PS: By selecting prewritten choices (dentist, dental hygienist, dental assistant, unsure)
b. DEPF (reference standard professional): The recorded type of dental healthcare provider who had performed the treatment regarded as the reference standard for data on dental healthcare provider involved.

Since all patients in the present project were children, the questionnaire was completed by the accompanying parent. Information regarding Demographic variables, level of education and country of birth was collected. Level of education was dichotomized into low and high, based on the Dutch education system. The highest education level was defined as higher general secondary education or higher. All other education was defined as low education level. Country of birth was divided into born in The Netherlands and not born in the Netherlands.

Statistical analyses

Firstly, descriptive analysis of demographic characteristics of the sample of parents who filled out the questionnaire was undertaken. Secondly, the validity of the different outcome variables concerning time measurements, type of treatment and type of dental healthcare providers was assessed based on agreement with their reference standards. The hypotheses were formulated to determine whether EPR and PS were equivalent to RA. EPR and PS were compared to the reference standard using The Two One-Sided Tests (TOST) equivalence procedure for the difference between paired means. . The TOST procedure is started on the smallest relevant effect size and can be used to statistically reject the presence of effects large enough to be considered as valuable. For the TOST, a difference in time of 5 minutes or less was considered as neither clinically nor economically relevant (10,11). P-values < 0.05 were considered statistically significant. For the two latter analyses, kappa statistics (κ) were used. The categorization of agreement for types of treatment and professional involved was defined as follows: $\kappa < 0$ poor agreement; 0 - 0.20 slight agreement; 0.21 - 0.40 fair

agreement; 0.41 - 0.60 moderate agreement; 0.61 - 0.80 substantial agreement and 0.81 - 1.00 almost perfect agreement (12,13). When κ was < 0.61, no satisfactorily equivalency was found between the methods. Analyses were performed in R Version 3.5.1.

Results

Background characteristics

A total of parents of 131 children participated, of whom 37 (28%) lived in rural and 94 (72%) in urban areas. Mean age of the patients was 12.6 years (SD = 13.0). Eighty five (72%) accompanying parents had a low educational level and 76 (58%) were of non-Dutch origin.

Equivalence of measures for time

Regarding time, waiting time, appointment time and total time for PS, EPR and RA (reference standard), and the results of equivalence tests for these is shown in Table 1. The mean differences in waiting time, appointment time and total time between RA and PS and between RA and EPR were less than 1 minute.

There was equivalence in waiting time and total time between PS and RA. Times recorded for PS and ERP appointment time were equivalent to the RA. No differences were found between the RA (mean 30.4, SD 12.4) and PS (mean 30.5, SD 12.5) concerning total time in dental clinic (95% two one-sided TOST interval: (-0.48, 0.70), $p < 0.01$).

Agreement of measures for dental healthcare provider involved

Regarding type of dental healthcare provider, κ for agreement between DEPF and PS for dental healthcare provider was fair (0.41); therefore, DEPF and PS data concerning the type of dental healthcare provider was not equivalent.

Table 1. Time (in minutes) registered by the reference standard (RA), self-reported data (PS), and the dental software (EPR).

Outcome	Method	Mean (SD)	Range	n
Waiting time	RA	11.5 (10.4)	(0.5;76.1)	114
	PS	12.1 (10.4)	(0.0;75.0)	114
	RA -PS*	-0.6 (3.2)	(-14.1;6.4)	114
Appointment time	RA	19.6 (9.4)	(4.3;52.6)	108
	PS	19.0 (9.4)	(2.0;53.0)	108
	RA - PS*	0.6 (3.5)	(-12.6;14.7)	108
	RA	20.0 (9.3)	(4.3;52.6)	119
	EPR	19.6 (10.0)	(5.0;55.0)	119
	RA - EPR*	0.3 (8.2)	(-22.4;28.0)	119
Total time	RA	30.4 (12.4)	(7.0;68.0)	115
	PS	30.5 (12.5)	(7.0;68.0)	115
	RA - PS*	0.1 (3.8)	(-20.4;14.2)	115

Result equivalence test: *$p < 0.01$

Agreement of measures for type of treatment

Regarding type of treatment, κ were below 0.60 for all treatments. Agreements for preventive consultations, restorations, radiographs and extractions between the DEPF and PS were moderate to substantial (κ = 0.4 - 0.56) and were slight to fair in cases of fluoride applications and sealants (κ = 0.15 - 0.26). The DEPF and PS data concerning the treatment performed was not equivalent. Patients reported less treatment instances for all treatment types, except for preventive consultations.

Table 2. Types of treatment selected and kappa values for agreement between PS and DEPF.

	DEPF (n)	PS (n)	Kappa (n)
Preventive consultation	69	77	0.54
Fluoride application	17	8	0.26
Sealant	10	2	0.15
Restoration	30	22	0.62
X-ray	13	6	0.50
Extraction	5	2	0.56

Discussion

To the best of the authors' knowledge, this is the first published study that compares and validates data collection methods required for cost-effectiveness analyses in dentistry. Time measurements collected through the dental clinic's EPR or through PS were equivalent to the measurements by RA. Data collected via patient self-reporting treatment volumes and type of dental health care provider had moderate to fair agreement with DEPF.

The finding of a good validity of PS and EPR for the collection of time, as no such similar studies have been reported, comparison was not possible. A recent review reported a lack of high quality economic evaluations within child oral health research, highlighting the need for more attention on dental costs and economic evaluations in this field (14). Poley and Vermaire also concluded that there is a need for improvement of the quality of economic evaluations in dentistry (15). The present study may contribute to these needs by providing possible ways to collect the desired data in a valid and simple manner.

Concerning time measurement, both PS and EPR were valid methods to collect treatment time data. Since no similar studies were found in the literature, comparison to previous findings was not possible. It should be noted that the data was collected

before the COVID-19 pandemic. During the COVID period the estimated time for clinical set-up and cleaning procedures and administrative tasks is assumed to be expanded.

A fair agreement of PS existed for the item ‘dental health care provider involved’, which also had no comparative data available. The relatively poor ability to identify the type of dental health care provider might be more of an issue for larger dental clinics with a wider variety of providers working due to task delegation, than it is for solo-practicing ‘family’ dentists. In dental team practices children may have not one regular dental care provider and see several different kinds of dental health care providers. The dental practices included in the current study were all group practices. That parents of patients did not know which type of dental health care provider had been treating their child, raises some concerns, both ethical and legal, about the clarity of communication about the specific provider type.

Furthermore, PS was not a valid data collection method for the ‘type of treatment performed’. There is a lack of comparable studies. A recent qualitative study suggests there is a need for more dialogue and openness of dentists with their patients (16). In the present study, parents did not report all different treatments that were actually performed, possibly explained by a poor communication between the dental provider and parent, leading to the parent being unaware of the treatment provided, which raises legal implications regarding informed consent for care. Another possibility is that the questionnaire design was ambiguous. In addition, of all parents, 16.8% reported a language problem, a putative reason for misunderstanding which type of treatment provided to their child or for misunderstanding of the survey. The proportion of parents with low level of education was also higher than in the national reference population. Individuals with a lower socioeconomic position (SEP) often have lower health literacy, and therefore the results might be different if this study was repeated in a higher SEP population (17).

The low kappa values considering the procedure of an extraction is striking. The children in this study were in average 12.6 years old and presumably changing their deciduous teeth. A possible explanation could be that removing of a deciduous tooth by the oral health professional might not be considered as an extraction.

Strengths and limitations

The particular strength of the present study is that it is the first to measure the validity of data collection methods for dental costs in general dental practices. To put the results in perspective, some points should be considered - firstly, the choice to appoint the dental systems as reference standard with regard to the treatment provided and the oral health provider type assumes that data are entered completely and accurately into the software systems. Since dental clinics participated voluntarily in this study and were intrinsicly motivated, we assume the data to be entered completely and accurately. Secondly, the estimates of appointment time depend on the accuracy of scheduled time vs. time actually spent. For this study, accuracy is likely to be high as treatments were usually technically fairly simple and staff of the participating dental clinics was experienced and well attuned to each other, supporting data validity.

Implications

The results of the present study have several implications for research regarding dental treatment costs. Firstly, the validity of various methods regarding data collection for dental care of children should be confirmed in other settings. Secondly, further research is needed on whether the present results also apply to adult dental care. That parents of patients were not able to record validly the type of treatments that their children had received, might not be applicable for adult patients receiving dental care themselves.

Conclusion

The present findings imply that time measurements using parental self-reports and through electronic patient records are valid methods for the purpose of economic evaluations. The fact that time estimations were appropriate using PS and EPR potentially reduces costs of follow-up research since there is no need for RAs to manually record time-periods. RAs' recording time periods for research purposes takes quite much time of the RAs and thereby makes cost-effectiveness studies expensive. Data on treatment types and oral health provider types should be collected using dental

management software systems. This can be embedded into routine practice relatively easily, showing excellent opportunities to collect data for the urgently required estimates of costs of dental care.

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CHAPTER 9

GENERAL DISCUSSION

General Discussion

The general aim of this thesis was to find ways to improve community-based preventive dental care for children by adding evidence regarding three themes: the targeting, the effectiveness, and the performance of the delivered care. The first theme, targeting, focuses on caries prevalence and socioeconomic differences among young children (Part I). The second theme, effectiveness, assesses the effects of two innovations in oral care (i.e., a newly initiated collaboration network between oral health professionals and well-child care professionals, and the use of a non-operative caries treatment and prevention program, starting from the eruption of the child's first tooth (Part II). The third theme, performance, deals with the implementation of interprofessional collaboration in oral health care for young children (Part III).

This general discussion addresses a summary of the main findings of the thesis, and discusses them in a broader context. Further, it addresses the strengths and limitations of the described studies, followed by possible implications for general and specialized practice, policy, education, and research. Figure 1 illustrates the relationship between the research questions (RQ).

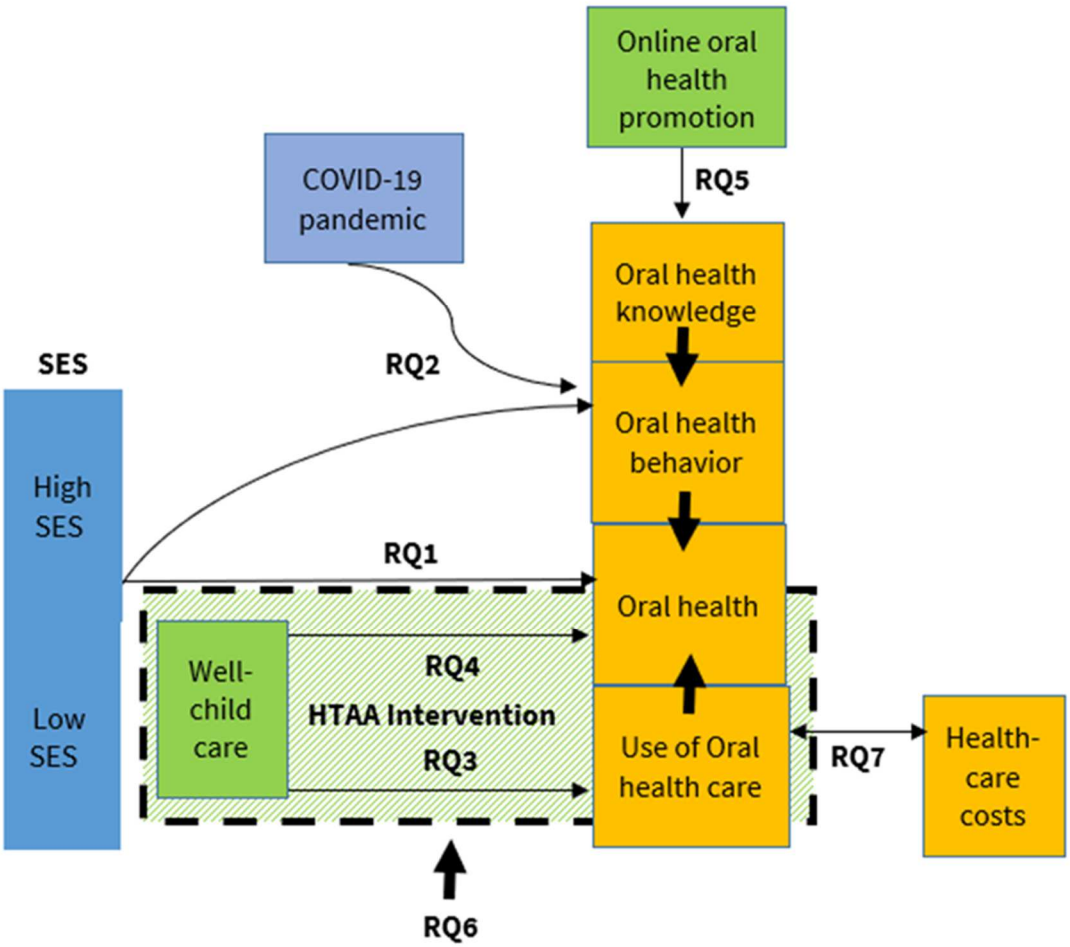

Figure 1. Conceptual model of this thesis and how the research questions (RQ) are related.

9.1 Main research findings

The first research question (RQ1) (Chapter 2) was*: What differences in caries experience, related to socio-economic status (SES), exist in a health-care system with full coverage of dental costs for children up to the age of 18?*

Data on caries experience in The Netherlands were derived from a cross-sectional study among children aged 5, 8, 11, 14, 17, 20 and 23 years. On these data hurdle negative binomial analyses were performed. At all ages, caries-free dentitions were less frequently found in low-SES children; in this group mean caries experience was also higher than in high-SES participants. Low-SES children had a higher risk of developing caries than high-SES children. Thus, even in a system with full coverage of paediatric dental care, socioeconomic inequality in caries experience continues to exist.

The second research question (RQ2) (Chapter 3) was*: In which ways did restrictive measures during the corona pandemic affect family structure and parental oral health behavior?*

Data collected via an online survey showed that during the corona lockdown, parents skipped toothbrushing more frequently in the morning, and more frequently let their child eat snacks and drink sugary drinks. Further, parents with a high educational level skipped tooth brushing more often in the morning than parents with a low educational level. In contrast, parents with a low educational level skipped toothbrushing more often in the evening than parents with a high educational level.

The third research question (RQ3) (Chapter 4) was: *Does referral of parents of babies for a first preventive dental visit by a well-child clinic physician lead to earlier initiation of dental care, and does this differ for active vs. passive referral?*

This issue was assessed in a quasi-experimental comparative study in two regions, one using active referral (initiative for the first appointment lay with the dental practice) and one using passive referral (initiative for the first appointment lay with the parents) by well-child clinic physicians for a first preventive dental visit. Referral of parents of babies by WCC physicians led to earlier initiation of preventive dental care; however, active referral had a larger effect than passive referral. Effects were large for children of low educated mothers, and even larger for children of high educated mothers.

The fourth research question (RQ4) (Chapter 5) was: *Does referral of parents of newborns by a well-child physician for an early first dental visit, combined with the Non-Operative Caries Treatment and Prevention approach in dental practices, decrease caries experience in children by the age of five years?*

In the same quasi-experimental study mentioned in Chapter 4, children in the intervention group with early referral had fewer caries experience in enamel (median d_{123}mfs=2 vs. 5, r=0.15, p<0.01) and lower numbers of inactive caries lesions than children in the care as usual (CAU) group (median=2 vs. 3, r=0.18, p<0.001). Both effects were small. However,no statistically significant differences were found neither for caries on d_3-level, nor for active caries lesions between both groups.

The fifth research question (RQ5) (Chapter 6) was: *What is the 6-month effectiveness of an 8.5-minute web-based film about oral health routines in well-child care aimed at improving parental knowledge about oral health?*

Using a quasi-experimental design, it was found that parental knowledge scores increased immediately after watching the film. After 6 months, although parental knowledge scores were lower than they had been immediately after watching, a statistically significant improvement still existed. Effect sizes for the immediate effect of the film and the 6-month follow-up were both substantial.

The sixth research question (RQ6) (Chapter 7) was: *How can the collaboration between well-baby clinics and oral health care be formalized to reach all young children and their parents earlier for (preventive) dental care?*

Based on the available evidence, a best way to provide preventive dental care to young children was described. In such an optimal system, WCC and oral health care collaborate in order to reach young children in the Netherlands and their parents earlier, leading to an earlier delivery of preventive dental care. Reaching the parents of the children who are currently being missed by oral health care professionals is of eminent importance. Both WCC practitioners and oral health professionals must be trained in collaboration skills to improve dental care for young children, either by following an E-learning tool like “Oral health care for children” or a practical course like Non Operative Caries Treatment Programme (NOCTP) to prepare for this collaboration.

Finally, the last research question (RQ7) (Chapter 8) was: *What is the validity of a) patients’ self-report and routine electronic patient records regarding time spent per visit, and b) patients’ self-report regarding type of treatment and type of dental professionals involved?*

In this study methods to obtain data were compared on time spent by professionals in dental care as a basis for future cost-effectiveness analyses in dentistry. It was found that time measurements collected through the dental cliniic’s electronic patient records filing system and through patients’ self-report were equivalent to measurements by an independent observer. Because data collection using patients’ self-reports on type of treatment and type of professionals involved was not sufficiently valid, it was concluded

that data could best be collected using the dental clinic's electronic patient files.

9.2 Interpretation of the main findings

In this chapter the findings regarding the earlier described three main themes will be discussed: I. Caries prevalence, and the socioeconomic differences in this prevalence, among young children; II. Effects of two innovations in oral health care: oral health promotion for young children and their parents, and collaboration between oral health professionals and well-child care professionals; and III. Implementation of interprofessional collaboration in oral health care.

Part I Caries prevalence and socioeconomic differences among young children

Significant absolute differences in caries prevalences were found between low- and high-SES for children aged 5 to 23 years, in a country providing a system of full dental coverage until the age of 18 years. These results confirm findings in other countries, among them several without such coverage (1). This socioeconomic difference in oral health may be explained by the greater problem of differences in general health, linked to social determinants worldwide (2). "The unequal distribution of power, income, goods, and services, globally and nationally, the consequent unfairness in people's access to health care, schools, and education, their conditions of work and leisure, their homes, communities, towns, or cities are explanations for these socioeconomic differences" (2). Next to having the financial resources to access dental care and being able to afford to buy healthy food, further important determinants of good oral health in children are parents' oral health-related knowledge and skills, as well as their oral hygiene and diet behavior, and their attitudes and culture. In this regard the socioeconomic gradient in caries experience remains clearly visible.

Despite full dental coverage for all Dutch children up to the age of 17, differences in caries experience between low-SES and high-SES children were already present in 5-year-olds. This finding suggests that full dental coverage for children alone is not enough to bridge the gap of oral health disparities, not even at a very young age. This supports previous findings of socioeconomic and cultural disparities at a very young age

in Sweden, which also provided dental coverage at young ages (3). Children who were most vulnerable for developing caries in the primary dentition, appeared least likely to receive early preventive dental care (4). Further, in the United States, Medicaid coverage of dental services for adults increased the likelihood that a child would have had a dental visit in the past six months or year (5). However, these studies suggest that although dental coverage promotes dental visits among children, it does not solve the problem of oral health inequalities related to socioeconomic status.

The findings in Chapter 3 indicated that the corona lockdown had a negative impact on parental oral health behavior. Such a period of lockdown may strengthen the effect of SES on oral health, exacerbating the disadvantage that children in low-SES families already have in extreme circumstances like the corona lockdown (work conditions, health conditions, childcare). This is probably related to mechanisms involving the consequences of this lockdown for parents' daily routines, related to the daily structure at home, including oral health behavior. Targeted preventive measures to promote oral health among children and their parents could protect children from the decline in oral hygiene and health caused by negatively associated factors.

Part II The effectiveness of oral health promotion for young children and their parents, and of collaboration between oral health- and well-child care (WCC) professionals

Our findings show that extra attention to oral health promotion in WCC, and interprofessional collaboration, can promote earlier preventive dental visits by the child, and somewhat less caries experience in enamel in children (Chapters 4, 5 and 6). The combined approach, with a referral from WCC to dental care (population approach) and the NOCTP approach in dental practices (individual approach), reached 54 % of children in the first year, and had positive but small effects on caries experience in enamel. Spectacular differences related to the first dental visit of the child were found. A comparable trial in Belgium on effectiveness of an oral health education program, added to a standard preventive care program in WCC during the first 3 years of life, showed limited to no effects on caries experience by the age of 5 years (6). Our study is

one of the first to show that interprofessional collaboration between WCC and dental care to promote oral health in young children was related to reduced caries lesions in enamel.

An 8.5-minute web-based film about oral health routines in well-child care was found to improve parental knowledge about oral health, even after 6 months (Chapter 3). This suggests a promising route to provide health education, and even more so in unforeseen circumstances like the COVID-19 pandemic. When personal contact with parents and patients is not possible, healthcare professionals can switch to other interventions to deliver preventive dental care. Audiovisual tools like a web-based film about how to keep children's teeth healthy can be very valuable, and can function as supportive measures to advise parents. This could be particularly helpful for parents who encounter difficulties in understanding the language. Moreover, in times like a pandemic, a web-based audiovisual intervention would be better than no intervention at all. Web-based interventions have the advantage of easily reaching a large group of parents without costing dental professionals extra time. Such interventions could easily reach parents via e-mail, websites or social media applications, or be shown by dental professionals and practitioners on screens in their waiting rooms.

Part III Implementation of interprofessional collaboration in oral health care

Interprofessional collaboration of WCC professionals and dental professionals seems an effective, feasible and affordable way to promote the oral health of young children. Training of WCC professionals in oral health care, and practical and theoretical training of dental professionals in the NOCTP approach and in communication with very young children, would be the basis to accomplish this. A Peruvian study reported that incorporation of specific oral health care activities into the existing mother and child health clinic program by trained nurses and health center dentists reduced the burden of caries in 3-year-olds (7). Another study evaluated the effectiveness of a preventive oral health program in Brazil by treating pregnant women of low socioeconomic status, educating them, and offering regular dental care for themselves, and later for their children. Women were enrolled during pregnancy and were followed up until their child

reached the age of 5 years. The program effectively prevented cavitated dentine lesions in those children who attended the program at least once a year from a very early age (8). One Scottish study linked four interventions (involving supervised toothbrushing and fluoride varnish application in a nursery setting, dental practice visits, and dental health support worker visits) of the effective 'Childsmile' program to dental inspection data from a large longitudinal cohort of five-year-olds (9). Evaluating the impact of each of the interventions on caries experience independently, they showed that supervised toothbrushing in the nursery setting and regular dental practice visits were most strongly associated with reduced odds of caries experience. The finding that regular dental practice visits are associated with caries experience shared similarities with our findings indicating the importance of individualized and regular dental check-ups from a very early age.

To explain how interprofessional collaboration could work, it is important to explore and understand the professionals' reasons for collaboration. Results of a qualitative study of interprofessional collaboration for oral health showed that although personnel in health centers considered collaboration valuable, they felt restricted by a lack of oral health training and supportive charting and referral systems (10). With support, they would be willing to take on responsibility for introducing oral health preventive measures into the well-child visits. Another qualitative study on perpectives on child oral health, among multidisciplinary professionals within and outside the dental sector, reported that a broad child-, parental-, and societal-centered educational communication strategy was perceived as promising (11). An understanding of the family's complex daily reality, and intensification of child oral health knowledge in dental practices, are necessary for collaboration with families, and with general health and social welfare organizations. One recent systematic review showed evidence regarding the linking of interventions to help families with young children to access community-based resources (12). The linked intervention types involved signposting, referral, and facilitation, and their effectiveness was related to relationships between provider and family, awareness of the landscape of local community support, and the capacity of the original service to support an individualized intervention.

Our findings on best sources for estimates of costs of dental care (Chapter 8) provide highly needed information, as evidence regarding the cost-effectiveness of preventive dental interventions is currently lacking. Time measurements collected through the dental clinic's electronic patient records or through patients' self-report were equivalent to measurements collected manually by a research assistant. Data regarding treatment volumes and type of dental health care provider can best be retrieved from the dental clinic's electronic patient files. Electronic patient files provide ample opportunity for retrieving data for clinical or research purposes. However, the validity of the data for a specific purpose must first be determined, for instance by practice-based research (13).

9.3 Methodological considerations

This section provides a discussion of the strengths and limitations of this thesis. It covers three main topics: the quality of the sample, the quality of the information, and considerations regarding causality. First, the general methodology wil be discussed.

9.3.1 General considerations

Research in healthcare settings is often a challenge, and it is not easy to make healthcare professionals enthusiastic for participation in research involving long-term follow-up. Because their core business is delivery of care for their patients, they do not prioritize participation in time-consuming research projects. Moreover, the immensity of their workload results in a chronic lack of time. Therefore, healthcare professionals must clearly understand the added value of research in terms of health outcomes, and improvement of care for themselves and their patients.

A general strength of the research presented in this thesis is that healthcare professionals in different regions were involved in clinical research while running their dental practice or WCC practice. It is a good example of evidence-based practice, involving vitally important multidisciplinary collaboration. Such collaborations can be hampered by differences in priorities and ideas within the healthcare professions. To come to a workable combined approach, it is important that healthcare professionals learn more about, and show interest in, each other's work. For example, it is important

to make other health professionals aware of the problem of caries experience in children; this calls for epidemiological data.

Research in routine practice presents a number of challenges, one of which is a high turnover in personnel in the participating practices. For our study, for example, a number of managers, dentists, physicians, nurses and assistants in the participating practices changed, and many new professionals had to be trained and instructed. It is therefore important in longitudinal studies to contact all participating organizations frequently, and to invest in contact persons in each organization who are clearly committed to and involved in the intervention. This practice based approach may be embedded in a model of academic collaborative centers (14) in dentistry.

A further general strength of this thesis is its use of different research methods. It includes one cross-sectional study making use of epidemiological data on caries experience, two quasi-experimental studies, one survey, one best practices description study, and one data collection validation study. By using this wide range of research methods it was possible to unravel different aspects of how to improve community-based preventive dental care for children by adding evidence on targeting, effectiveness and performance.

9.3.2 Quality of the samples

Related to our range of research methods, a series of different samples were used, all sharing as common characteristic that they were community-based, involving either respondents from the general population or people receiving routine community-based care. Moreover, participation by professionals working in general dental practices enhances the generalization of our outcomes. Furthermore, as the literature indicates, caries is associated with socioeconomic status and with ethnicity. An important strength of our trial for the effectiveness of the community-based intervention was that it was carried out in regions where many families with low socioeconomic status and with multicultural backgrounds live.

Obtaining and maintaining participation of respondents is generally a challenge, and even more so in evaluation research; that also holds for the studies presented in this thesis. Low response- and high drop-out rates make selection bias more likely. For

example, in the samples used for the two quasi-experimental studies, a relatively large number of participants were lost to follow-up. This drop-out rate may have led to retention of the more motivated parents (Chapters 2 and 5). However, in Chapter 2 the respondents were recruited in regions with background characteristrics representative of the general Dutch population, and in Chapter 5 respondents were recruited especially in regions with higher percentages of citizens of non-Dutch ethnicity or low-SES background. Results were compared for low and high-SES to adjust for confounding. Furthermore, for Chapter 5 confounding is unlikely to have affected the difference between the intervention and CAU, as the drop-out similarly affected both groups.

Our second effectiveness study (Chapter 5) was influenced by the COVID-lockdowns, making it necessary to extend follow-up; moreover, the drop-out was relatively high. This may have led to bias: e.g., longer participation, greater variance in the ages of the children at clinical examinations, and more difficult clinical examination procedures – all because of the COVID-19 restrictions. However, the impact on internal validity is expected to be limited because both groups were equally affected by the COVID-19 restrictions.

9.3.3 Quality of the information

Regarding assessments, data using clinical assessments and questionnaires, as well as from electronic registry systems were collected. Regarding the clinical assessments (Chapters 2 and 5), a strength is that the dental examinations were performed by well-trained and calibrated dental researchers, blinded for the sample group to which the children were allocated, to prevent possible bias. Another strength is that two of these studies among children used clinical outcomes regarding decayed, missing, and filled surfaces; few Dutch studies are known to have been made among children with clinical dental outcomes (dmfs) (15). Evidently, a disadvantage of clinical assessments is that they involve rather high costs: well-trained professionals are needed to perform such assessments.

Regarding questionnaires, these were used particularly to obtain information on oral health behavior: dental attendance, toothbrushing, and frequency of consumption of foods and drinks. When interpreting the results of studies reporting self-reported oral

health behavior, one should be aware of the risk that participants tend to give socially desirable answers. This may lead to slightly more positive than realistic outcomes (Chapters 3, 4, 6 and 7). To prevent socially desirable answers anonymous questionnaires were used with special attention to their construction and language.

Regarding registry data, in dental practices data from electronic patient files were retrieved to determine the validity of this method for purposes of cost effectiveness. A strength of these data is that they provide information on care provided to all patients. Use of registry data from dental practices thus provides a wealth of information for research.

9.3.4 Considerations regarding causality

Regarding causality and the potential for causal inferencing, a strength is that two quasi-experimental studies were performed to evaluate the effectiveness of two oral health promotion interventions implemented in WCC. A limitation of the quasi-experimental design is the risk that the two groups being compared may have had an unbalanced composition, which could have led to chance confounding. To contain this risk several analyses with adjustment for potential confounders like SES, ethnicity, age, and gender were performed. In the cross-sectional studies adjustments were made for confounding factors by comparing the results by low and high-SES.

A risk of inference on the effectiveness of the interventions is that contamination may have occurred, i.e., the control group may have followed some of the advice directed at the intervention group. If this in fact occurred, our findings may have underestimated some of the actual effects. To limit this risk publicity about the purpose of the study and the intervention program was avoided. However, focus on the topic of oral health care for children may already have alerted some of the healthcare staff to the importance of the caries problem among young children. Although such awareness among the staff is important, and a positive development, it may have decreased possible contrasts between the intervention and control groups. This implies that the real effects might have been underestimated.

9.4 Implications

9.4.1 Implications for policy, practice and education

The research presented in this thesis was performed in the general population, during routine practice, thus potentially enabling evidence-based practice. Between low- and high-SES groups, large absolute differences were found in caries prevalence rates for children aged 5 to 23 years in a country with a system of full dental coverage until the age of 18 years; this implies that additional oral health promotion and further action for children and families are necessary to combat these differences.

Our finding that, after referral from WCC to dental care (population approach), 54% of the children received dental care in the first year compared to 7% of the children without the referral, implies that this approach provides a valuable opportunity for better, i.e., earlier, oral prevention in children. Investing in its implementation is the next logical step. The active referral method had a larger effect than the passive referral. In the Dutch WCC system a central theme is that parents are in control, and that care is patient- and client centered. Taking the latter into account, passive referral might be preferred over active referral, although from the perspective of effectiveness active referral is recommended for WCC policies. Such preventive referrals should also make part of the training of professionals in preventive child health care and of dentists, dental hygienists, and dental preventive nurses. Similary, the recent 'Clinical practice guideline dental and oral care for kids and adolescents' (16) should be included in the education curricula and training programs, and in professional guidelines. Offering post-academic training programs may also help to reduce professionals' hesitance to act when it comes to very young children. It would be helpful for parents to know which dental practices they can visit with their babies during the first year(s), and to have agreement among local dental practices regarding the expertise necessary for the dental care of young children; one dental practice may have more experience and enthusiasm than another regarding prevention for this group. Also, to facilitate implementation, research is recommended on how to finance the use of the NOCTP approach among dental professionals.

We found that interprofessional collaboration helps to promote oral health

among children by an early initiation of dental prevention; this implies a need for further implementation in the Netherlands. Oral health-care should be part of preventive policies, like the Dutch “Healthy and Active Living Agreement” (in Dutch GALA) for the local public health services (17). Its inclusion can facilitate implementation and adoption of new oral health promotion interventions. This can greatly enhance Dutch oral health. Another important aspect of the Dutch context is that both curative oral health care and preventive oral health care are a responsibility of the Ministry of Health, Welfare and Sport, but are managed by different directorates. This evidently requires good coordination.

Collaboration between WCC professionals and dental professionals seems an effective, feasible, and affordable opportunity to decrease caries experience in enamel in young children. It also provides a means to realize the recommendations of the recent ‘Global Oral Health Status Report’ of the WHO: to set policies with practical approaches for better integration of oral health into primary health care, supported by improved interprofessional collaboration (18). The ‘Healthy teeth: all aboard!’ example in Chapter 7 can be used as a best practice to guide further investments in interprofessional collaboration in oral health care.

Our finding that, despite dental coverage, socioeconomic differences still exist from a very young age implies that additional oral health promotion is of great importance. Concerning dental coverage and preventive child care for children, many differences exist in systems worldwide (19). In general, many countries have no separation between preventive and curative care. For instance, in some countries, like Germany and the United States, a pediatrician has the preventive task of monitoring the growth and development of children, whereas in children in the Netherlands this is the task of the preventive child healthcare system, in this thesis denoted as WCC (20). Unfortunately, in many European countries the preventive task of monitoring children’s health does not exist, or only to a limited degree (21). Preventive child health services like WCC should be implemented further throughout the world, especially in poor countries, where oral health promotion could easily be embedded.

A web-based film about oral health routines in well-child care was found to

improve parental knowledge about oral health. This implies that further implementation in WCC or a similar setting is promising to reach large groups of people without requiring large numbers of staff to deliver the intervention. One important condition for this implementation is that it should preferably be included as part of a larger program aimed at changing oral health and oral health behavior.

Our finding that during the corona lockdown parental oral health behavior worsened implies that when confronted by such an unforeseen situation, more effort is necessary to help parents themselves to maintain their children's oral health. In such circumstances oral health counselling on line, or by phone, could be a good option to keep all parents motivated to maintain their daily oral hygiene patterns. Interventions like the web-based oral health film could also be used for these counselling sessions. Also recommended is to prepare society for extreme circumstances in the future. Determining how to perform as a dental care provider, while coping with restrictive measures such as during the COVID-19 pandemic, can help to limit the negative consequences for oral health.

9.4.2 Implications for further research

The HTAA intervention was found to be effective in reaching families with low socioeconomic status and/or different ethnicities (Chapters 4 and 5). This leads to several questions on how to further strengthen this intervention. A first issue is how it can better decrease differences in oral health between children from different SES groups and ethnicities. To decrease the socioeconomic oral health gap, investment in collective oral health promotion may be needed. This may include enhancing oral health literacy, as well as improving parental skills and self-efficacy, in relation to preventive oral health behavior. However, recent clinical epidemiological data for the oral health status of Dutch children is as yet lacking.

Our finding that large differences in caries prevalence rates exist between low and high SES children, in spite of a system with dental coverage, implies that more evidence regarding other factors that could explain such SES differences is required. One underlying factor may be the growing problem of a higher intake of highly processed foods with added sugars in low-SES households (22,23), a problem which

maintains the socioeconomic gap in (oral) health. Parents are challenged to limit the daily consumption of fermentable carbohydrates and let their child(ren) drink water more frequently (instead of juices and sweetened drinks). Dental health professionals, well-childcare doctors, nurses, and general practitioners should collaborate more at the community level to motivate parents, especially among low-SES families, to limit the frequency of consumption of fermentable carbohydrates. Further research is recommended to determine whether better regulation policies for production, pricing and provision of highly processed foods with fermentable carbohydrates can decrease the socioeconomic oral health differences in children.

Such further research may also address how further to improve the reach for a timely first dental visit during a child's first year. This could be by multiple recalls of the referral and a more active approach of the referral: e.g., parents receive an invitation for the first appointment. Response mechanisms that indicate to WCC practitioners which parents attended (or did not) will help with such recall referrals. Furthermore, adjustments for this approach in the digital healthcare cystem of WCC will simplify these tasks for practitioners.

The finding that an web-based film on oral health improves parental knowledge justifies further implementation of this method. An implication for research is to explore which groups most often use these web-based interventions, and whether these include risk groups. Results of a focus group study suggest that motivation to change a health behavior, as well as curiosity about the intervention and its content, were important factors in adults' decisions to visit an internet intervention (24). And the challenge remains: how can dissemination of web-based interventions like the oral health film be improved, specifically among the risk population?

Data collection from the dental clinic's electronic patient records, using time measurements, is valid and feasible for cost-effectiveness studies in oral health care. When using registry data of patients, one must apply strict registry criteria to prevent bias; this somewhat complicates the use of such data (25). Furthermore, in collaboration with the dental program builders of the electronic systems, one should assess how best to retrieve such data for research purposes. It is recommended that cost effectiveness

studies in dentistry be sponsored by the government, thereby leading to evidence based decisions regarding new oral health policies.

Time measurements, collected through the dental clinic's electronic patient records, were found to provide valid information. This underlines the value of performing CEA studies. For policy-makers, it is important to consider the cost effectiveness of adopting new oral interventions. Because resources are limited, it is necessary to get the greatest possible value for the money spent. Earlier Dutch research on the cost effectiveness of the NOCTP approach among 6- to 9-year olds showed, according to the societal perspective, that it costs 100 EURO to prevent 1 dmfs in children (26,27). For now, the next step is to determine the cost-effectiveness of promising interprofessional collaboration approaches for WCC and oral health care like the 'Healthy teeth: all aboard!' intervention (Chapter 4,5 and 7) and the 'Toddler Oral Health' intervention (28). This requires further research on this issue.

The finding that, despite dental coverage, socioeconomic differences still exist from a very young age implies that not only coverage, but also additional oral health promotion, are of vital importance (Chapter 2). Which coverage of caries prevention and oral health care services has optimal effect for children's oral health? The "WHO's Global Oral Health Action Plan" proposed an 80% global coverage target for essential oral health care services by 2030, while they estimated baseline to include less than 30% of the global population (29). Currently, no clear consensus appears to exist regarding what to consider cost-effective; e.g., one relevant question is where to draw the line regarding additional costs to prevent one case of dmfs in children. Further research about better implementation of innovations, and about how to value the burden of caries and our willingness to pay to prevent one dmfs in children is recommended.

9.5 General conclusion

To conclude, this thesis provides insight into: 1) caries prevalence and the SES differences related to this prevalence among young children, 2) the effects of two innovations in oral health care, and 3) the implementation of interprofessional collaboration in oral health care. We found that, in spite of a system of full free pediatric dental coverage, SES differences persist: low-SES children still have a greater risk of a

high caries experience than high-SES children. We further found two interventions to be promising in promoting the oral health of children, i.e., a short web-based film about oral health routines in WCC, and referral of parents of babies by the WCC physicians. Interprofessional collaboration between WCC and oral health care is feasible. This supports the value of further implementation. The next step is cost-effectiveness research, using time measurements collected through the dental clinic's electronic patient records filing system as a valid method of data collection. Finally, the findings of this thesis can be be applied to improve oral health among children, and particularly among those in low-SES groups.

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SUMMARY

The general aim of this thesis was to find ways to improve community-based preventive dental care for children by adding evidence regarding three themes: the targeting, the effectiveness, and the performance of the delivered care. The first theme, targeting, focuses on caries prevalence and socioeconomic differences among young children (Part I). The second, effectiveness, assesses the effects of two innovations in oral health care (i.e., a newly initiated collaboration network between oral health professionals and well-child care professionals, and the use of a non-operative caries treatment and prevention program, starting from the eruption of the child's first tooth (Part II). The third theme, performance, deals with the implementation of interprofessional collaboration in oral health care for young children (Part III).

The aim of this thesis has been translated to the following research questions:

1. What differences in caries experience, related to socio-economic status (SES), exist in a health-care system with full coverage of dental costs for children up to the age of 18?
2. In which ways did restrictive measures during the corona pandemic affect family structure and parental oral health behavior?
3. Does referral of parents of babies for a first preventive dental visit by a well-child clinic physician lead to earlier initiation of dental care, and does this differ for active vs. passive referral?
4. Does referral of parents of newborns by a well-child physician for an early first dental visit, combined with the Non-Operative Caries Treatment Programme (NOCTP) approach in dental practices, decrease caries experience in children by the age of five years?
5. What is the 6-month effectiveness of an 8.5-minute web-based film about oral health routines in well-child care aimed at improving parental knowledge about oral health?
6. How can the collaboration between well-baby clinics and oral health care be formalized to reach all young children and their parents earlier for (preventive) dental care?

7. What is the validity of a) patients' self-report and routine electronic patient records regarding time spent per visit, and b) patients' self-report regarding type of treatment and type of dental professionals involved?

Chapter 2 addresses whether differences in caries experience, related to SES, exist in a health-care system with full coverage of dental costs for children. Data on caries experience in The Netherlands were derived from a cross-sectional study among children aged 5, 8, 11, 14, 17, 20 and 23 years. On these data we performed hurdle negative binomial analyses. At all ages between 5 and 23 years, we found caries-free dentitions less frequently in low-SES children; in this group, mean caries experience was also higher than in high-SES participants. Furthermore, low-SES children had a higher risk of developing caries than high-SES children. Thus, even in a system with full coverage of paediatric dental care, socioeconomic inequality in caries experience continues to exist.

This finding implies that additional oral health promotion and further action for less privileged children and families are needed to combat these oral health differences related to SES.

Chapter 3 addresses whether the restrictive measures during the corona pandemic affected family structure and parental oral health behavior. The data collected via an online survey showed that during the corona lockdown, parents let their child eat snacks and drink sugary drinks more frequently. Furthermore, parents with a high educational level skipped tooth brushing more often in the morning than parents with a low educational level. In contrast, parents with a low educational level skipped toothbrushing more often in the evening than parents with a high educational level.

The findings imply that when confronted by such an impactful situation, more effort from professionals is necessary to help parents to maintain their children's oral health themselves.

Chapter 4 addresses whether referral of parents of babies for a first preventive dental

visit by a well-child clinic physician lead to earlier initiation of dental care and whether this differs for active vs. passive referral. It regarded a quasi-experimental comparative study in two regions: one using active referral (initiative for the first appointment lays with the dental practice) and one using passive referral (initiative for the first appointment lays with the parents) by well-child clinic physicians for a first preventive dental visit. Referral of parents of babies by WCC physicians led to earlier initiation of preventive dental care; however, active referral had a larger effect than passive referral. Effects were large for children of low educated mothers, and even larger for children of high-educated mothers.

These findings imply that this approach of referral for a first preventive dental visit by a well-child clinic physician provides a valuable opportunity for better, i.e., earlier, oral prevention in children. Educators of future WCC practitioners and nurses should implement these preventive referrals in their curricula and guidelines.

Chapter 5 addresses whether referral of parents of newborns by a well-child physician for an early first dental visit, combined with the NOCTP approach in dental practices, decreases caries experience in children by the age of five years. In the same quasi-experimental study as described in Chapter 4, children in the intervention group with early referral had less caries experience in enamel and lower numbers of inactive caries lesions than children in the care as usual group. Both findings were considered as small effects. For other measures of caries, i.e. lesions on d_3-level and active caries lesions, we did not find differences between the two groups.

These findings imply that investing in its implementation is the next logical step. Educators of future dentists, dental hygienists, and dental preventive nurses should also implement these preventive referrals in their curricula and guidelines. Offering post-academic training programs may also help to reduce professionals' hesitance to act when it comes to interaction with very young children and their parents. It would be helpful for parents to know which dental practices will welcome them with their babies during the first year(s). Also, to facilitate implementation, reimbursement of the NOCTP approach should be incorporated in a better way in the health care system.

Chapter 6 addresses the 6-month effectiveness of an 8.5-minute web-based film about oral health routines in well-child care aimed at improving parental knowledge about oral health. Using a quasi-experimental design, it was found that parental knowledge scores increased immediately after watching the film. After 6 months, a statistically significant improvement still existed, although the scores were lower than they had been immediately after watching, Effect sizes for the immediate effect of the film and the 6-month follow-up were both substantial.

The finding implies that further implementation in WCC or a similar setting is promising to reach large groups of people without requiring large numbers of staff to deliver the intervention. It is known that educational interventions like a web-based film alone have limited impact on oral health, but could still be considered useful for initiating oral health promotion in children. Further research is needed to address the effects of a web-based film on outcomes such as parental self-efficacy, attitude, intentions, and perceived behavioral control, that are important determinants for changing parental oral hygiene behavior.

Chapter 7 describes a collaboration to provide preventive dental care to young children. In such an optimal system, WCC and oral health care collaborate in order to reach young children in the Netherlands and their parents earlier, leading to an earlier delivery of preventive dental care. Reaching parents of the children who are currently being missed by oral health care professionals is of eminent importance. Both WCC practitioners and oral health professionals must be trained in collaboration skills to improve dental care for young children, either by following an E-learning tool like “Oral health care for children” or a practical course like the NOCTP approach to prepare for this collaboration.

These findings imply that collaboration between WCC professionals and dental professionals seems an effective, feasible, and affordable opportunity to promote the oral health of young children. It is important to set policies with practical approaches for better integration of oral health into primary health care, supported by improved interprofessional collaboration.

Chapter 8 addresses a comparison of methods to obtain data on time spent by professionals in dental care as a basis for future analyses of cost-effectiveness in dentistry. It was found that time measurements collected through the dental clinic's electronic patient records filing system and through patients' self-report were equivalent to measurements by an independent observer. Because data collection using patients' self-reports on type of treatment and type of professionals involved was not sufficiently valid, it was concluded that data could best be collected using the dental clinic's electronic patient files.

This finding implies that costs dental care can be estimated based on electronic patient files. This should be confirmed in other settings.

Chapter 9 provides an overview and discussion of the main findings, addresses methodological issues, and provides a reflection on the implications of the findings for dental practice, policy, education, and research. Results related to the three main themes were discussed: the caries prevalence and socioeconomic differences among young children; the effects of two innovations in oral care (i.e., a newly initiated collaboration network between oral health professionals and well-child care professionals, and the use of a non-operative caries treatment program, starting from the eruption of the child's first tooth and the implementation of interprofessional collaboration in oral health care for young children. Below, the core implications of the findings presented in this thesis are provided.

Our finding that, despite dental coverage, socioeconomic differences still already exist at a very young age implies that additional efforts in oral health promotion are highly needed. Referral from well-child care to dental clinics at an early age is promising in this regard. This could be done in other countries with such a system as well. Countries without such a well-child care system should seriously consider its introduction, because of reasons of dental health but also because of other child health reasons.

Moreover, our findings show that providing an online educational oral health film may be promising to promote parental knowledge regarding oral health. Its wider

implementation shoud definitely be considered. Under extreme circumstances like the COVID-19 restrictive measures, interventions like the online oral health film could be even more useful.

Because financial resources are limited, it is necessary to make choices in the healthcare system that yield most value for the money spent for oral health and our findings yield important tools for assessing costs regarding this. A next step is to determine the cost-effectiveness of innovations like interprofessional collaboration methods for WCC and the NOCTP approach in dental care. Data collection from the dental clinic's electronic patient records could facilitate performing such cost-effectiveness studies in oral health care.

The finding that interprofessional collaboration helps to promote oral health among children by an early initiation of dental prevention implies a need for further implementation in the Netherlands. Oral health care should be part of preventive policies, like the Dutch "Healthy and Active Living Agreement" (in Dutch "GALA") for the local public health services. Its inclusion can facilitate implementation and adoption of new oral health promotion interventions. This can greatly enhance oral health in The Netherlands, and should be strongly supported at national level as well.

Collaboration between WCC professionals and dental professionals seems an effective, feasible, and affordable opportunity to promote the oral health of young children. It also provides a means to realize the recommendations of the recent 'Global Oral Health Status Report' of the WHO: to set policies with practical approaches for better integration of oral health into primary health care, supported by improved interprofessional collaboration (WHO, 2022).

In conclusion, in spite of a system of full free pediatric dental coverage, SES differences persist and low-SES children still have a greater risk of a high caries experience than high-SES children. Further two interventions were found to be promising in promoting the oral health of children, i.e., a short web-based film about oral health routines in WCC, and referral of parents of babies by the WCC physicians. Interprofessional collaboration between WCC and dental care is feasible.

This supports the value of further implementation of this intervention. Finally, the findings of this thesis can be applied to improve oral health among children, and particularly among those in low SES groups.

SAMENVATTING

Het doel van dit proefschrift was om manieren te vinden om de preventieve tandheelkundige zorg voor kinderen in de samenleving te verbeteren door wetenschappelijke onderbouwing toe te voegen met betrekking tot drie thema's: de doelgerichtheid, de effectiviteit en de uitvoering van de preventieve mondzorg. Het eerste thema, doelgerichtheid, richt zich op cariësprevalentie en sociaaleconomische verschillen onder jonge kinderen (deel I). Het tweede thema, effectiviteit, beoordeelt de effecten van twee innovaties in de mondgezondheidszorg (d.w.z. een nieuw gestart samenwerkingsnetwerk tussen mondzorgprofessionals en professionals in de jeugdgezondheidszorg en het gebruik van de Gewoon Gaaf methode vanaf de doorbraak van de eerste tand van het kind (Deel II). Het derde thema, uitvoering, gaat over de implementatie van interprofessionele samenwerking in de mondzorg voor jonge kinderen (Deel III).

Het doel van dit proefschrift leidde tot de volgende onderzoeksvragen:

1. Welke verschillen in cariëservaring, gerelateerd aan sociaaleconomische status (SES), bestaan er in een gezondheidszorgsysteem met volledige vergoeding van tandheelkundige kosten voor kinderen tot 18 jaar?
2. Op welke manieren waren beperkende maatregelen tijdens de coronapandemie van invloed op de gezinsroutines en het mondgezondheidsgedrag van ouders?
3. Leidt verwijzing van ouders van pasgeborenen voor een eerste preventief tandheelkundig bezoek door een jeugdarts van een consultatiebureau tot een eerdere start van tandheelkundige zorg, en verschilt dit voor actieve versus passieve verwijzing?
4. Vermindert verwijzing van ouders van pasgeborenen door de jeugdarts voor een vroeg eerste tandartsbezoek, in combinatie met de aanpak van het Non-Operative Caries Treatment Programme (NOCTP) in tandartspraktijken, de cariëservaring bij kinderen op de leeftijd van vijf jaar?
5. Wat is de effectiviteit na 6 maanden van een 8,5 minuten durende film via internet over mondgezondheidsroutines voor een gezond kindergebit gericht op de kennis van ouders over mondgezondheid?

6. Hoe kan de samenwerking tussen de jeugdgezondheidszorg en de mondzorg geformaliseerd worden om alle jonge kinderen en hun ouders eerder te bereiken voor (preventieve) tandheelkundige zorg?
7. Wat is de validiteit van a) zelfrapportage door patiënten en routinematige elektronische patiëntendossiers met betrekking tot de tijdsbesteding per bezoek, en b) zelfrapportage door patiënten met betrekking tot het type behandeling en het type betrokken tandheelkundige professionals?

Hoofdstuk 2 beschrijft of verschillen in cariëservaring, gerelateerd aan SES, bestaan in een gezondheidszorgsysteem met volledige vergoeding van tandheelkundige kosten voor kinderen. Gegevens over cariëservaring in Nederland werden verkregen uit een cross-sectionele studie onder kinderen van 5, 8, 11, 14, 17, 20 en 23 jaar. Op deze gegevens voerden we hurdle negative binomial analyses uit. Op alle leeftijden tussen 5 en 23 jaar vonden we minder vaak cariësvrije gebitselementen bij kinderen met een lage SES; in deze groep was de gemiddelde cariëservaring ook hoger dan bij kinderen met een hoge SES. Bovendien hadden kinderen met een lage SES een hoger risico op het ontwikkelen van cariës dan kinderen met een hoge SES. Dus zelfs in een systeem met volledige vergoeding van tandheelkundige zorg voor kinderen, blijft sociaaleconomische ongelijkheid in cariëservaring bestaan.

Deze bevinding impliceert dat aanvullende mondgezondheidsbevordering en verdere actie voor minder bevoorrechte kinderen en gezinnen nodig zijn om deze mondgezondheidsverschillen gerelateerd aan SES te bestrijden.

Hoofdstuk 3 gaat in op de vraag of de beperkende maatregelen tijdens de coronapandemie invloed hadden op de gezinsroutines en het mondgezondheidsgedrag van ouders. De gegevens die verzameld werden via een online vragenlijst toonden aan dat ouders tijdens de corona lockdown hun kind vaker snacks lieten eten en suikerhoudende dranken lieten drinken. Bovendien sloegen ouders met een hoog opleidingsniveau het tandenpoetsen 's ochtends vaker over dan ouders met een laag

opleidingsniveau. Ouders met een laag opleidingsniveau daarentegen sloegen 's avonds vaker hun tanden over dan ouders met een hoog opleidingsniveau.

De bevindingen impliceren dat wanneer ouders geconfronteerd worden met een dergelijke impactvolle situatie, meer inspanningen van professionals nodig zijn om ouders te helpen zelf de mondgezondheid van hun kinderen te onderhouden.

Hoofdstuk 4 beschrijft of verwijzing van ouders van baby's voor een eerste preventief tandheelkundig bezoek door een jeugdarts van een consultatiebureau leidt tot eerdere start van tandheelkundige zorg en of dit verschilt voor actieve versus passieve verwijzing. Het betrof een quasi-experimentele studie in twee regio's: één met actieve verwijzing (initiatief voor de eerste afspraak ligt bij de mondzorgpraktijk) en één met passieve verwijzing (initiatief voor de eerste afspraak ligt bij de ouders) door artsen van een consultatiebureau voor een eerste preventief tandheelkundig bezoek. Verwijzing van ouders van baby's door jeugdartsen leidde tot een eerdere start van preventieve tandheelkundige zorg; actieve verwijzing had een groter effect dan passieve verwijzing. De effecten waren groot voor kinderen van laag SES moeders en zelfs groter voor kinderen van hoge SES moeders.

De bevindingen impliceren dat deze aanpak van verwijzing voor een eerste preventief tandheelkundig bezoek door een jeugdgezondheidszorg professional van een consultatiebureau een waardevolle mogelijkheid biedt voor vroegere, preventieve tandheelkundige zorg bij kinderen. Opleiders van toekomstige jeugdartsen en -verpleegkundigen zouden deze preventieve verwijzingen moeten implementeren in hun curricula en richtlijnen.

Hoofdstuk 5 gaat in op de vraag of verwijzing van ouders van pasgeborenen door een jeugdgezondheidszorg professional voor een vroeg eerste tandartsbezoek, in combinatie met de NOCTP-aanpak in tandartspraktijken, de cariëservaring bij kinderen op vijfjarige leeftijd vermindert. In dezelfde quasi-experimentele studie als beschreven in hoofdstuk 4 hadden kinderen in de interventiegroep met vroege verwijzing minder cariëservaring in het glazuur en lagere aantallen inactieve cariëslaesies dan kinderen in

de controlegroep. Beide bevindingen werden beschouwd als kleine effecten. Voor andere maten van cariës, d.w.z. laesies op dentine-niveau en actieve cariëslaesies, vonden we geen verschillen tussen de twee groepen.

Deze bevindingen impliceren dat investeren in de implementatie ervan de volgende logische stap is. Het zou goed zijn om de preventieve verwijzing en NOCTP aanpak ook te implementeren in de opleidingen van toekomstige tandartsen, mondhygiënisten, preventief verpleegkundigen en jeugdgezondheidszorgprofessionals. Het aanbieden van post-academische trainingsprogramma's kan ook helpen om de aarzeling van professionals te verminderen als het gaat om het behandelen van zeer jonge kinderen en hun ouders. Verder zou het nuttig zijn voor ouders om te weten bij welke tandartspraktijken ze welkom zijn met hun pasgeborene gedurende het eerste jaar of de eerste jaren.

Hoofdstuk 6 gaat in op de effectiviteit na 6 maanden van een film via internet van 8,5 minuten over mondgezondheidsroutines verspreid via consultatiebureaus, gericht op het verbeteren van de kennis van ouders over mondgezondheid. Met behulp van een quasi-experimentele studie werd gevonden dat de kennisscores van ouders direct na het bekijken van de film toenam. Na 6 maanden was er nog steeds sprake van een statistisch significante verbetering, hoewel de scores lager waren dan direct na het zien van de film. Effectgroottes voor het directe effect van de film en de 6-maanden follow-up waren beide substantieel.

De bevinding impliceert dat verdere implementatie bij consultatiebureaus of een vergelijkbare setting veelbelovend is om grote groepen ouders te bereiken zonder dat er veel personeel nodig is om de interventie toe te passen. Het is bekend dat educatieve interventies zoals een webgebaseerde film alleen een beperkte impact hebben op de mondgezondheid, maar toch als nuttig beschouwd kunnen worden voor het initiëren van mondgezondheidsbevordering bij ouders en kinderen. Verder onderzoek is nodig naar de effecten van een web-based film op uitkomsten zoals eigen effectiviteit van ouders, attitude,en gedragsintenties, wat belangrijke determinanten zijn voor het veranderen van mondhygiënegedrag van ouders.

Hoofdstuk 7 beschrijft een nieuwe manier om preventieve tandheelkundige zorg te bieden aan jonge kinderen. In zo'n systeem werken de jeugdgezondheiszorg en mondzorg samen om jonge kinderen in Nederland en hun ouders eerder te bereiken, wat leidt tot eerdere preventieve tandheelkundige zorg. Het bereiken van de ouders van de kinderen die momenteel worden gemist door mondzorgprofessionals is van potentieel belang. Zowel jeugdgezondheidszorgprofessionals als mondzorgprofessionals moeten getraind worden in kennis en vaardigheden om de tandheelkundige zorg voor jonge kinderen te verbeteren, hetzij door het volgen van een E-learning tool zoals "Mondzorg voor kinderen" of een praktische cursus zoals de NOCTP aanpak ter voorbereiding op deze samenwerking.

Deze bevindingen impliceren dat samenwerking tussen jeugdgezondheidszorg professionals en mondzorgprofessionals een effectieve en haalbare mogelijkheid lijkt om de mondgezondheid voor jonge kinderen te bevorderen.

Hoofdstuk 8 behandelt een vergelijking van methoden om gegevens te verkrijgen over de tijd die professionals besteden aan tandheelkundige zorg als basis voor toekomstige analyses van kosteneffectiviteit in de tandheelkunde. Het bleek dat tijdmetingen verzameld via het elektronisch patiëntendossier van de tandartspraktijk en via tijdmetingen door ouders van patiënten overeen kwamen met tijdmetingen door een onafhankelijke onderzoeker. Omdat het verzamelen van gegevens met behulp van zelfrapportages van patiënten over het type behandeling en het type betrokken professionals niet voldoende valide was, werd geconcludeerd dat gegevens het beste verzameld konden worden met behulp van de elektronische patiëntendossiers van de tandartspraktijk.

Deze bevinding impliceert dat de kosten van tandheelkundige zorg kunnen worden geschat op basis van registraties in het elektronische patiëntendossiers.

Hoofdstuk 9 geeft een overzicht en discussie van de belangrijkste bevindingen, gaat in op methodologische kwesties en geeft een reflectie op de implicaties van de bevindingen voor de tandheelkundige praktijk, beleid, onderwijs en onderzoek.

Resultaten met betrekking tot de drie hoofdthema's werden besproken: de prevalentie van cariës en sociaaleconomische verschillen onder jonge kinderen; de effecten van twee innovaties in de mondzorg (d.w.z. een nieuw geïnitieerd samenwerkingsnetwerk tussen mondzorgprofessionals en jeugdgezondheidszorgprofessionals, en het gebruik van de NOCTP aanpak, beginnend vanaf de doorbraak van het eerste tandje van het kind en de implementatie van interprofessionele samenwerking in de mondzorg voor jonge kinderen. Hieronder worden de kernimplicaties van de bevindingen in dit proefschrift worden gegeven:

Onze bevinding dat er, ondanks de vergoeding voor tandheelkundige zorg voor de jeugd, op zeer jonge leeftijd nog steeds sociaaleconomische verschillen bestaan, impliceert dat extra inspanningen ter bevordering van de mondgezondheid hard nodig zijn. Verwijzing van jeugdgezondheidszorg naar mondzorgpraktijken op jonge leeftijd is in dit opzicht veelbelovend. Dit zou ook gedaan kunnen worden in andere landen met een dergelijk systeem. Landen zonder zo'n systeem voor goede jeugdgezondheidszorg zouden de invoering ervan serieus moeten overwegen, om redenen van mondgezondheid, maar ook om andere redenen met betrekking tot de gezondheid van kinderen.

Bovendien laten onze bevindingen zien dat het aanbieden van een online educatieve mondgezondheidsfilm veelbelovend kan zijn om de kennis van ouders over mondgezondheid te bevorderen. Een bredere implementatie moet zeker overwogen worden. Onder extreme omstandigheden zoals de beperkende maatregelen van COVID-19 zijn interventies zoals de online mondgezondheidsfilm zelfs van nog groter belang.

Omdat de financiële middelen beperkt zijn, is het noodzakelijk om in de gezondheidszorg keuzes te maken die de meeste waarde qua gezondheid opleveren voor het geld dat wordt besteed. Een volgende stap is het bepalen van de kosteneffectiviteit van innovaties zoals interprofessionele samenwerkingsmethoden van de jeugdgezondheidszorg en mondzorg en de NOCTP aanpak in de mondzorg. Het verzamelen van gegevens uit de elektronische patiëntendossiers van de tandheelkundige kliniek zou het uitvoeren van dergelijke kosteneffectiviteitsstudies in de mondzorg kunnen vergemakkelijken.

De bevinding dat interprofessionele samenwerking helpt bij het bevorderen van mondgezondheid bij kinderen door een vroegtijdige start van tandheelkundige preventie impliceert een behoefte aan verdere implementatie in Nederland. Mondzorg zou onderdeel moeten zijn van preventief beleid, zoals het Nederlandse "Gezond en Actief Leven Akkoord" (GALA) van het Ministerie van Volksgezondheid, Welzijn en Sport, gemeenten, gemeentelijke gezondheidsdiensten en zorgverzekeraars. De inclusie van mondzorg kan de implementatie en toepassing van nieuwe interventies ter bevordering van de mondgezondheid vergemakkelijken. Dit kan de mondgezondheid in Nederland sterk verbeteren en zou ook op nationaal niveau krachtig ondersteund moeten worden. Een dergelijke nauwere samenwerking op lokaal niveau zou bij voorkeur ondersteund moeten worden op landelijk niveau.

Samenwerking tussen jeugdgezondheidszorgprofessionals en mondzorgprofessionals lijkt een effectieve, haalbare en betaalbare mogelijkheid om de mondgezondheid van jonge kinderen te bevorderen. Het biedt ook een manier om de aanbevelingen van het recente 'Global Oral Health Status Report' van de WHO te realiseren: het opstellen van beleid met praktische benaderingen voor een betere integratie van mondgezondheid in de eerstelijnsgezondheidszorg, ondersteund door een verbeterde interprofessionele samenwerking (WHO, 2022).

Concluderend vonden we dat, ondanks een systeem van volledige vergoeding van tandheelkundige zorgvoor kinderen, SES verschillen blijven bestaan en dat kinderen met een lage SES nog steeds een groter risico lopen op veel cariës dan kinderen met een hoge SES. Verder vonden we twee interventies die veelbelovend zijn voor het bevorderen van de mondgezondheid van kinderen, namelijk een korte web-based film over mondgezondheidsroutines via het consultatiebureau en verwijzing van ouders van baby's door jeugdgezondheidszorg professionals van consultatiebureaus. Interprofessionele samenwerking tussen jeugdgezondheidszorg en tandheelkundige zorg is haalbaar. Dit geeft aanbeveling tot verdere implementatie van de Healthy teeth: all aboard! interventie. Tot slot kunnen de bevindingen van dit proefschrift worden

toegepast om de mondgezondheid van kinderen te verbeteren, en (zelfs) ook van kinderen in lage SES groepen.

DANKWOORD

Het dankwoord van een proefschrift geeft mooi weer hoe het promotieproces is verlopen. Een moment om terug te blikken op de afgelopen jaren als promovendus. En wat was het een mooie tijd! Ik heb ontzettend veel geleerd, een mooi onderzoek mogen uitvoeren, maar vooral met heel veel leuke, intelligente en vooral ook hele lieve mensen mogen samenwerken. Meer dan eens heb ik mij gerealiseerd dat het zeker niet vanzelfsprekend is om een promotie-onderzoek uit te voeren en de kans hiervoor te krijgen. Wat ik mij ook vaak heb gerealiseerd is dat promotie-onderzoek onmogelijk is om alleen te doen. Er zijn zoveel mensen die een significante bijdrage hebben geleverd aan mijn proefschrift op vele verschillende manieren, en die wil ik hieronder heel graag bedanken.

In het bijzonder gaat mijn dank uit naar mijn promotoren en co-promotor die een zeer belangrijke bijdrage hebben gehad aan mijn proefschrift.

Prof. Dr. Menno Reijneveld, beste Menno, ik wil je enorm bedanken voor je professionele begeleiding al die jaren. Ik ben onder de indruk van jouw intelligentie en kritische blik. Jouw talent voor structuur en schrijven en het vermogen om zowel oog te hebben voor de grote lijn als de details is bijzonder. Je zag alles altijd glashelder en kon elke tekst en elk overleg prima structureren. Daar waar ik de lijn soms even kwijt was, daar pakte je hem snel weer terug. Ik heb veel van je geleerd; om beter te schrijven, hoe ik mijn werk efficiënter kon organiseren en aanpakken en om tot de kern van de boodschap te komen. Het was heel fijn dat je altijd bereid was tot het geven van commentaar en tijd maakte voor overleg. Nooit hoefde ik op commentaar te wachten en altijd was je bereid om weer een tekst te reviewen. Iets wat ik toch altijd bewonderenswaardig heb gevonden gezien jouw zeer uitdagende werkschema. Het was erg fijn om in dit traject jouw expertise vanuit de gezondheidswetenschappen te combineren met de expertise van Annemarie en Erik vanuit de tandheelkunde. Het bleek voor mij een perfecte combinatie te zijn. Ook heb je mij gestimuleerd om tijdens het hele onderzoek met het schrijven van papers bezig te blijven. Daar ben ik je zeer dankbaar voor, want anders was het nooit gelukt om alle artikelen af te ronden.

Dr. Annemarie Schuller, beste Annemarie, allereerst wil ik je bedanken voor jouw enthousiaste begeleiding alle jaren. Het zit er nu echt op en wat hebben we een leuke tijd meegemaakt tijdens dit onderzoek. Je hebt mij enorm veel geleerd en op zowel werkgebied als privégebied gesteund. Zonder jou was ik waarschijnlijk nooit aan een promotie-onderzoek begonnen dus ik heb dit eigenlijk wel aan jou te danken. Ik kan mij nog goed herinneren dat wij het plan voor mijn promotie-onderzoek bespraken in de tuin van TNO samen met Erik, toentertijd aan de Wassenaarse weg. En hier staan we dan! Ik heb genoten van onze vele inspirerende overleggen, leuke en diepe gesprekken, lange wandelingen, etentjes, congresbezoeken en zo kan ik nog wel even doorgaan. Je hebt mij geleerd om de dingen aan te gaan die ik moeilijk vind. Ook heb je een aanstekelijk enthousiasme. Als jij ergens voor gaat dan ben je niet te stoppen en dat is mooi om te zien. We kunnen goed praten met elkaar en dat was erg fijn tijdens het traject. Zoals bij elk promotietraject kwamen we ook barrières tegen onderweg. Dit was zeker niet altijd gemakkelijk, maar opgeven was nooit een optie. Als het weer eens iets anders liep dan we hadden gedacht grapte je weleens dat we in een volgend leven toch echt microscopenonderzoek moesten gaan doen, omdat we de condities en de omgeving dan beter konden controleren maar als ik eerlijk ben lijkt mij dat veel te saai. Alle hobbels die wij tegenkwamen hebben wij als team getrotseerd. Ook op persoonlijk vlak stond jij altijd klaar met een luisterend oor als dit nodig was, veel dank daarvoor. Bij veel belangrijke momenten was jij erbij, en dat is iets dat ik nooit zal vergeten. Ik ben blij dat we dit uitdagende en vooral superleuke onderzoek samen hebben kunnen uitvoeren van begin tot eind. Ik kijk met plezier terug op een zeer leuke tijd met veel mooie herinneringen en ik zal het ook zeker missen. We blijven in contact, dat staat vast.

Dr. Erik Vermaire, beste Erik, enorm veel dank voor jouw begeleiding en betrokkenheid tijdens mijn wetenschappelijke reis. Hoe leuk is het, dat ik voort mocht bouwen op jouw prachtige promotie-onderzoek die het Gewoon Gaaf programma voor tandartspraktijken in Nederland heeft geïntroduceerd. Jouw expertise vanuit jouw werk en eerdere onderzoek was echt een must voor een goede uitvoering van het GigaGaaf! onderzoek. Van jou heb ik geleerd wat de kracht is van communiceren, want daar ben je een ster in. Je hebt mij laten zien dat het goed is om je eigen pad te volgen en ik

waardeer je oprechtheid en je prettige manier van samenwerken. De trainingen in Groningen, Coevorden en Den Haag deden we samen, en dat was altijd gezellig. Je draaide je hand er niet voor om, om kris kras door het hele land te gaan hiervoor. Dat je mij wilde blijven begeleiden terwijl je afscheid had genomen van het UMCG en TNO vond ik zeer bijzonder en het laat wel zien hoe loyaal je bent. Ontzettend veel dank daarvoor. Je bent iemand op wie je altijd kan vertrouwen.

Geachte leden van de leescommissie, Prof. Dr. Josef Bruers, Prof. Dr. Marlou de Kroon, Prof. Dr. David Manton, Dr. Miriam Bildt, Prof. Dr. Katarina Jerkovic-Ćosić en Prof. Dr. Erik Verrips hartelijk dank voor jullie bereidheid om deel te nemen in de leescommissie en de tijd die jullie hebben besteed aan het kritisch lezen van mijn proefschrift.

ZonMw wil ik graag bedanken voor het mogelijk maken van het GigaGaaf! onderzoek. Beste Patty Proost, veel dank voor jouw betrokkenheid als programmaleider hierbij.

Beste bestuursleden van de Nederlandse Vereniging voor Kindertandheelkunde, heel veel dank voor de sponsoring van materialen voor het GigaGaaf! onderzoek, super!

Beste Christien Timmer, dank voor de cadeautjes voor de kinderen die hebben meegedaan, dit maakte het voor de kinderen extra leuk!

Beste ouders en kinderen die hebben meegwerkt aan het GigaGaaf! onderzoek en aan de dataverzameling, ik ben jullie allen zeer dankbaar voor jullie inzet voor dit onderzoek. Jullie bijdrage was ongelooflijk belangrijk. Het wordt weleens onderschat wat we bij deelname aan longitudinale studies met een klinische meting vragen van ouders en hun kinderen.

Beste zorgprofessionals van de aan GigaGaaf! participerende mondzorgpraktijken en jeugdgezondheidszorgorganisaties, jullie waren cruciaal voor het slagen van dit onderzoek. Jullie hebben enorm hard gewerkt en heel veel energie gestopt in het slagen van de interventie en het onderzoek. Ik wil jullie allemaal heel erg bedanken voor jullie jarenlange medewerking en enthousiasme om de mondzorg voor de jeugd te verbeteren, fantastisch!

Beste Ineke, collega en vriendin van de overkant op de vierde etage van de Schipholweg, je hebt het promotie-onderzoek vanaf het begin meegemaakt en ook bij meerdere projectonderdelen geholpen. Vooral bij het organiseren van het veldwerk is jouw hulp van onschatbare waarde geweest. Van jou heb ik geleerd om te relativeren en vooral ook actief te blijven. De lunchwandelingen bij TNO waren altijd fijne momenten om even in de frisse buitenlucht te zijn en over de dagelijkse dingen te praten. We hebben hele fijne gesprekken gehad al die jaren en dat schept een band. Je toonde altijd interesse in mijn promotie-onderzoek en wilde altijd helpen waar nodig. Ook gaf je mij adviezen als ik tegen logistieke of organisatorische problemen aanliep. Dit was zeer waardevol. Veel dank voor alles al die jaren. Hopelijk zetten we onze gezellige verjaardagslunches voort!

Beste Erik (Sr), collega van het clubje mondzorg bij TNO, je introduceerde mij binnen het team mondzorg van TNO. Samen begonnen we aan het project mondzorg voor ouderen. Van jou heb ik veel vrijheid en vertrouwen gekregen om uitdagende en leuke onderzoeken aan te gaan binnen de mondzorg, daar ben ik je erg dankbaar voor. Je humor en relativeringsvermogen maakte de ouderwetse ‘mondzorg’ overleggen bij TNO altijd gezellig. Ook liet je mij inzien hoe ik mijn eigen weg kan vinden tijdens een promotie-onderzoek. Ik kijk terug op een mooie en vooral gezellige tijd met ons clubje mondzorg.

Beste Caroline, Elies, Mariëlle, Puck en Tineke, heel veel dank voor jullie hulp bij het uitvoeren van het veldwerk. Het was zo fijn dat ik op alle drukke veldwerkdagen voor 100% op jullie kon rekenen. De drukte was soms lastig te voorspellen, sommige veldwerkdagen waren rustig en op andere dagen moest er keihard non-stop doorgewerkt worden. Jullie flexibele instelling hierbij waardeerde ik zeer. Beste Joke, heel veel dank voor het bellen met alle ouders en het maken van alle afspraken voor de klinische onderzoeken. Wat was jouw ondersteuning fijn bij de voorbereiding van het veldwerk.

Beste Henri en Tjalling, Luc en Hans, hartelijk dank voor de steun en de ruimte die jullie mij hebben gegeven tijdens mijn promotie-onderzoek. Zonder jullie steun was dit onmogelijk geweest. Beste Nynke en Miriam, ik ben enorm blij dat ik in jullie

expertisegroepen terecht ben gekomen bij het CTM. Jullie waren geïnteresseerd in mijn onderzoek en waren betrokken leidinggevenden. Helaas was ik door de grote afstand niet zo vaak aanwezig in Groningen maar jullie hebben mij altijd het gevoel gegeven dat ik erbij hoorde en toonden begrip hiervoor. Beste William, dank voor jouw gezelligheid. Je hielp bij de vertaling van de vragenlijsten naar het Engels, heel veel dank daarvoor. Beste Dien, hartelijk dank voor je feedback. Beste Tiny en Petra, heel veel dank voor al jullie steun aan GigaGaaf! en de gesprekken die we hadden. Jullie waren altijd betrokken en geïnteresseerd, ik zal jullie missen! Beste Alina, dank voor het meedenken met lastige vraagstukken binnen het onderzoekstraject. Beste Jacqueline, dank voor alle hulp bij al mijn administratieve vragen. Beste Arnoud en Sytze, dank voor jullie hulp bij de financiële overzichten. Beste collega's van expertisegroep Beschouwende en Gedragswetenschappelijke Tandheelkunde en expertisegroep Kindertandheelkunde, heel veel dank voor de fijne samenwerking alle jaren. Beste stagiaires, heel veel dank voor jullie interesse en inzet voor de deelprojecten van het GigaGaaf! onderzoek. Er zijn vele mooie scripties uit voort gekomen!

Beste collega's van Public Health Research (PHR), dank voor jullie feedback. De meetings van PHR waren zeer leerzaam. Beste Janneke, dank voor alle hulp bij het plannen en organiseren van afspraken met alle onmogelijke agenda's.

Beste collega's van TNO Child Health, wat was het fijn om onderdeel te mogen zijn van jullie afdeling. Ik heb ontzettend veel van jullie geleerd en met veel lieve collega's mogen samenwerken. Beste Maaike, Symone, Daan, Pepijn en Fieke, ik ben erg dankbaar dat ik bij TNO Child Health kon werken tijdens mijn promotie-onderzoek. Het voelde altijd vertrouwd, heel veel dank. Zonder deze steun had ik het nooit kunnen doen. Beste Mieke, Monica en Sigrid, wat was het gezellig op de vierde van de Schipholweg! Ik wil jullie bedanken voor de leuke tijd bij TNO. Tijdens onze lunchwandelingen leerden we elkaar steeds beter kennen, ook al werkten we niet direct met elkaar samen. Ik heb genoten van alle lunchwandelingen, gesprekken, pubquizes, kerstfeesten en taart- en koffiemomenten. Beste Paula en Ernest, veel dank voor jullie statistische ondersteuning als ik er zelf niet meer uit kwam. Zonder jullie waren de analysen nooit gelukt! Wat fijn dat ik altijd bij jullie kon aankloppen met vragen over

statistiek. Beste Jolanda, dank voor jouw hulp en betrokkenheid de afgelopen jaren, je staat altijd klaar voor iedereen bij TNO Child Health. Beste Jaap, dank voor de mooie ontwerpen voor alle materialen van de GigaGaaf! interventie. Beste Claire, kamergenoot bij TNO aan de Wassenaarse weg, dank voor jouw gezelligheid. Ik heb mooie herinneringen aan die tijd. Beste Caren en Ko, dank voor jullie bijdrage aan het artikel over sociale ongelijkheid in mondgezondheid. Beste Karin, Kitty, Marlies en Wilma bij jullie ben ik gestart als stagiaire en junior onderzoeker bij TNO. Ik heb mooie onderzoeken onder jullie leiding mogen uitvoeren, dank daarvoor.

Beste Marten Poleij, Job van Exel en Werner Brouwer, bedankt voor jullie hulp bij het gezondheideconomische gedeelte van de studie.

Beste Astrid Talsma, het voelt alsof we collga's zijn geworden. Ik wil je bedanken voor onze vele leuke gesprekken over hoe het verder zou moeten met de mondzorg voor de jeugd, jouw betrokkenheid en inzet voor het onderzoek en jouw rol in de samenwerking van het UMCG en de GGD Groningen. Beste Anita Kootwijk-Jonker en Eveline de Jong, dank voor jullie betrokkenheid bij GigaGaaf! in Den Haag. Het was fantastisch om jullie steun te krijgen vanuit de GGD Haaglanden. Jullie enthousiasme en creativiteit om de mondzorg voor kinderen (en ouderen) op de kaart te zetten is geweldig.

Beste collega's van Jeugdtandzorg West, maar in het bijzonder Lina Jasulaityte, Hans Berendsen en Nicolette Kleppe wil ik graag enorm bedanken voor de jaren steun aan GigaGaaf! Jullie locatie's hebben met enthousiasme meegewerkt aan het project en dat is fantastisch. Ook met het veldwerk waren we steeds weer welkom bij jullie, heel veel dank daarvoor. Lina, ik heb heel veel bewondering voor jouw enthousiasme en passie om Gewoon Gaaf en Motivational Interviewing in de praktijk naar een hoger niveau te krijgen, veel dank daarvoor.

Beste collega's van Mondzorgcentrum Winschoten, ontzettend veel dank voor jullie steun aan GigaGaaf! In het bijzonder Dian Perdok-Nitters, Carlyn Estadella Codina, Hester Brandes, Arie Hoeksema, Yvonne de Waal, Arthur Noorman, en Maurits de Kuijper, jullie enthousiasme en interesse in het meedoen aan GigaGaaf! was bijzonder

waardevol! Ook bij jullie waren we meerdere dagen welkom om de klinische metingen uit te voeren, hartelijk dank daarvoor.

Beste Lucy Smit, Madeleine Snip, Bianca van Vreeswijk en Karin Keijser, jullie steun en interesse in het onderwerp mondzorg vanuit de jeugdgezondheidszorg is heel belangrijk, veel dank daarvoor. En Lucy en Madeleine, de prachtige E-learning mondzorg die jullie hebben ontwikkeld voor de Jeugdgezondheidszorg is zeer waardevol.

Beste Denise Duijster, dank voor het delen van je ervaringen uit je eigen onderzoek en de vragenlijsten en interesse in het GigaGaaf! onderzoek.

Beste Milou Munk, dank voor de interesse in de mondzorg voor de jeugd en samenwerking met de consultatiebureaus vanuit de KNMT.

Beste Eva, Femke, Joyce, Karen, Leon, Maarten, Razia, Sabrine en Sandesh, “nieuwe” collega’s van Z&Z, dank voor jullie steun en interesse en het warme welkom dat jullie mij hebben gegeven. Ik leer enorm veel van jullie, dank daarvoor.

Als laatste wil ik mijn lieve vrienden en familie bedanken die tijdens mijn promotie-onderzoek uiteraard een belangrijke rol hebben gespeeld.

Lieve Adriènne, onze vriendschap is mij zeer dierbaar en ik ben heel blij dat je naast mij staat als mijn paranimf. Met jouw steun erbij komt het zeker goed, ontzettend veel dank daarvoor. Lieve Anouk B, Anouk P, Dragana, Fabiënne, Janneke, Kristel, Lotte, Nathalie, Niki, Sanne en Saskia, wat zou ik toch zonder jullie moeten? We kennen elkaar door en door en hebben al veel met elkaar meegemaakt. Ik wil jullie enorm bedanken voor jullie luisterend oor, de fijne gesprekken, heerlijke etentjes, gezellige borrels, mooie weekendtrips en vakanties. Ten slotte is ontspanning tussendoor ook heel belangrijk. Ook al zien we elkaar niet meer wekelijks door de alledaagse drukte, we staan altijd voor elkaar klaar en delen lief en leed met elkaar. Jullie vroegen mij regelmatig hoe het ging met mijn onderzoek en vroegen natuurlijk ook hoe jullie het tandenpoetsen thuis leuker en gemakkelijker konden maken. Dit herinnerde mij eraan hoe zeer het onderwerp van mijn promotie-onderzoek leeft bij ouders van jonge kinderen. Lieve Joël en Kelly, Michel en Melanie, bedankt voor jullie interesse in mijn onderzoek en de gezellige

concertavonden, etentjes en weekendjes met elkaar. Ik kijk al uit naar het volgende weekend in Center Parcs!

Lieve Ciska en Ben, Diana en Son, en Marianne, dank voor jullie steun en betrokkenheid. Ik kan altijd bij jullie terecht. We gaan samen uit eten, even koffie drinken, of een dagje erop uit, altijd gezellig. En ook tonen jullie altijd interesse in mijn werk. Hartelijk dank daarvoor.

Lieve Oma, als grootmoeder van zo'n grote familie en op bijna 90-jarige leeftijd bent u nog steeds erg zelfstandig, sterk en zorgzaam. Nog steeds verzorgt u iedereen die bij u langs komt en maakt u verschillende Indonesische lekkernijen! Als ik in mijn werk kijk naar de inlvoed van cultuur en etniciteit en de verschillen die er zijn, denk ik er ook aan hoe het voor u moet zijn geweest. Ruim zeventig jaar geleden kwam u met opa en toen drie jonge kinderen naar Nederland. Een vreemd land met een vreemde taal zonder uw familie. Alles opnieuw opbouwen. En hoe u de Nederlandse cultuur met de Indonesische cultuur samen heeft gebracht en alle kansen heeft vrijgemaakt voor onze generatie. Dat is bijzonder en daar ben ik u zeer dankbaar voor. Uw doorzettingsvermogen en kracht zijn bewonderenswaardig. Lieve familie Verlinden, ook al is het niet zo vaak meer, het is altijd gezellig als wij met zijn allen bij elkaar komen bij oma. Hartelijk dank voor jullie interesse in mijn onderzoek.

Lieve Piet en Anja, jullie steun is enorm waardevol geweest. Jullie hebben een hart van goud en 'alles is familie' kenmerkt jullie. Op al die momenten als ik een cursus had in Groningen, of op de veldwerkdagen, stonden jullie altijd met liefde klaar om David en Fajah op te vangen. Zonder zorgen kon ik mij dan focussen op het werk. Zonder jullie had ik niet de vrijheid gehad om dit te kunnen doen, veel dank daarvoor. En ook met de verhuizing naar Voorschoten hebben jullie mij ontzettend veel geholpen, en daar ben ik zeer dankbaar voor. Lieve Mirjam, Ronald, Quinten, Ruben, Ruud, Karleen, Lucas en Marcus, dank voor de vele gezellige familievakanties, etentjes, feestjes en uitjes, met jullie vieren we alles wat er ook maar gevierd kan worden in het leven. En daar draait het toch om. Het is altijd gezellig bij familie van den Bogaard!

Lieve Paul, altijd was en ben jij er voor mij. Zonder jou had ik nooit promotie-onderzoek kunnen doen. Ook al zijn we niet meer samen, we hebben nog altijd goed contact met elkaar en je bent een fantastische vader voor Fajah en David en mij zeer dierbaar. Ook nu nog steun je mij als dit nodig is. Zo bleef je regelmatig bij Fajah en David als ik nog even door moest werken. Ik realiseer mij heel goed dat dit geen vanzelfsprekendheid is in onze situatie. Heel veel dank daarvoor.

Lieve Patrick, mijn kleine broertje ben je allang niet meer, althans qua lengte dan. Ik ben ontzettend blij dat je vandaag aan mijn zijde staat als mijn paranimf. Wat is het veel waard dat we zo hecht zijn en wat ben ik trots op jou. We hebben een hoop meegemaakt samen. Dit alles heeft onze band alleen maar hechter gemaakt. We lopen de deur misschien niet dagelijks plat bij elkaar maar wat er ook gebeurt, altijd kunnen wij op elkaar rekenen. Ik ben zeer dankbaar voor zo'n lieve broer. Lieve Caron, schoonzus, wat ben ik blij dat jij in Patrick zijn leven bent gekomen. Jullie zijn een geweldig team samen. Ik wens jullie heel veel geluk samen voor de toekomst en kijk enorm uit naar jullie huwelijk.

Lieve Noa, lieve zus, ik ben heel trots op je waar je nu staat. Saai zal het met jou nooit zijn, dat staat vast. Je bent echt een strijder zullen we maar zeggen, enthousiast en uniek. We zijn totaal elkaars tegenpolen, zowel qua innerlijk als qua uiterlijk, alleen qua lach zijn we identiek, al weet ik niet of dat nu zo positief is ;). Samen lachen kunnen we als de beste, dit was altijd een goede manier om te relativeren tijdens mijn onderzoek. Dank daarvoor. Vertrouw op je eigen kracht en blijf altijd je unieke zelf!

Lieve Mam, was je nog maar bij ons en wat had ik je graag vandaag erbij gehad. In de laatste weken toen je al erg ziek was vertelde ik je dat ik zou starten met een promotie-onderzoek. Ik weet nog goed dat je ondanks de extreme vermoeidheid een stralende lach liet zien. Je was trots en verheugd over het nieuws. Soms worden dit soort momenten ineens heel waardevol. Want wat ben ik nu blij dat je nog hebt meegekregen dat ik promotie-onderzoek zou gaan doen. Ik ben dankbaar dat ik zo'n lieve moeder heb gehad, alle kansen die jij en pap mij hebben gegeven in het leven en de liefde die ik van jullie heb gekregen. Ik denk nog heel vaak terug aan onze fijne gesprekken en

momenten. Het gemis nu je niet meer bij ons bent blijft er altijd en stiekem hoop ik dat je van vandaag toch nog wat meekrijgt.

Lieve Pap, je vond het fantastisch dat ik een promotie-onderzoek binnen de tandheelkunde ging doen en nu is het dan eindelijk zover. Ook al was het eigenlijk puur toeval dat ik in de wereld van de tandheelkunde terecht kwam. Het is wel erg handig om samen over tandheelkundige vraagstukken te kunnen praten. En zelfs heb je nog aan een kleine acteerklus meegewerkt tijdens het onderzoek, hoe leuk is dat! Tijdens mijn promotie-onderzoek werd je helaas ziek en dat was een spannende tijd. Gelukkig is het nu stabiel en kun je weer genieten. Je hebt mij vaak tijdens het traject laten weten dat je trots was en dit was zeker een steun. Ik ben dankbaar voor zo'n lieve vader.

Lieve Fajah en David, wat ben ik dankbaar dat ik jullie om mij heen heb. Jullie zijn zo verschillend, en dat vind ik juist zo leuk. En ook al kan ik heus weleens even mopperen in de haast van alledag, gewoon gezellig tijd doorbrengen met jullie doe ik het allerliefste. En ik kijk er dan ook naar uit om samen heel veel leuke uitjes te gaan plannen. Volg jullie dromen en ik zal jullie daarin steunen. Jullie maken mij trots! Dank voor jullie liefde, dank jullie voor alles, hou van jullie.

ABOUT THE AUTHOR

Ashley Verlinden was born on August 1st 1987 in Voorburg, The Netherlands. She grew up in the village of Leiderdorp, The Netherlands. After completing her Master's degree in Health Sciences at the VU Amsterdam in 2010 Ashley started working at TNO Child Health as a junior researcher. At TNO she mainly worked on research regarding the design and evaluation of interventions to improve oral health, of both young children and elderly people in the Netherlands. In 2014, she started her PhD research "Healthy teeth: all aboard!" or in Dutch “GigaGaaf!” at the University Medical Center Groningen, Center for Dentistry and Oral Hygiene. She has a particular research interest in oral health promotion for children and families and social inequalities in oral health. In 2023 Ashley started working as a researcher at Health Insurance Company Zorg en Zekerheid. She lives in Voorschoten together with her daughter Fajah and her son David.

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