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ACTA UNIVERSITATIS OULUENSIS

*Kari Rantavuori*

ASPECTS AND  
DETERMINANTS OF  
CHILDREN'S DENTAL FEAR

FACULTY OF MEDICINE,  
INSTITUTE OF DENTISTRY,  
UNIVERSITY OF OULU





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*KARI RANTAVUORI*

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CHILDREN'S DENTAL FEAR**

Academic dissertation to be presented, with the assent of the Faculty of Medicine of the University of Oulu, for public defence in Auditorium I of the Institute of Dentistry (Aapistie 3), on November 28th, 2008, at 12 noon

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## **Rantavuori, Kari, Aspects and determinants of children's dental fear**

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### ***Abstract***

The aims of this study were to explore different aspects of dental fear and their determinants among children at different ages.

The study samples comprised 378 children from the Veneto region of Italy aged 3–13 years and 1474 children from Jyväskylä and Kuopio, Finland, aged 3, 6, 9, 12 and 15 years. In the Italian study, the child's age, first dental visit, number of subsequent visits and dental fear, and the parent's dental fear were asked in a questionnaire. In the Finnish study, a questionnaire was used that contained 11 dental fear-related questions and family member's dental fear and questions on oral health habits and family characteristics. Dental status was determined clinically and information on treatment procedures from three preceding years was collected from patient records.

A total of 21 to 36% of Finnish children were quite or very afraid of something in dental treatment. The prevalence of dental fear among Finnish children was not lower among older children but rather fluctuated among different ages. The characteristics of dental fear differed among children at different ages. Among Finnish children, four aspects of dental fear were revealed from the questionnaire, i.e. 'Treatment of dental decay', 'Attending dentist', 'Peak value for dental fear' and 'Fear of dental treatment in general'. Correlations between the four abovementioned aspects, the differences between age groups separately for the above mentioned aspects, and the determinants of dental fear were studied. At younger ages, the dental fear was abstract, commonly related to attending dentist. At older ages, dental fear was often related to invasive treatment, such as fear of local anaesthesia and drilling. Fear of pain which was common among all age groups. Among Italian children, the first dental experiences were strong determinants of dental fear. Among Finnish children, dental fear among other members of the family was more often found among children with dental fear than among non-fearful children. 15-year-old girls were more likely to be afraid than boys of the same age but gender differences were not found at younger ages. The results indicated that dental fear is not solely based on direct conditioning but rather consists of child, family and environment related determinants.

*Keywords:* child, dental fear, direct, indirect, conditioning, etiology



## **Rantavuori, Kari, Hammashoitopelon piirteitä ja määreitä**

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### ***Tiivistelmä***

Tutkimuksen tarkoituksena oli selvittää lasten hammashoitopelon piirteitä ja niihin liittyviä seikkoja eri-ikäisillä lapsilla.

Tutkimuksessa käytettiin havaintoaineistoa, joka koostui 378:sta 3–13-vuotiaasta italialaisesta lapsesta Veneton maakunnan alueelta sekä 1474:stä 3-, 6-, 9-, 12- ja 15-vuotiaasta lapsesta Jyväskylältä ja Kuopiosta. Tutkimuksessa italialaisilla lapsilla vanhempi täytti kyselylomakkeen, joka sisälsi kysymyksiä lapsen iästä, hammashoitopelosta, ensimmäisestä hammashoitokäynnistä ja seuraavien hoitokäyntien lukumäärästä sekä vanhemman omasta hammashoitopelosta. Suomalaisilla lapsilla tutkimustiedot kerättiin kyselylomakkeella, joka sisälsi 11 kysymystä lapsen hammashoitopelosta ja kysymyksiä lapsen suun terveystottumuksista sekä perheeseen liittyvistä seikoista, kuten perheenjäsenten hammashoitopelosta. Hampaiden senhetkinen kliininen tila sekä kolmen tarkastusta edeltävän vuoden hoitokäynnit ja tuolloin tehdyt toimenpiteet otettiin mukaan tutkimukseen.

Suomalaisista lapsista 21–36 % pelkäsi jonkin verran tai paljon jotain asiaa hammashoidossa. Suomalaisten lasten hammashoitopelko ei ollut alempi nuoremmilla lapsilla vaan vaihteli ikäryhmien välillä. Myös hammashoitopelon luonne vaihteli ikäluokittain. Suomalaisesta kyselystä löydettiin neljä pelon osa-alueita: paikkaushoitoon liittyvä pelko, hammaslääkärissä käymiseen liittyvä pelko, yleinen hammashoitopelko sekä voimakkaimmaksi koettu hammashoitoon liittyvä yksittäinen pelko. Tutkimuksessa tutkittiin pelon osa-alueiden välisiä korrelaatioita ikäryhmittäin, erikseen yksittäisen pelon osa-alueen vaihtelua ikäryhmien välillä sekä hammashoitopelon liittyviä seikkoja ikäryhmittäin. Nuoremmilla lapsilla hammashoitopelko oli useammin abstraktia, yleensä hammashoidossa käymiseen liittyvää pelkoa. Vanhemmilla lapsilla hammashoitopelko oli usein hammashoitotoimenpiteisiin liittyvää pelkoa, esimerkiksi puudutuksen ja porauksen pelkoa. Kivun pelko oli yleistä kaikissa ikäryhmissä. Ensimmäiset hammashoitokokemukset olivat voimakkaita hammashoitopelon selittäjiä italialaisilla lapsilla. Suomalaisten lasten hammashoitopelko oli vahvasti yhteydessä muiden perheenjäsenten hammashoitopelkoon. 15-vuotiaat tytöt pelkäsivät hammashoittoa enemmän kuin pojat, mutta sukupuolten välisiä eroja ei havaittu nuoremmissa ikäryhmissä. Tutkimus osoittaa, että lasten hammashoitopelko ei ole ainoastaan seurausta suorasta ehdollistumisesta hammashoitokokemusten kautta vaan siihen vaikuttavat enemmänkin lapseen, perheeseen ja ympäristöön liittyvät seikat.

*Asiasanat:* lapsi, hammashoitopelko, suora, epäsuora, ehdollistuminen, etiologia





*To Mari, Nuutti and Niila*



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Espoo, October, 2008

Kari Rantavuori

## Abbreviations

CFSS-DS	Children's Fear Survey Schedule-Dental Subscale
DAS	Dental Anxiety Scale
DFSS-CS	Dental Fear Survey Schedule-Children's Subscale. Also known as CFSS-DS
DMFT	Number of decayed, missing and/or filled permanent teeth
dmfs	Number of decayed, missing and/or filled surface(s) in primary teeth
DMFS	Number of decayed, missing and/or filled surface(s) permanent teeth
dmfs/DMFS	Sum of dmfs and DMFS
MDAS	Modified Dental Anxiety Scale



## List of original papers

This thesis is based on the following articles, which are referred to in the text by Roman numerals I–IV.

- I Rantavuori K, Zerman N, Ferro R & Lahti S (2002) Relationship between children's first dental visit and their dental anxiety in the Veneto Region of Italy. *Acta Odontol Scand* 60: 297–300.
- II Rantavuori K, Lahti S, Hausen H & Seppä L (2004) Dental fear and oral health and family characteristics of Finnish children. *Acta Odontol Scand* 62: 207–213.
- III Rantavuori K, Lahti S, Hausen H & Seppä L (2005) Dental fear of Finnish children in the light of different measures of dental fear. *Acta Odontol Scand* 63: 239–244.
- IV Rantavuori K, Lahti S, Tolvanen M, Seppä L & Hausen H (2008) Factors associated with different measures of dental fear among children at different ages. *J Dent Child*. In press.





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# 1 Introduction

Children have normative fears throughout childhood. These are normal reactions to real or imagined threats and are considered to be adaptive and integral aspects of normal development (King *et al.* 1988). The fears of children form a complex pattern that changes throughout development. Many fears are universal and during human evolution have been vital for survival because they operate as a system that alerts the individual to avoid danger. Now, however, the objects of fear have changed to meet the threats of modern society.

Dental fear is a specific fear which is common among children. It is unique fear in comparison to other specific fears because it has a stronger component of bodily injury than many other fears. The oral region is a very sensitive area and includes more receptors of somatic sensation than any other part of the human body (Bear *et al.* 2001 pp. 414–415). This oral region is also used for a variety of purposes, such as eating and talking. It is particularly important for development in early childhood (Freud 1916, Erikson 1950, Piaget 1986). Thus, it is not surprising that this emotion-related part of the human body is receptive to experiences of fear. Whether or not the normal fearful reactions towards dental treatment develop into more pathological fear is associated with a variety of factors, including direct conditioning via experiences of dental treatment, indirect learning via other people as well as personality and environmental factors (Shoben & Borland 1954, Davey 1989, Weiner & Sheehan 1990, Alwin *et al.* 1991, Milgrom *et al.* 1995a–b, Klingberg & Broberg 1998, Gustafsson *et al.* 2007, Klingberg & Broberg 2007). These interrelated factors complicate understanding of and research on dental fear.

Dental fear has been shown to be acquired mainly in childhood and adolescence (Locker *et al.* 1999). Earlier research suggests that direct conditioning is the main pathway for acquisition of dental fear in childhood (Locker *et al.* 1999), although other factors have also been suggested (Shoben & Borland 1954, Venham *et al.* 1979a, Winer 1982, Holst & Crossner 1987, Murray *et al.* 1989, Milgrom *et al.* 1995a–b, Locker *et al.* 1999, Poulton *et al.* 2001, ten Berge *et al.* 2002a). All children in Finland are entitled to comprehensive dental care from birth and practically all participate in this free care. Thus, they are predisposed to experiences of preventive treatment. Many children develop caries despite prevention and also experience invasive treatment. Even though the occurrence of caries, and thus dental treatment procedures, has decreased since the 1970's (Nordblad *et al.* 2004), dental fear continued to be prevalent in the

1990's (Tuutti 1986, Alvesalo *et al.* 1993a–b). On the other hand, some children do not acquire dental fear despite painful invasive experiences. These contradictory findings together with a personal interest to understand the human mind have been the initiatives for studying dental fear in children.

## 2 Review of the literature

### 2.1 Definitions

To enable the reader to understand the vocabulary in this field of research, some definitions are introduced in this chapter.

*Fear* is a reaction to real or imagined threat and is considered to be an integral and adaptative aspect of normal development (King *et al.* 1988). According to the Oxford dictionary (2008), fear is an unpleasant emotion caused by the belief that someone or something is dangerous, likely to cause pain, or a threat. Clinically, fear is used to describe a pathological reaction to specific objects such as needles or spiders. Exposure to fearful objects creates several different reactions in the body including physiological, cognitive, emotional and behavioral reactions (Lang & Cuthbert 1984). The physiological element includes involuntary changes in the body after perceived threat; these are both internal (invisible hormonal and neurological changes) and external (visible changes, e.g. increase in heart rate and changes in body language and facial expressions). The cognitive element describes the expectations, perceptions and recollection of thoughts about a specific situation or information about an unpleasant event. The emotional element consists of more conscious reactions to thinking about confronting a threat, such as panic or stomach ache. The behavioral element is used to describe the consequence of the fear reaction. (Lang & Cuthbert 1984.) After several exposures to a threat, a smell or taste related to the feared stimulus may trigger a fear reaction. Thus, we learn unconsciously how to escape from the danger before we confront it. This avoidance behavior leads to withdrawal and avoidance of the feared stimulus (Berggren & Meynert 1984, Milgrom *et al.* 1995b).

*Anxiety* is very similar to fear. It is formed of the same elements and functions the same way. Anxiety emotions are, however, more diffuse than specific fear and are attached to many different situations and events (Freud 1916, Stein & Hollander 2002: 416). Although anxiety differs from fear, intense fears may generalize into a wider anxiety concerning other life circumstances (Stein & Hollander 2002: 416). In contrast to fear, anxiety may be felt even though the feared stimulus is not present. For example, a subject who has increased heart rate, is shaky and becomes nervous thinking about future dental treatment can be considered anxious. This situation can be described as anticipatory anxiety which

concept was introduced by Sigmund Freud (1916). Among children under 12 years, the term anxiety is not used as their reactions cannot be separated from fears (Erikson 1950: 402, Freud 1916).

*Phobia* is an intense fear related to a specific object that usually provokes avoidance (Stein & Hollander 2002: 415), e.g. dental phobia. There are diagnostic criteria for specific phobia (APA 1994). Phobic individuals overestimate the consequences of enduring exposure to the feared stimulus, and the responses are out of proportion to the realistic danger (Beck *et al.* 1985). Exposure to the phobic stimulus almost invariably provokes an immediate anxiety response (APA 1994). The reactions are similar to fear reactions but differ in the degree of intensity. When avoidance is of such intensity that it causes significant distress or interferes with social or role functioning, the reaction qualifies as phobia (APA 1994, Milgrom *et al.* 1995b).

*Dental behaviour management problem* is a collective expression for uncooperative and disruptive behaviours, which result in delay of treatment or render treatment impossible, regardless of the type of behaviour or its underlying mechanism(s).

## **2.2 Fear and child development**

The development of a child is a unique combination of genetics, physical maturation and environmental influences. Throughout development, children experience fears which are not based on reality and dangerous situations but are fears associated with loss and helplessness (Freud 1916, Freud 1965, King *et al.* 1988, Gullone 2000). In order to understand the origins of fears in children, in this chapter some theories of development will be briefly described.

Theories of development describe personality development from early infancy through adolescence to adulthood. There are psychodynamic and cognitive theories of development that facilitate understanding of this complex process. Previous theories for the personality development of children, e.g. the psychoanalytic theories of Freud (1916) and Eriksson (1950), and the cognitive theory of Piaget (1986), represent psychological development as a series of individual stages or phases. These are presented in Table 1. In general, children are able to reach the next developmental stage or phase after maturation to certain level of the previous stage. Although each of the above theories has its own restrictions, they all reflect an aspect of psychological development and how it may be interpreted.

**Table 1. a) Psychodynamic theory for personality development (Freud 1916, 1949, 1965).**

Oral phase 0–18 months	Anal-sadistic phase (2–3 years)	Oedipalphase (3–5 years)	Latency phase (6–10 years)	Preadolescence (around 11 to 14)
In this phase of development the mouth is an erotogenic zone and is associated with pleasurable sensations arising from the oral mucosa. The infant makes no distinction between the pleasure of sucking and the ingestion of milk.	In this phase of development the child has, for the first time, control over its bowels and bladder. With biological control comes psychological control. This is observed as the child torturing, clinging, trying to dominate and control the mother. The child reacts strongly to separations, disappointments, and frustrations. All teeth have erupted. Food cravings for sweets and biscuits is characteristic of this phase.	The child discovers that sexual differences exist between boys and girls. This is associated with furious feelings in the girl whose mother has deprived her of a penis and anxiety in the boy who fears he will lose his penis. Known as castration anxiety it paves the way for the child to enter the Oedipal phase. The Oedipal phase is characterized by possessiveness in relation to the parent of the opposite sex and jealous of the parent of the same sex.	This is a quiet phase of development. Latency is characterized by a child who has well-circumscribed personality and personality traits (Freud 1949; it is a quiet time. Children in the latency phase are biddable and are able to look after their bodies and attempt to brush their teeth. The latency phase is recognizable in the dental surgery since children are easily managed.	This phase is the prelude to adolescent revolt with the return of previous ambivalent behaviours. The pre-adolescent causes disharmony at home and at school. Thus, the impact of the instinctual forces (sexual) is apparent to parents and teachers who come into contact with the preadolescent.

**Table 1. b) Children’s developmental stages according to psychosocial theory by E.H. Erikson (1950).**

Oral-Sensory stage (0–18 months)	Muscular-Anal stage (18 months–3-years)	Locomotor stage (3–6 years)	Latency stage (6–12 years)	Adolescence (12–18 years)
Trust vs mistrust	Autonomy vs shame and doubt	Initiative vs guilt	Industriousness vs inferiority	Identity cohesion vs role diffusion
The infant forms a first loving, trusting relationship with the caregiver, or develops a sense of mistrust.	Develops physical skills, walking grasping, rectal control. Child learns control and autonomy but may develop shame and doubt if external control is not stable and encouraging.	Continues to become more assertive and takes initiative socially. Child may still have too strict self control, leading to guilt feelings.	Child is willing to learn new skills. Faces the fact that cannot stay only sheltered by family. It is essential for the child at this stage to discover pleasure in being productive and the need to succeed. Child is at risk of sensing inferiority, failure and incompetence.	Child is searching for own identity. Adolescent’s experience of self identity consists of the ability to integrate to earlier identification, libido changes in puberty, talents and the possibilities given by social roles. Role diffusion becomes a threat if an adolescent is incompetent to stabilize into an occupational or other identity.

**Table 1. c) Stages of cognitive development by Jean Piaget (1986).**

Sensori-motor stage (0–2 years)	Preoperational stage (2–7 years):	Concrete operational stage (7–11 years)	Formal operational stage (11 years–)
Differentiates self from objects. Begins to act intentionally: e.g. hits a drum to make noise. Achieves object permanence: realizes that things continue to exist even though they are no longer present to the senses.	Learns to use language, represent images and words. Thinking is egocentric. Classifies objects by single feature: e.g. groups together red blocks regardless of shape.	Starts to think logically about objects and events but thinking is still quite concrete: e.g. proverbs mean what they literally state. Understands the meaning of (age 6), mass (age 7) and weight (age 9). Classifies objects according to several features.	Can think logically about abstract propositions and test hypotheses systematically. Becomes concerned with the hypothetical, the future, and ideological problems (e.g. religion).



What determines whether a child acquires a persistent fear is dependent on a variety of factors. Parental psychopathology, parenting practices (Donovan & Spence 2000, Morris & March 2004) and previous conditioning (Rachman 1976, Rachman 1991), but also genetics (Stevenson *et al.* 1992) and temperamental predisposition (Biederman *et al.* 1990) are reported to have an effect on the genesis of fears. Different fears arise at different developmental stages: for example, height-phobic (Menzies & Clarke 1993a) and water-phobic (Menzies & Clarke 1993b) adults often report always having had their fear, whereas animal and blood-injection phobics are reported to have mean age of onset of 7- and 9-years, respectively (Öst 1987). For social phobias, however, the mean age of onset is 20 years (Öst 1987).

The psychodynamic concept and cognitive model of anxiety propose different aspects that may be important for understanding fears. The term anxiety used in the literature in psychodynamic and cognitive models should not, however, be used when describing fears in young children before the age of 12, as children of that age are not able to think abstractly (Erikson 1950: 402, Piaget 1986) and are thus not able to behave in an anxious manner. The difference between anxiety and fear should be kept clearly in mind (see description in Chapter 2.1.). Hence, we use the expression dental fear in this book apart from review of the literature.

According to psychoanalytic theory (Freud 1916) anxiety is considered as a 'signal' for danger. Freud (1916) made a distinction between realistic and external dangers and unrealistic and internal dangers (see also page 25). In both situations the individual will react with anxiety; in children the propensity of unrealistic and internal dangers is greater as can be observed in children's apparent bravery in the face of real dangers e.g. putting their hand close to an open fire. Thus children's fears arise from unrealistic and internal fears such as fears of the dark and of being alone (Freud 1916). The greatest fear for young children is the fear of being abandoned and being separated from those they love i.e. their mothers. In psychoanalytic theory this is referred to separation anxiety. The younger the child the more crushing and terrifying is the separation from mother (Freud 1952, 1965).

Cognitive models of anxiety (Beck *et al.* 1985, Wells 1997) are based on the assumption that anxiety is a learned model of behaviour that is a consequence of several complex and diverse responses to the feared stimulus. Based on the theory of Piaget (1986), the ability to cope with traumatic events develops in the concrete operational stage and increases throughout childhood (Winer 1982). For example, the ability to cope with dental procedures is individual and usually

children under the age of 3 years do not yet have the ability to cope with the situation (Rud & Kiesling 1973, Alwin *et al.* 1991). Adults with anxiety may misperceive or exaggerate perceptions of fear, leading to maladaptive evocation of anxiety (Beck *et al.* 1985). They may have systematic errors in processing information, i.e. catastrophizing, thinking dichotomously or selectively abstracting. They have underlying schemas, i.e. underlying beliefs or assumptions that reflect threat or danger. These individuals have impaired ability to evaluate their threat-bound cognitions rationally and realistically. The core of anxiety disorders is the context of vulnerability: a person's perception of himself as subject to internal or external dangers over which he lacks control is lacking or is insufficient to afford him a sense of safety. The whole cognitive system plays a vital role in appraising the individual of danger and activating physiological, motivational, affective and behavioral systems. These factors function in multiple combinations to set the stage and provide the conditions for the development, onset and maintenance of anxiety. (Beck *et al.* 1985, Stein & Hollander 2002.)

In addition to the previously mentioned linear developmental theories and aspects of anxiety, there are also non-linear developmental theories. These theories are theoretical models that are focused especially on explaining developmental changes and driving forces behind development. The term dynamic systems theory is used, and here dynamic refers to seeing development as a system transition. These include cellular, social and ecological level variables. (Fogel 1993, Thelen & Smith 1994, Oyama 2000.) Dynamic theories do not focus on what core activities an infant has or what is truly organic or genetic but rather on how the parts of the system co-operate to produce stability or engender change. This concept of development is based on several systemic theories that do not predict development causal-linearly but view it more as a social, situational and relational process. Psychological processes such as learning and development operate on a system consisting of the individual and his/her environment. When one factor of the system expands or changes, the other factors of the system also change (Thelen & Fogel 1987). These are complex processes including several parts of the system. Communication plays an important role in this theory.

Dynamic systems theory could be utilized to explain the development of fears. Sroufe (1997) has proposed a developmental model of psychopathology as an outcome of non-linear development. The developmental model does not attempt to explain behaviour as merely an expression of underlying, endogenous neurophysiological differences. This means that behaviour is inseparable from its

context and the influence of an experience, a stressor or genetic variation. Protection from psychopathology is the capacity to rebound after following periods of maladaptation. This capacity evolves over time within the total context of developmental influences. It has been called resilience (Sroufe 1997). The capacity to remain organized in the face of challenge, e.g. dental treatment, is evolved by the person in interaction with the environment across successive periods of adaptation. The successful construction of resilience is based on early secure attachment and stable emotional support in the toddler stage (Sroufe *et al.* 1990). In other literature (Marks 1978, Beck *et al.* 1985), phenomena similar to resilience have been used and called coping ability. The above theories may be important for understanding the acquisition of different fears.

### **2.3 Models of dental fear acquisition**

Some models of fear acquisition that are mainly used elsewhere in the field of fear research have also been applied to dental fear. The models are used primarily to understand dental fear in adults, but children's dental fear has also been approached with different models.

Freeman (1998, 2007) applied psychodynamic theory to aid the understanding of dental anxiety and phobias in children (Freud 1916). As mentioned previously (see page 23) realistic anxiety is a rational fight, fright or flight reaction associated with an external dangerous situation. Neurotic anxiety is a response to internal danger and represents a danger to the self and since children's fears were predominantly neurotic. Freeman (2007) suggested that dental anxiety in children represented a neurotic fear. The internal dangers that children experience were associated with fears concerning loss of mother, fear of bodily harm, and helplessness which Freeman (2007) suggested were displaced or foisted onto the dental treatment situation. Thus, child dental anxiety could be thought of as a neurotic anxiety and a consequence of the threat of an internal danger based on the child's imaginings or fantasies about what might happen to them during dental treatment. Therefore, dental work could precipitate emotional reactions leading to anxiety attacks with dental instruments being perceived as objects of pain, violence and destruction (Sharma & Sharma 1976). If the child was able to cope with the intensity of anxiety stirred up by the dental treatment experience then the child despite their dental fear would be able to accept treatment. However if the child was unable to cope with the intensity of anxiety experienced then (s)he might refuse treatment, have a panic attack and/or react

with aggression towards the dentist. In this scenario the dentist would be perceived as the perpetrator of the internal danger (Freud 1952). In addition, the psychoanalytic view of dental anxiety includes concepts of ‘false connections’ or misunderstandings. ‘False connections’ are simply misunderstandings when an individual mixes-up what they have seen, heard of experience in one situation with what they have seen, heard of experience in another. The confusion occurs because the two situations have something in common: e.g. a painful innoculation injection being confused with a local anaesthetic injection. The fear of the innoculation injection is transferred or displaced onto the local anaesthetic injection. Thus the patient presents with dental anxiety associated with injections – the fear belongs not with the present local anaesthetic injection but with the experience of the painful innoculation injection. (Freeman 1998).

The cognitive model focuses in learned responses to treatment and other related factors. The cognitive model of dental anxiety is based on several assumptions. There are two major factors involved in development of dental fear: the patients’ earlier experiences of dentistry, direct and indirect, and the patients’ perceptions of whether they have or could have control over what will happen to them. The model proposes that fear and avoidance behaviour are acquired through a variety of direct and indirect experiences. These have an effect on the patient’s perception of dentistry and leave the patient with certain expectations about what will occur. Past experiences may lead him to believe that he will experience terrible things during the next visit to a dental office that are beyond his coping ability; thus, fear emerges. (Milgrom *et al.* 1995b.) Phobics may be caught in a vicious cycle where fear, pain, feelings of guilt and inferiority may prevent good oral hygiene and treatment (Berggren & Meynert 1984). This theory might also help us to understand the behaviour of children in dental settings.

Weiner and Sheehan (1990) suggested categorization of dental fear into endogenous and exogenous designs. Endogenous refers to internal personality vulnerabilities related to anxiety disorders as evidenced by multiple fears, generalized anxiety or panic disorders. Exogenous refers to direct or vicarious conditioning through traumatic experiences of a threat, such as dental treatment. The state-trait anxiety (Spielberger *et al.* 1970) division is used to describe the same type of categorization of anxiety and is based on the state-trait anxiety inventory of Spielberger *et al.* (1970). This approach has also been utilized in the dental anxiety literature (Klages *et al.* 2004). State anxiety reflects a transitory emotional state or condition of the patient characterized by subjective, consciously perceived feelings of tension and apprehension. It leads to heightened

activity of the autonomic nervous system. Trait anxiety reflects relatively stable individual differences in proneness to anxiety and refers to a general tendency to respond to perceived threats with anxiety.

### 2.3.1 Rachman's model of acquisition of dental fear

Rachman (1976, 1991) suggested that there are several pathways to the acquisition of fears. In his model, in addition to the above-mentioned direct conditioning experiences, both observational (vicarious) learning and information could lead to fear. Although Rachman believed that clinical fears would be the likely result of direct conditioning experiences, less intense fears could still emerge from vicarious learning episodes and exposure to negative information (the indirect pathways). There is considerable evidence that vicarious learning is a viable way of acquiring fears (Bandura 1969, Öst 1987, Menzies & Clarke 1993b, Field *et al.* 2001, Field & Lawson 2003). Table 2 presents the three pathways leading to acquisition of fear suggested by Rachman (1991).

**Table 2. The three pathways leading to fear suggested by Rachman (1976, 1991).**

Pathway	Direct conditioning	Vicarious learning	Informational pathway
Explanation	Negative experience may cause fear through classical conditioning i.e. an unconditioned stimulus may cause conditioned response (fear).	Fears may be acquired through observation of parents.	Information from the environment may cause fear in some individuals.
An example of dental fear	A painful experience of dental treatment, such as drilling without local anaesthesia.	Observation of parents fearful behaviour during dental treatment.	Negative information on dental treatment from media, peers or parents.

Traditionally in the dental literature, Rachman's model of fear acquisition (Rachman 1976, 1991) is most often used to explain the acquisition of dental fear in children, and it covers some of the aspects mentioned in the previous models (Davey 1989, Murray *et al.* 1989, Milgrom *et al.* 1995a, Milgrom *et al.* 1995b, Berggren *et al.* 1997, Locker *et al.* 1999, Townend *et al.* 2000, Locker *et al.* 2001a–b, Poulton *et al.* 2001, ten Berge *et al.* 2002a, Karjalainen *et al.* 2003, Milsom *et al.* 2003, van Meurs *et al.* 2005).

### *Direct conditioning*

Dental fear and several other prevalent specific fears of children differ in the presence of an actual threat of bodily injury and the pain the child may experience during dental treatment. Several other fears, such as social phobia, exist without such component. The role of direct conditioning in the acquisition of dental fear is well established (Öst & Hugdahl 1985, Davey 1989, Klingberg *et al.* 1995a–b, Milgrom *et al.* 1995a, Locker *et al.* 1996, Berggren *et al.* 1997, Poulton *et al.* 1997, Kruger *et al.* 1998, Locker *et al.* 1999, Townend *et al.* 2000, Locker *et al.* 2001a, ten Berge *et al.* 2002a, Raadal *et al.* 2002, Karjalainen *et al.* 2003, Milsom *et al.* 2003). Several studies have found that children with signs of caries experience (measured with the DMFT index) are more anxious than those without such experience (Klingberg *et al.* 1995a, Locker *et al.* 1996, Kruger *et al.* 1998, Locker *et al.* 1999, Raadal *et al.* 2002). However, poor dental health at the age of 5 was not found to be associated with dental anxiety at the age of 18 (Poulton *et al.* 1997), but caries experience at the age of 15 was related to dental anxiety at the age of 18 (Poulton *et al.* 1997). The investigators suggested that poor oral health during middle childhood and early adolescence was related to the onset of dental fear in the age of 18. Few studies have reported a relationship between children's dental fear and the treatment procedures they have experienced (ten Berge *et al.* 2002a, Karjalainen *et al.* 2003, Milsom *et al.* 2003). In these studies, extractions were associated with increased dental anxiety; but no such relationship was found for fillings (ten Berge *et al.* 2002a, Karjalainen *et al.* 2003, Milsom *et al.* 2003). In addition, Townend *et al.* (2000) found that 7- to 10-year-old children with missing teeth were more anxious than were children of the same age without missing teeth. However, less consistent findings regarding the role of direct conditioning in the acquisition of dental fear have also been suggested (Murray *et al.* 1989, Klingberg *et al.* 1995b, Milgrom *et al.* 1995a, Townend *et al.* 2000). Klingberg *et al.* (1994a) found that children with behaviour management problems had fewer filled surfaces than did children without behaviour management problems. In a longitudinal study of dental fear from 9 to 12-year olds, the increase in dental anxiety was more common in children who had not received invasive treatment than in those who had. The invasive treatment was suggested to act as a prophylactic for acquisition of dental fear. (Murray *et al.* 1989.)

The first negative dental experiences have been reported to affect on dental fear later in life (Alwin *et al.* 1991, Milgrom *et al.* 1995a, Liddell & Gosse 1998,

Townend *et al.* 2000). The content of negative experiences contributed more to the etiology of dental fear than did the age when the experiences occurred (Locker *et al.* 1996). However, experiences of dental treatment early in life have been found to be especially important. Townend *et al.* (2000) found that children with dental fear had encountered their first traumatic experience earlier in life than non-fearful children had. Those children who had had teeth extracted at a young age were more fearful later in life than those who had not had extractions (Townend *et al.* 2000). Alwin *et al.* (1991) studied children referred to a specialist because of poor cooperation and revealed that 23% of the children had had an unpleasant first dental visit while the corresponding percentage for children in the control group was 10%.

Not only first dental experiences have an impact on the age of onset and direct conditioning of dental fear. Davey (1989) modified the explanation for acquisition of fear through classical conditioning with a phenomenon called latent inhibition theory in dental phobics. Those subjects who reported painful dental experience but did not acquire dental anxiety reported a favourable history of dental treatment prior to the investigation. The anxious subjects had received two or more painful experiences compared to those subjects who had once been anxious but now relaxed about dental treatment. In those subjects who have had negative experiences, but not many, the conditioned response to fear might have been retarded or even prevented. (Davey 1989.) Similarly, younger anxious children with unpleasant treatment may have had fewer positive visits to the dentist prior to their first unpleasant treatment visit than older children did, thus it has been suggested that invasive treatment should be postponed, if possible, until the child is ready to cope with the treatment situation (Townend *et al.* 2000). Later, the latent inhibition theory has received support (de Jongh *et al.* 1995a, ten Berge *et al.* 2002a). This theory might also have an effect on the acquisition and age of onset of dental anxiety.

### *Indirect conditioning*

A strong evidence points to the importance of indirect factors in the acquisition of dental fear. Several associations have been found between dental fear and indirect factors. Many studies have supported a positive relationship between the dental fear of a child and his/her family members that may be due to indirect learning (Tuutti & Lahti 1987, Lahti *et al.* 1989, Klingberg *et al.* 1992, Milgrom *et al.* 1994, Kinirons & McCabe 1995, Townend *et al.* 2000, Arnrup *et al.* 2002, ten

Berge *et al.* 2002a). Maternal anxiety has been reported to be associated with a young child's behaviour already during the first dental visit (Wright *et al.* 1973). Oral health status and dietary habits (Arnrup *et al.* 2002) as well as factors related to the child's family have also been reported to be associated with child's dental fear (Tuutti & Lahti 1987, Lahti *et al.* 1989, Klingberg *et al.* 1992, Kinirons & McCabe 1995, Kinirons & Stewart 1998, Kruger *et al.* 1998, Arnrup *et al.* 2002, Colares & Richman 2002). Children with high caries occurrence (Tuutti & Lahti 1987, Klingberg *et al.* 1992) and poorer dental attendance (Kinirons & McCabe 1995) compared to controls have been found to have more often a parent with dental fear or anxiety. The direction and strength of the association between guardian's socio-economic status, child's dental fear or dental anxiety, and dental status have differed in different studies (Lahti *et al.* 1989, Milgrom *et al.* 1995a, Arnrup *et al.* 2002).

Parents of uncooperative child dental patients have been shown to differ from the parents of cooperative children in terms of attitudinal aspects, i.e. having poorer dental knowledge and taking more responsibility for their children in relation to dental care (Arnrup *et al.* 2002). In addition, the behaviour of mothers of fearful children during a dental visit have been found to differ from that of parents of fearless children. Often the parents of fearful children visibly withdraw from the ongoing dental investigation (turning away from the child and the dentist), while at other times they would participate more (by gesturing empathetically to their offspring or by volunteering explanations about dental procedures) (Townend *et al.* 2000). Accordingly, the parents have an influence on the communication between dentist and child during dental treatment: more fearful children are more likely than less fearful children to have had experiences of disturbed communication between dentist, child and parent (Klaassen *et al.* 2007).

Multivariable analyses that include both indirect and direct components have been utilized in only a few studies reported in the literature. Compared to direct experiences, the contribution of indirect conditioning and other pathways has been suggested to be minor (Milsom *et al.* 2003), whereas other researchers have suggested that direct and indirect experiences are equally important (Murray *et al.* 1989, Milgrom *et al.* 1995a, ten Berge *et al.* 2002a). In two studies, family characteristics were included in multivariable analyses together with treatment experiences (ten Berge *et al.* 2002a, Milsom *et al.* 2003), and the results indicated that parental anxiety also contributed to children's dental fear. The former study covered a single age group (Milsom *et al.* 2003), while the latter used pooled



samples with a wide age range without reporting age-specific results (ten Berge *et al.* 2002a). Although several studies have found a positive relationship between child's and parent's dental fear, not all have found the association to be the main reason for a child's dental fear (Corkey & Freeman 1994, Majstorovic *et al.* 2001, Milsom *et al.* 2003). Instead, parental dental fear may colour the child's ability to cope with dental treatment (Milsom *et al.* 2003, Klingberg *et al.* 1995b). It has been suggested that the functionality of the family and the ability of the parents to form positive, consistent and nurturing interactions with their children is essential for the child's ability to cope with dental treatment (Versloot *et al.* 2004, de Oliveira *et al.* 2006, Freeman 2007).

Vicarious learning of dental fear may occur not only through observation and information about the behaviour of the child's family members but also via the media (Milgrom *et al.* 1995b). They note that cartoons in newspapers and magazines are often filled with characterizations of dentists as inflictors of torture. Child may see this as a warning: "If you go to the dentist, you can expect to be hurt" (Milgrom *et al.* 1995b). However, this has not been examined in scientific studies.

Taken together, indirect conditioning has been found to be an important contributor to dental fear, but the contributions of direct and indirect factors differ in different studies.

## **2.4 Determinants of dental fear**

The previously mentioned models have often been used to help us understand acquisition of dental fear. In addition, several other determinants have been thought to be associated with dental fear.

### **2.4.1 Gender**

Results on gender differences in dental fear are controversial. Some studies have found no gender differences in children's and adolescent's dental fear (Locker *et al.* 2001c, Majstorovic *et al.* 2003, van Meurs *et al.* 2005). However, several studies report that girls are more fearful (Holst & Crossner 1987, Liddell 1990, Bedi *et al.* 1992, Alvesalo *et al.* 1993b, Milgrom *et al.* 1994, Milgrom *et al.* 1995a, Raadal *et al.* 1995, ten Berge *et al.* 2002b, Versloot *et al.* 2004, Majstorovic & Veerkamp 2005, Klingberg & Broberg 2007). These results seem to differ according to the age of the children. In younger age groups, no

significant gender effect has been found (Holst & Crossner 1987, Neverlien 1994). However, more dental fear has been found in adolescent girls than in boys of the same age (Holst & Crossner 1987, Bedi *et al.* 1992, Neverlien 1994). In a longitudinal study (Murray *et al.* 1989), self-efficacy, fear of danger and death, and the number of dentists visited were found to be predictors of dental anxiety for boys. For girls, dental anxiety three years before, peer ratings and medical fears were found to be predictors of dental anxiety. It has been suggested that boys with dental anxiety may be more responsive to stress in their environment, while girls' dental anxiety could be more internally mediated (Liddell 1990). These results suggest that dental fear and factors associated with it differ between boys and girls.

### **2.4.2 Psychopathology and psychosocial factors**

Personality traits have been found to differ in children with and without dental fear, which has been found to be positively related to temperamental factors such as general fearfulness, lowered self-esteem, shyness, negative emotionality, pessimism and weaker attention span (Venham *et al.* 1979b, Murray *et al.* 1989, Alwin *et al.* 1991, Neverlien *et al.* 1991, Klingberg *et al.* 1994b, Klingberg *et al.* 1995b, Milgrom *et al.* 1995a, Klingberg & Broberg 1998, ten Berge *et al.* 1999, Cinar & Murtomaa 2007). Children with dental fear have also been reported to have less persistence than those without dental fear (Alwin *et al.* 1991). Among Norwegian children, optimism-pessimism was found to contribute to clinical dental anxiety (Neverlien *et al.* 1991); however, in a 5-year follow-up dental anxiety had only a weak negative effect on optimistic disposition (Neverlien 1994). Despite the above findings, no significant associations were found between dental anxiety and behaviour, for example social problems or withdrawal (Raadal *et al.* 1995).

Everyday life events have also been found to be associated with co-operation during dental treatment. Gustafsson *et al.* (2007) studied child patients referred because of dental behaviour management problems. Compared to the reference group, the study subjects more often lived in families with low socioeconomic status, had parents not living together, participated in fewer leisure-time activities, and were assessed as doing worse in social interactions. Although, the concepts of dental behaviour management problems and dental fear are not synonymous, the above findings should be taken into consideration when we deal with dental fear. This is supported by studies among adults: dental fear has been shown to have an

impact on psychosocial consequences, i.e. more psychological reactions, more avoidance/inhibition (Berggren & Meynert 1984, Locker *et al.* 2003). Moreover, a recent finding suggests that children's dental fear has a negative effect on their oral-health-related quality of life, especially social and emotional well-being (Luoto *et al.* 2008).

Similarly to studies conducted with children, adults with dental anxiety have been shown to be more likely than dentally non-anxious to have a psychiatric diagnosis, e.g. conduct disorder, agoraphobia, social phobia, simple phobia and depression (Berggren *et al.* 1992, Roy-Burne *et al.* 1994, Eli *et al.* 1997, Locker *et al.* 2001a–b), as well as other personality traits such as interpersonal sensitivity and substance abuse (Roy-Byrne *et al.* 1994, Eli *et al.* 1997, Locker *et al.* 2001b).

### **2.4.3 Sensitivity and experience of pain**

Children's experiences and expectations of pain during dental care have been shown to be more common among subjects with dental fear (Alwin *et al.* 1991, Versloot *et al.* 2004). It has been suggested that rather than being due to invasive procedures, children's subjective perception of treatment might be decisive in acquisition of dental fear (Townend *et al.* 2000, ten Berge *et al.* 2002a). However, a multidimensional aspect suggesting pain to be as much a cognitive and emotional as a physiological experience has been proposed (Maggirias & Locker 2002).

Children use a variety of coping strategies for managing pain during dental treatment; and their coping skills seem to vary according to age and level of dental anxiety (van Meurs *et al.* 2005). It has been suggested that children with dental fear lack personal resources for managing pain and are dependent on parents and professional staff to teach and enhance their coping skills (Versloot *et al.* 2004).

Among adults, the relationship between sensitivity to pain, fear of pain and dental anxiety has been shown to be associated with dental anxiety (Maggirias & Locker 2002, van Wijk & Hoogstraten 2003, Klages *et al.* 2004, Klages *et al.* 2006). Other psychopathological factors have also been suggested to have an effect on sensitivity to pain (ten Berge *et al.* 2002a, Maggirias & Locker 2002, Klages *et al.* 2006). In a recent study, adults who expected more pain before restorative treatment were more anxious than non-anxious subjects, and anxious subjects also experienced more pain during treatment than non-anxious subjects

did. Adults who are sensitive to anxiety have been suggested to be prone to exaggerate their expectations of pain. (Klages *et al.* 2006.)

#### **2.4.4 Age and development**

The prevalence of children's dental fear has been shown to differ between 6 and 56% depending on the age but also on culture and time of the study (Tuutti 1986, Murray *et al.* 1989, Alvesalo *et al.* 1993a–b, Milgrom *et al.* 1994, Klingberg *et al.* 1995b, Milgrom *et al.* 1995a, Locker *et al.* 2001c, ten Berge *et al.* 2002b, Wogelius *et al.* 2003, Baier *et al.* 2004, Versloot *et al.* 2004, Majstorovic & Veerkamp 2005, Klingberg & Broberg 2007). In 1977, of the 7- to 10-year-old children in Finland, 56% were reported to be quite or very afraid of the dentist (Tuutti 1986). In 1991, among 10- to 14-year-old Finnish children the figure was 30% (Alvesalo *et al.* 1993a–b). In 2004, mean value of 7.4 from MDAS was found in 10- to 12-year-old Finnish children (Cinar & Murtomaa 2007). In studies conducted in 1985 and in 1991 in Finland, drilling and local anaesthesia were reported to be the most frightening procedures (Tuutti 1986, Alvesalo *et al.* 1993a). In several cross-sectional studies the prevalence of children's dental fear has been suggested to be lower among older children than among younger ones (Holst & Crossner 1987, Klingberg *et al.* 1994b, Klingberg *et al.* 1995b, Milgrom *et al.* 1995a, Raadal *et al.* 1995, Majstorovic & Veerkamp 2005, Klingberg & Broberg 2007), although controversial results have been found, which indicate that the prevalence is higher with an increasing age (Murray *et al.* 1989) or that fear does not differ in different age groups (ten Berge *et al.* 2002a–b).

Despite many studies on the prevalence of dental fear, the age of onset and factors related to it have received less attention (Locker *et al.* 1999, Locker *et al.* 2001b, Poulton *et al.* 2001). In a longitudinal birth cohort up to the age of 26 years, one third of the study subjects first experienced dental anxiety during childhood or early adolescence, one third during late adolescence and one third during early adulthood (Locker *et al.* 2001c). Direct and indirect experiences, as well as having a vulnerable personality (Locker *et al.* 1999, Poulton *et al.* 2001) have been found to differ in importance for the acquisition of dental anxiety in childhood and adolescence. The following factors have been reported to predict childhood onset of dental anxiety: frightening, painful and embarrassing dental experiences, and family history of dental anxiety (Locker *et al.* 1996). Among child and adolescent patients, the importance of psychopathological factors has been underlined together with conditioning as contributors in the development of

dental anxiety (Poulton *et al.* 2001). A similar trend has been observed in young adults (Poulton 2001, Locker *et al.* 2001b). In the same longitudinal data, dental fear was rarely a persistent problem among young adults but more fluctuating with recurrent and remitting periods (Locker 2001c).

The developmental stage of a child has been suggested to have an additional mediating role on the development of dental fear (Venham *et al.* 1979b, Murray *et al.* 1989, ten Berge *et al.* 2002a–b, Folayan *et al.* 2004). Younger children in the pre-operative period, usually between the ages of 2 and 4, do not necessarily have the ability to cope with dental treatment (Piaget 1986, Rud & Kiesling 1973, Alwin *et al.* 1991, Folayan *et al.* 2004), thus, they might be more prone to acquisition of problems in behaviour management during a dental visit. At this pre-operative stage (Piaget 1986), the child can only focus on the perceptual dimension and finds it hard to comprehend the differences between similar situations. For example, a child who was once hurt by the prick of a needle would find it difficult to understand that dental needle is different and that the method of application may not hurt (Folayan *et al.* 2004). At this stage the perceptual illusions are believed to be predominant over logical reasoning (Piaget 1986). Naturally, the developmental stage varies individually among children. Venham *et al.* (1979b) found that relatively delayed social and language development correlated with anxious response to a dental visit during the pre-operative period.

When children reach the concrete operational stage (Piaget 1986), they are able to reason logically and also co-operate in the dental chair (Folayan *et al.* 2004). Later in childhood, children move into the formal operational stage. At this stage of cognitive development, children are able to develop more cognitive abilities and different coping styles, thus, possibly affecting their perception of dental treatment and development of fear (Winer 1982, Kent 1985b, ten Berge *et al.* 2002a). At this time, children may be able to comprehend differences between treatment phases; and more sophisticated cognitive abilities may make them more sensitive, for example, to worrying about the dentist's competence (Kleinknecht *et al.* 1973, Winer 1982, ten Berge *et al.* 2002a)

#### **2.4.5 Aspects of dental fear**

Children's dental fear has been measured with verbal (questionnaires, such as CFSS-DS (Cuthbert & Melamed 1982) and DAS (Corah 1969), and interviews) and non-verbal (e.g. Frankl scale (Frankl *et al.* 1962), the dentist's perception) measures. The problem in different measures of dental fear is that they not only

do not reveal the same subjects as being anxious but also measure different types of dental fear (Schuurs & Hoogstraten 1993, Locker *et al.* 1996, Aartman *et al.* 1998). When measures of dental fear for children (Aartman *et al.* 1998), adolescents and adults (Schuurs & Hoogstraten 1993) have been compared in review articles, each questionnaire has been shown to have its own limitations. Although some dental fear questionnaires have been shown to have moderate correlations with each other (Schuurs & Hoogstraten 1993, Aartman *et al.* 1998), it should be borne in mind that one measure of dental fear may capture, for example, the aspect of state anxiety more while another measure emphasizes the aspect of trait anxiety (Aartman *et al.* 1998). Earlier studies suggest that dental fear should be studied with more than one measure (Locker *et al.* 1996, Schuurs & Hoogstraten 1993). However, a balance has to be achieved between using multiple measures and the burden caused to the respondents.

The Dental Subscale of the Children's Fear Survey Schedule (CFSS-DS), which is one commonly used measure of dental fear among children (Cuthbert & Melamed 1982, Alvesalo *et al.* 1993b, Milgrom *et al.* 1994, Milgrom *et al.* 1995a, de Jongh *et al.* 1995a, Klingberg *et al.* 1995a–b, ten Berge *et al.* 1998, Klingberg & Broberg 1998, ten Berge *et al.* 2002a–c, Majstorovic *et al.* 2003, Majstorovic & Veerkamp 2005, Nakai *et al.* 2005), is presented in Appendix 1. The CFSS-DS contains 15 items of different aspects of dental fear and has been shown to be reliable and have moderate validity (Aartman *et al.* 1998). It is the only questionnaire so far for which there are normative data from several countries (Cuthbert & Melamed 1982, Alvesalo *et al.* 1993b, Klingberg *et al.* 1994b, Milgrom *et al.* 1994, Nakai *et al.* 2005).

In studies that have explored the construct of CFSS-DS (Alvesalo *et al.* 1993b, Milgrom *et al.* 1994, ten Berge *et al.* 1998, ten Berge *et al.* 2002c, Nakai *et al.* 2005), factors related to highly invasive procedures, less invasive aspects of dental treatment and victimization have been revealed among 3–13-year-olds. Correlations between the total dental score of CFSS-DS and other measures of dental fear have been studied (Klorman 1978, Klingberg *et al.* 1995a, Aartman *et al.* 1998, Majstorovic *et al.* 2003); and the relationships with other measures have, although significant, been found to be weak to moderate. (Aartman *et al.* 1998). However, correlations between subscales of CFSS-DS obtained by factor analyses and other measures of dental fear have not been studied previously.

## **2.5 Implications of previous research for the present study**

In the dental literature, several models have been used to describe acquisition of dental fear. Dental fear is commonly suggested to be multifactorial and multidimensional, consisting of behavioural, physiological and cognitive components (Shoben & Borland 1954, Freeman 1985, Davey 1989, Murray *et al.* 1989, Milgrom *et al.* 1995a, Locker *et al.* 1996, Aartman *et al.* 1998, Kruger *et al.* 1998, Locker *et al.* 1999, Townend *et al.* 2000, ten Berge *et al.* 2002a, Raadal *et al.* 2002, Karjalainen *et al.* 2003, Milsom *et al.* 2003).

Although dental fear is a much studied and prevalent phenomenon, the acquisition and characteristics of dental fear are still not well understood, especially in children. In some studies dental fear has been compared among different ages, developmental stages and according to different developmental theories (Winer 1982, Kent 1985b, Folayan *et al.* 2004, Freeman 2007). Although the measures of fear in children have been able to capture different aspects of dental fear, the different aspects have not been taken into account in analyses of dental fear at different ages. In addition, in a one-sided approach, many studies have used Rachman's multidimensional pathway to explain dental fear. Developmental theories have seldom been utilised. Clearly, the role of direct conditioning in the acquisition of dental fear is well-established. Still, other factors, such as different fears related to dental treatment situation, are not well understood in children of different ages. There are few studies where factors related to dental fear at different ages have been compared using a representative sample. These findings point to the examination of how different aspects of dental fear in children differ at different ages in a normal child population and whether possible differences in children's dental fear at different ages could be better understood by taking developmental theories into account.





### **3 Aims**

The overall aim of this work was to deepen and strengthen understanding of children's dental fear. Further aims were to explore different aspects of dental fear and their determinants among children at different ages.

The specific objectives were to examine in children at different ages:

1. the construct of modified CFSS-DS and its reliability
2. the occurrence of different aspects of dental fear and correlations among them
3. the determinants of different aspects of dental fear.



## 4 Material and methods

### 4.1 Study population

#### 4.1.1 Finnish study population

The current studies (Papers II–IV) were part of a larger study project that examined the occurrence and distribution of dental caries (Seppä *et al.* 2000). The subjects were 3-, 6-, 9-, 12- and 15-year-olds in two middle-sized Finnish cities (Jyväskylä and Kuopio) in 1998. These cities are situated less than 150 kilometers apart, are of fairly equal size, and are similar with regard to distribution of sources of livelihood (Statistical yearbook of Finland 1998). The sizes of the original independent random samples in both cities were 180 for each age group. All study subjects were examined both clinically and radiographically. During the clinical examination, they received a questionnaire that included questions related to dental fear, oral health habits and social background. Written consent from the parents was obligatory for participation in the study. Subjects who did not reply to the questionnaire (Papers II–IV), whose clinical examination data were missing (Paper IV) or who did not have written consent were excluded from the study. The total inclusion rates were 80%,  $n = 1157$  (Paper IV), 82%,  $n = 1474$ , including 3-year-olds (Paper II) and 83%,  $n = 1212$  (Paper III). The numbers of respondents and the response rates in Paper II are presented in Table 3. Experience of earlier treatment was assessed with dmfs/DMFS (Paper II), with previous treatment procedures (Paper IV) or not assessed at all (Paper III). Therefore, the inclusion rates differed between studies. Of the subjects, 51% were girls and 49% were boys. At different ages the percentage of girls varied from 49 to 52%.

**Table 3. Numbers of respondents and response rates among each age group in Jyväskylä and in Kuopio in Paper II. From both cities the total number of subjects in the samples was 180 per age group.**

City	3-year-olds		6-year-olds		9-year-olds		12-year-olds		15-year-olds	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Jyväskylä	142	79	148	82	142	79	148	82	142	79
Kuopio	147	82	152	84	154	86	152	84	147	82
Total	289	80	300	83	296	82	300	83	289	80

### **4.1.2 Italian study population**

The study sample consisted of 3 to 13-year-old children from the Veneto region of Northern Italy in 1999–2000 (Paper I). In Italy, it was difficult to obtain a random sample. Thus, the objective was to collect a convenience sample of children, aiming at 100 consecutive children from each location where both public and private service were represented in rural and urban areas. Three different study locations were selected: Dental Clinic of the University of Verona (Public 1, urban), Dental Clinic of Cittadella Hospital (Public 2, rural) and a clinic operated by a pediatric dentist in Verona (Private, urban). As Italian children are not routinely invited to check-ups, but seek care mainly depending on need, the first dental visit is not scheduled at a certain age. Thus, we also included older children in the study. All child patients attending the clinics were invited to participate. The data were collected with the help of local Italian dentists, and the author recorded the data on a computer (Study I). Data collection started in July 1999 and was completed by the end of the year 2000. By that time, 378 participants had volunteered and three children under 3 years of age were excluded. The distribution of the children according to the study sites and age groups is presented in Table 4.

**Table 4. Distribution of children in Paper I according to study site and age group (%).**

Age group (years)	Public1, urban (n = 143) %	Private, urban (n = 121) %	Public 2, rural (n = 105) %	Total (n = 369) %
3–5	29	31	23	28
6–9	30	33	55	38
10–12	25	16	17	20
13 or more	15	20	5	14
Total	39	33	28	100

## **4.2 Questionnaires, clinical examination and treatment records**

### **4.2.1 Finnish study population**

During the clinical examination each child received a questionnaire to be filled out at home with the help of parents, if needed. This questionnaire consisted of questions on dental fear, oral hygiene habits and social background. Eight

questions related to dental fear were taken from the Finnish version of the Dental Fear Survey Schedule (DFSS-C), also known as CFSS-DS. These included questions on fear of keeping the mouth open, the dentist, teeth being cleaned by a dentist or nurse, drilling, local anaesthesia, hearing the sound of drilling, being unable to breath, and instruments put in the mouth. In addition, questions on fear of suction used in the mouth, fear of dental treatment causing pain and fear of dental treatment in general were included. Dental fear of family members was asked with the following question “There might be members in your family who have dental fear. Please, estimate how much each of the following is afraid of dentistry: mother, father, sibling, other – who”. Likert-scale with five reply alternatives 1 = ‘not afraid’, 2 = ‘a little afraid’, 3 = ‘afraid to some degree’, 4 = ‘quite afraid’ or 5 = ‘very afraid’ was used for each of the fear-related questions. The questionnaire is presented in Finnish in Appendix 2 and called the modified CFSS-DS.

Oral hygiene habits were included in the questionnaire with several multiple choice questions. Sugar consumption, tooth brushing habits and appointed candy day were selected for the study (Papers II and IV) because they were considered to be indicators of family characteristics and related to dental fear. In addition, mother’s and father’s levels of education were included in the study (Papers II and IV), as these have been shown to be related to dental fear (Lahti *et al.* 1989, Milgrom *et al.* 1995a, Arnrup *et al.* 2002).

All data concerning dental treatment procedures during the three years preceding the examination were collected from patient records. In addition, clinical and radiographic examinations were performed for the study subjects by two calibrated dentists (Papers II and IV). The inter-examiner kappa value was 0.77 (Seppä *et al.* 2000). In Papers II-IV, among respondents eligible for the analyses (Papers II-IV), on average, 20% and 6% of the item-specific values were missing or in most cases marked as 6 = no experience of the matter for fear related and other items, for dependent and independent variables respectively. Before the analyses reported in Papers II-IV, the children who did not answer the fear-related questions or did not have experience of such a fear were considered not to be anxious, and their responses were coded as 1. This was done because missing replies were considered to represent a case where the child either had no experiences or no fear-related behaviour had been observed by the parents in these situations.

In addition, a variable ‘Peak value for dental fear’ was formed to describe the highest value the individual child had on the 11 fear questions, and this was used

as a clinically relevant indicator that the child is (quite or very) afraid of something in dental treatment and might thus show fear-related behaviour.

#### **4.2.2 Among Italian children**

The parents of the participants were asked to fill out a questionnaire that was distributed on their arrival to the dental clinic (Paper I). The questionnaire contained eight questions with multiple choice answers and open-ended questions. It was translated to Italian from an English version (Appendix 3) by native Italian dentists and an English native health professional who was thoroughly fluent in both languages. Child's and parental dental fear were measured with single questions: "Is your child afraid of dentist", "Are you afraid of dentist?". Five-point Likert-scale reply alternatives from 'not afraid' to 'afraid very much' were used. The number of previous dental visits for the child was recorded as none, once, 2–3 times, 4–5 times and 6 times or more. Occurrence of problems during first dental visit was asked by "yes" or "no" reply alternatives and the types of problems were asked in an open-ended question. The child's age was recorded as 3–5 years, 6–9 years, 10–12 years, or 13 years or more.

In Paper I there were only a few ( $n = 0$  to 5) missing values for each item included in the analyses.

### **4.3 Statistical analyses**

#### **4.3.1 Construct of modified CFSS-DS and its reliability**

Among each age group, explorative factor analysis with varimax rotation was performed on the 10 fear-related items, but excluding the question on fear of dental treatment in general (Paper III). Factors were extracted using principal component analysis with an eigenvalue of one as the cut-off point. Reliability of the questionnaire and the factor solutions in terms of internal consistency were studied separately for each age with Cronbach's alpha (Cronbach 1951).

Instead of using factor scores for further age-specific analyses, we calculated summary values for items that loaded higher than 0.5 for each factor. Two factors were revealed from the factor analysis for each age group and were called 'Treatment of dental decay' and 'Attending dentist'. Summary values were calculated separately for each factor, i.e. values for items loading high on the

factor were summed. Then the means of the summary values were calculated separately for both factors, which made the further analyses easier to interpret.

#### ***4.3.2 Occurrence of different aspects of dental fear and correlations between them***

For 11 items, the occurrence of dental fear was measured separately for each age group and was expressed as percentages of children who reported being quite or very afraid and also as percentages of children who reported being afraid to some degree, quite or very afraid (Paper II).

The mean values for individual fear-related questions, 'Peak value for dental fear', 'Fear of dental treatment in general' and summary mean values of factors 'Treatment of dental decay' and 'Attending dentist', were calculated separately for each age group. The differences between age groups were tested with analyses of variance (significant at  $p < 0.05$  level) separately for each fear-related item and the above-mentioned four aspects of dental fear (Paper III).

For each age, Pearson's correlation coefficients were used to compare the summary values for factors 'Treatment of dental decay' and 'Attending dentist' with 'Peak value for dental fear' and 'Fear of dental treatment in general'.

#### ***4.3.3 Determinants of different aspects of dental fear***

Spearman's correlation coefficients were used to study bivariate associations between different treatment procedures and different aspects of dental fear, i.e. 'Peak value for dental fear', 'Fear of dental treatment in general', 'Treatment of dental decay' and 'Attending dentist' (Paper IV). The numbers of different treatment procedures were rather small, and many of them did not correlate with any measure of dental fear i.e. orthodontic treatments, surgical procedures, preventive procedures. The number of fillings, extractions, pulpal treatments and local anaesthesia correlated with some of the measured aspects of dental fear and were summarized into one variable 'Treatment procedures'. Associations between 'Treatment procedures' and different aspects of dental fear were tested with analysis of variance (significant at  $p < 0.05$  level) separately for different ages.

Exploratory multivariable logistic regression modelling was used in Papers I, II and IV to analyse the determinants of dental fear separately for each age (Papers II and IV). Among the available candidates for independent variables the ones were chosen that, based on previous studies, were related to children's dental

fear. A summary of the variables and their codings in different papers is presented in Table 5.

**Table 5. Summary of the variables and their codings used in different papers (represented as Roman numerals I–IV).**

Variables	Used as a dependent variable	Used as an independent variable
<b>Dental fear</b>		
Fear of dentist: (not afraid – afraid to some degree = 0, quite or very much afraid = 1)	I	
Peak value for dental fear: (not afraid – afraid to some degree = 0, quite or very afraid = 1)	II, IV	
Fear of dental treatment in general: (not afraid or little afraid = 0, afraid to some degree, quite or very afraid = 1)	IV	
'Treatment of dental decay' : (mean values 1.00–1.99 = 0, and mean values 2.00–5.00 = 1)	IV	
'Attending dentist' : (mean values 1.00–1.99 = 0, and mean values 2.00–5.00 = 1)	IV	
<b>Gender</b>		II, IV
Child's age (0 = 3–9 years, 1 = 10+ years)		I
City of residence (Kuopio = 0, Jyväskylä = 1)		II
Sector of obtained treatment (Public = 0, Private = 1)		I
<b>Family determinants</b>		
Limitation for eating candy only one day per week (limitation = 0, no limitation = 1)		II, IV
Child's tooth brushing frequency (twice a day or more often = 0, once a day or less often = 1)		II, IV
Frequency in the intake of sugar items (used less than once a day = 0, used daily = 1)		II
Family members' dental fear was included (not afraid – afraid to some degree = 0, quite or very afraid = 1) separately for mother, father and sibling separately		I*, II, IV
Basic education (lower than secondary school = 0, secondary school or higher = 1) for mother and father separately		II
Basic education: (parents' combined education, high = 0, parents' combined education, lowest quartile = 1)		IV
<b>Dental experiences</b>		
Experiences on invasive treatment procedures (none = 0, at least one = 1).		IV
Caries experience (dmfs/DMFS < 1 = 0, dmfs/DMFS ≥ 1 = 1)		II
Problems with the first dental visit (0 = no, 1 = yes)		I
Number of previous dental visits (0 = 0–3 visits, 1 = 4 or more visits)		I

\* Family member's dental fear was counted only for the parent who accompanied the child to the dental clinic (Paper I).



The initial models were full models that included all independent variables and their first-order interactions. The method of manual backward elimination was used to exclude all interaction terms for which the regression coefficients did not reach statistical significance ( $p < 0.05$ ). After elimination of non-significant interaction terms, the main effects that did not reach statistical significance ( $p < 0.05$ ) or were not part of a significant interaction term were eliminated manually, resulting in a model that was parsimonious and fit sufficiently well (Papers I and II). In Paper IV all interaction terms for which the regression coefficients did not reach statistical significance ( $p < 0.02$ ) were excluded. After the elimination of non-significant interaction terms, the elimination was similar to that in Paper II. The independent variables in Paper IV were the same as in Paper II with the following exceptions: because caries experience (dmfs/DMFS) correlated strongly with number of treatment procedures, to avoid problems caused by collinearity, it was excluded from the analyses (Tu *et al.* 2004). In addition, education of the mother and father were combined into one variable. The city of residence and daily intake of sugary items were examined in the analyses reported in Paper II and were excluded from the analyses in Paper IV.

In all studies (Papers I–IV) the statistical analyses were executed with the current versions of the Statistical Package for the Social Sciences (SPSS) for Windows and the Statistical Analyses System (SAS) for calculating 95% confidence intervals for the odds ratios in logistic regression analyses.

#### **4.4 Ethical considerations**

Participation in the studies was voluntary in both Italy and Finland, and parental consent was obtained for each child's participation. The personal identity numbers and dental history from the preceding three years were collected for the study of Finnish children (Papers II–IV), which was approved by the Ethics committee of the University of Kuopio (Appendix 4).

In the Italian study the identity of the children was not known. Personal identity numbers, dental data or other information that could help in identifying study subjects were not included in the Italian study data (Paper I). The children were not exposed to any pain or danger due to participation in the study. The study was approved by Professor Nicoletta Zerman from the University of Verona and Chief Surgeon Roberto Ferro from Cittadella Hospital Dental Clinic, both of whom participated in the data collection.



## 5 Results

### 5.1 Construct of the modified CFSS-DS and its reliability

From the 10 fear-related items, two factor structures were revealed with explorative factor analyses for children of different ages. Tables of the results are presented in the original article (Paper III). The first factor was called ‘Treatment of dental decay’ because items loading high on that factor included mainly situations related to invasive treatment of decay, for example, drilling, hearing the sound of drilling, local anaesthesia and pain. The second factor was called ‘Attending dentist’ as the high loading items described less invasive situations related to dental visits in general, for example, fear of the dentist, keeping the mouth open, teeth being cleaned by a dentist or nurse, and suction used in the mouth. In general, the factor structures were similar among children at different ages with the following exceptions: fear of instruments used in the mouth was included in the ‘Attending dentist’ factor among 6- and 9-year-olds and in the ‘Treatment of dental decay’ factor among 12- and 15-year-olds. Among 6-year-olds, fear of suction used in the mouth was included in the ‘Treatment of dental decay’ factor; while being unable to breath did not fulfill the inclusion criteria for either factor. For each age, except for 9-year-olds, the ‘Treatment of dental decay’ factor explained nearly half of the common variance.

The internal consistency of the Finnish questionnaire was assessed in Paper III. Cronbach’s alpha coefficients (Cronbach 1951) were 0.87, 0.87, 0.87, 0.89 for 6-, 9-, 12-, and 15-year-olds, respectively. Cronbach’s alpha coefficients for items loading high on the ‘Treatment of dental decay’ factor were 0.82, 0.82, 0.87, 0.88 for 6-, 9-, 12- and 15-year-olds, respectively. For the items loading high on the ‘Attending dentist’ factor, Cronbach’s alpha coefficients were 0.81, 0.82, 0.74, 0.79 for 6-, 9-, 12- and 15-year-olds, respectively. These values indicated good reliability for the questionnaire and subscales.

## **5.2 Occurrence of different aspects of dental fear and correlations between them**

Among Finnish children, the occurrence of dental fear at each age was expressed in two ways: first, as percentages of children who reported fear of different fear-related items (Paper II). Second, the mean values for each item and different aspects of dental fear at each age were reported (Paper III).

The percentages of children who reported being quite or very afraid as well as the mean values for different dental fear-related situations in the modified CFSS-DS are presented for different age groups in Table 6. Children in all age groups were most often quite or very afraid of pain. Among 12- and 15-year-olds, drilling and local anaesthesia were reported as the second and third most often, and among 6- and 9-year-olds, being unable to breath was the second most common.

Fear of dental treatment causing pain had the highest mean value among 9-, 12- and 15-year-olds and the second highest value among 6-year-olds. The fear of drilling, local anaesthesia, hearing the sound of drilling and dental treatment causing pain had higher mean values among older children than among younger children. All differences between age groups were statistically highly significant, except for being unable to breath.

In Table 6, summary mean values for items loading high on ‘Treatment of dental decay’ and ‘Attending dentist’ factors are presented as are mean values for ‘Peak value for dental fear’ and ‘Fear of dental treatment in general’ (Paper IV). Mean values for ‘Treatment of dental decay’ were higher among older children than among younger ones, whereas mean values for ‘Attending dentist’ and ‘Fear of dental treatment in general’ were lower among older children than among younger ones. Mean values for the ‘Peak value for dental fear’ seemed to remain fairly constant across age groups and seemed to have clearly higher mean values across ages than did the mean values for ‘Fear of dental treatment in general’.

**Table 6. Percentages of children who were quite or very afraid and mean values for fear (standard deviations) of different situations related to dental treatment as well as means of 'Treatment of dental decay', 'Attending dentist', 'Peak value for dental fear' and 'Fear of dental treatment in general' at different ages.**

Afraid of	6-year-olds		9-year-olds		12-year-olds		15-year-olds	
	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%
Keeping the mouth open*	1.59 (1.06)	8	1.25 (0.64)	2	1.15 (0.43)	0	1.19 (0.56)	2
Dentist*	1.58 (0.93)	5	1.33 (0.76)	3	1.25 (0.64)	2	1.27 (0.69)	2
Teeth being cleaned by dentist or nurse*	1.63 (1.01)	6	1.41 (0.73)	2	1.26 (0.62)	1	1.26 (0.75)	3
Drilling*	1.73 (1.29)	14	1.88 (1.14)	10	2.10 (1.24)	15	2.18 (1.31)	19
Local anaesthesia*	1.44 (1.02)	8	1.63 (1.14)	11	1.80 (1.14)	12	1.91 (1.24)	14
Hearing the sound of drilling†	1.52 (1.08)	8	1.50 (0.94)	4	1.66 (1.05)	9	1.75 (1.13)	9
Being unable to breath	1.87 (1.30)	14	1.92 (1.24)	13	1.87 (1.09)	9	1.92 (1.23)	13
Instruments put in the mouth*	1.98 (1.26)	14	1.67 (1.01)	7	1.53 (0.91)	6	1.56 (0.95)	5
Suction used in the mouth*	1.56 (1.09)	9	1.29 (0.74)	3	1.15 (0.46)	1	1.20 (0.62)	3
Pain*	1.96 (1.39)	17	2.18 (1.27)	16	2.25 (1.22)	15	2.50 (1.33)	25
Treatment of dental decay*	1.64 (0.90)		1.82 (0.88)		1.87 (0.86)		1.97 (0.96)	
Attending dentist*	1.69 (0.86)		1.39 (0.60)		1.20 (0.41)		1.22 (0.52)	
Peak value for dental fear	3.02 (1.38)		2.78 (1.29)		2.77 (1.27)		2.87 (1.34)	
Dental treatment in general*	1.93 (1.09)		1.67 (0.87)		1.53 (0.80)		1.59 (0.89)	

Analysis of variance between mean values for different age groups: level of significance †p = 0.010,

\*p < 0.001

Percentages of Italian children reporting 'Fear of dentist' are presented in table 7 according to study site. Differences between levels of dental fear between children from public or private practice or among children from different study

sites were not statistically significant. In addition, 22% of the parents of the Italian subjects indicated they were fairly or very afraid of dentist.

**Table 7. Percentages of Italian children reporting ‘Fear of dentist’ according to study site.**

‘Fear of dentist’	Public 1 % (n = 147)	Private % (n = 121)	Public 2 % (n = 109)	Total % (n = 377)
Not afraid at all	52	73	63	62
Just a bit afraid	14	11	6	11
Afraid to some degree	25	5	15	15
Fairly afraid	6	5	10	7
Very much afraid	3	6	6	5

Pearson’s correlation coefficients between the factor summary values, ‘Peak value for dental fear’ and ‘Fear of dental treatment in general’, are presented in Table 8. ‘Treatment of dental decay’ correlated more strongly with both ‘Peak value for dental fear’ and ‘Fear of dental treatment in general’ among older children than among younger ones. In contrast, ‘Attending dentist’ correlated more strongly with ‘Peak value for dental fear’ and ‘Fear of dental treatment in general’ among younger children than among older ones. The correlation coefficients for ‘Treatment of dental decay’ were higher with ‘Peak value for dental fear’ than with ‘Fear of dental treatment in general’, whereas the correlation coefficients for ‘Attending dentist’ were higher with ‘Fear of dental treatment in general’ than with ‘Peak value for dental fear’.

**Table 8. Pearson’s correlation coefficients ( $p < 0.001$ ) between the ‘Fear of dental treatment in general’, ‘Peak value for dental fear’ and the mean values of ‘Treatment of dental decay’ and ‘Attending dentist’ among each age group.**

Fear	6-year-olds	9-year-olds	12-year-olds	15-year-olds
‘Fear of dental treatment in general’				
‘Treatment of dental decay’	0.31	0.49	0.56	0.61
‘Attending dentist’	0.71	0.68	0.67	0.63
‘Peak value for dental fear’				
‘Treatment of dental decay’	0.67	0.78	0.80	0.84
‘Attending dentist’	0.64	0.66	0.60	0.55
‘Fear of dental treatment in general’	0.60	0.62	0.60	0.61

### **5.3 Determinants of different aspects of dental fear**

Experiences of earlier treatment and child- and family-related characteristics were found to be associated with dental fear. Different determinants were revealed for different aspects of dental fear, even when the same measure was compared among children of different ages (Papers I, II, IV).

#### **5.3.1 Characteristics of earlier treatment**

Of all the Italian children, 14.4% had had problems during their first visit to a dentist. The percentages were 12.2% in Verona University, 19.8% in Verona private clinic and 11.1% in Cittadella. The difference in the percentages of children who had had problems during their first visit in the public (11.8%) and private (19.8%) sector was statistically significant ( $p < 0.05$ ). Of the children who were afraid and had had problems with the first dental visit, 72% had visited a dentist three times or less often.

The results of the logistic regression analyses used to examine the association between 'Fear of dentist', problematic first dental visit, parental dental fear and number of dental visits among Italian children are presented in Table 9 (Paper I). Problematic first dental visit was the best predictor of dental fear in children. The effect of a problematic first dental visit on child's dental fear was modified by the number of subsequent visits. Those children who had had more than three visits to a dentist were less likely to be fearful than those who had three or fewer visits. In addition, children whose parents were afraid of dental treatment were more likely to be afraid of dental treatment than children whose parents were not afraid. The open-ended question regarding what had actually happened at the problematic first visit had received only a few answers ( $n = 32$ ). The most frequently reported problem was that the child had shown fear or cried during the first dental visit.

**Table 9. Relationship between dental fear of children (0 = not afraid – afraid to some degree, 1 = fairly afraid – very much afraid) and related factors in the final model of logistic regression analysis (including their first-order interaction terms) (Paper I).**

Variables and their dichotomization	OR	95% CI Lower	95% CI Upper
Problems at the first dental visit 0 = no, 1 = yes			
among children with 0 to 3 previous dental visits	19.84	7.21	54.54
among children with 4 or more previous dental visits	4.55	1.46	14.12
Parents' dental fear 0 = not afraid – afraid to some degree, 1 = fairly afraid – very much afraid	2.30	1.07	4.93
Goodness-of-fit test $\chi^2 = 0.333$ P = 0.954 Nagelkerke R <sup>2</sup> = 0.297			

Among Finnish children, the correlations between different aspects of dental fear and number of treatment procedures are presented in the original article (Paper IV). The hypothesis was that the association between number of earlier treatment procedures from the 3 preceding years and dental fear is not straightforward. Thus, to make the results easier to interpret, the treatment procedures were categorized as (0 / 1 / 2–4 / 5–). Among children of all ages, the greater the number of treatment procedures, the higher the mean values for ‘Peak value for dental fear’ and ‘Treatment of dental decay’. These differences were statistically significant, except for ‘Peak value for dental fear’ among 15-year-olds. At all ages, the mean values for ‘Attending dentist’ and ‘Fear of dental treatment in general’ were rather low and were similar in relation to the number of treatment procedures. However, among 12-year-olds ‘Fear of dental treatment in general’ peaked at 2–4 treatment procedures.

In the logistic regression analyses, the relationship between different measures of dental fear and treatment procedures at different ages differed according to the measure of fear at different ages. When fear was measured as ‘Peak value for dental fear’ or ‘Treatment of dental decay’, those children who had experienced treatment procedures during the last three years were more likely to be afraid than those with no experience of treatment procedures. In contrast, the fear ‘Dental treatment in general’ was not associated with treatment procedures at any age and ‘Attending dentist’ was associated with treatment experiences only among 12-year-olds.

### **5.3.2 Child- and family-related characteristics**

Age-specific percentages of subjects in different categories of the independent variables, including the percentage of children with dmfs/DMFS > 0 and



‘Treatment procedures’ > 0, are shown in Table 10. The first logistic regression analyses were performed with ‘Peak value for dental fear’ as dependent variable (Paper II). Family characteristics were the best predictors of dental fear, except for 12-year-olds. Among 12-year-olds, only caries experience (dmfs/DMFS) entered the final model.

**Table 10. Age-specific percentages of subjects in different categories of the independent variables in Papers II and IV.**

Variable	3-year-olds (%)	6-year-olds (%)	9-year-olds (%)	12-year-olds (%)	15-year-olds (%)
Boys	50	51	49	48	48
Mother's dental fear (quite or very afraid)	12	14	12	13	15
Father's dental fear (quite or very afraid)	6	7	8	4	4
Sibling's dental fear (quite or very afraid)	4	8	11	6	9
Toothbrushing once a day or less	8	6	5	11	11
At least daily intake of soft drinks	0	1	3	5	13
At least daily intake of sweets	2	3	4	13	18
At least daily intake of sugared juices	29	23	26	27	24
At least daily intake of cookies	19	17	17	16	20
Caries experience (dmfs/DMFS > 0)	4	32	58	38	30
‘Treatment procedures’ > 0	9	33	72	75	69
Family has agreed upon one candy day per week	45	55	55	33	9
Mother's education secondary school or higher (Paper II)	69	66	65	63	57
Father's education secondary school or higher (Paper II)	56	56	55	45	49
Parents' combined education higher (Paper IV)	49	49	47	39	43

The relationship between different measures of dental fear, child- and family related characteristics and treatment procedures at different ages are presented in Table 11 (Paper IV). A more informative table is presented in Paper IV. The results of the logistic regression analyses differed among children at different ages even when the same measure of dental fear was used as the dependent variable. However, some similarities were found in addition to the previously mentioned relationship between fear measures and treatment procedures. Apart from the 12-year-olds, either mother's, father's or sibling's dental fear was more strongly associated with the fear ‘Treatment of dental decay’ or with the ‘Peak value for

dental fear' than the number of treatment procedures were. The family members whose fears were associated with a child's dental fear differed at different ages and for different fear measures.

In addition to treatment procedures and family members' dental fear, gender and family characteristics entered some of the models. Among 15-year-olds, girls were more likely than boys to report dental fear with all four fear measures, and brushing teeth once a day or less often was associated with the fear 'Attending dentist'. Among 12-year-olds, gender was not associated with any of the fears. Among younger children, gender modified the effect of limitation on eating candies on 'Fear of dental treatment in general' and 'Peak value for dental fear'. Girls, who were allowed to eat candies only once a week, were more likely to report these dental fears, while among boys no such association was observed. Among 9-year-olds, children of parents with low education were more likely to report 'Fear of dental treatment in general' than children of parents with higher education.

**Table 11. Summary of the results of the final logistic regression analyses among 6-, 9-, 12- and 15-year-olds using the fears 'Peak value for dental fear', 'Treatment of dental decay', 'Attending dentist' and 'Dental treatment in general' as dependent variables. Odds ratios are presented as: OR < 1.00 = -, OR 1.00–1.99 = +, OR 2.00–3.99 = ++, OR ≥ 4.00 = +++.**

Age	'Peak value for dental fear'	'Treatment of dental decay'	'Attending dentist'	'Dental treatment in general'
15-yrs	Sibling's dental fear +++ Girl ++ Mother's dental fear ++ ≥ 1 procedures ++	Sibling's dental fear ++ Girl ++ Mother's dental fear ++ ≥ 1 procedures +	≤ a day brushing +++ Girl ++	Sibling's dental fear ++ Girl ++
12-yrs	≥ 1 procedures+++	≥ 1 procedures ++ Mother's dental fear ++	≥ 1 procedures +++	
9-yrs	Father's dental fear ++ ≥ 1 procedures ++ Candy limitation among girls ++ among boys –	Father's dental fear +++ ≥ 1 procedures +++		Candy limitation among girls ++ among boys – Parent's low educ. ++
6-yrs	Sibling's dental fear +++ Father's dental fear ++ ≥ 1 procedures +	Sibling's dental fear +++ ≥ 1 procedures +++		Candy limitation among girls ++ among boys –

## 6 Discussion

### 6.1 Methodological considerations

#### 6.1.1 Study population

##### *Finnish study population*

The Finnish studies on dental fear in children (Papers II–IV) consisted of random samples of (3-, 6-, 9-, 12- and 15-year-old children in Kuopio and Jyväskylä. Thus, the samples also included children with low fear. In these studies valuable information was gathered on different fears related to dental treatment in Finland. Finnish dentists have been found to be reliable in registering treatment procedures (Helminen *et al.* 1998, Hausen *et al.* 2001), which made it possible to gather reliable data from children's previous dental care for a relatively large study population. Studies using random samples with this type of design have not been conducted earlier in Finland, although Alvesalo *et al.* (1993a–b) conducted a study with a sample of 10- to 14-year-olds in two Finnish cities. They examined the construct of the measure and different dental fears in children between two age groups. This kind of comparison between random samples of children at different ages has, however, not been conducted elsewhere.

The participation rates were good (80–83%). The differences in the inclusion rates between the Papers II–IV are due to the fact that the dental data from preceding years were missing for some children from Papers II and III which may be partly due to migration into the cities during the period between the studies. However, the participation rates in Kuopio and Jyväskylä were similar.

##### *Italian study population*

In Paper I the relationship between problematic first dental visits and children's dental fear is reported. Here a convenience sample was used to obtain enough children to study the statistical differences in this population. The questionnaires were administered consecutively until enough subjects were recruited to allow statistical analyses. In Italy, random sampling was difficult to organize, and this had an effect on the representativeness of the study. Therefore, to obtain information from different organizations providing services, subjects were

recruited from both the private and public sectors in rural and urban areas. With this design we also attempted to reach families from different social backgrounds, as parents from lower socio-economic groups were assumed to use the public sector more often than the private one. As the dental service set-ups in Italy differ throughout the country, the results from this group of subjects cannot be generalized to the Italian child population as a whole. To increase its attractiveness and feasibility, the questionnaire was kept short and personal background was not included.

The response rate was not controlled, as we aimed at gathering 100 subjects from each study location. This led to a long period of data collection, which was due to different patient volumes and service designs in different clinics.

### **6.1.2 Questionnaires, clinical examination and treatment records**

#### *For the Finnish study population*

In the literature, the CFSS-DS questionnaire is widely used to study children's dental fear and anxiety (Cuthbert & Melamed 1982, Alvesalo *et al.* 1993, Klingberg *et al.* 1994b, Milgrom *et al.* 1994, de Jongh *et al.* 1995a, Klingberg *et al.* 1995a–b, Milgrom *et al.* 1995a, ten Berge *et al.* 1998, Klingberg & Broberg 1998, ten Berge 2002a–c, Majstorovic *et al.* 2003, Majstorovic & Veerkamp 2005, van Meurs *et al.* 2005, Nakai *et al.* 2005, Klingberg & Broberg 2007). In Papers II–IV a modified version of the CFSS-DS was used for the following reasons. These studies were part of a larger study project on fluoridation and dental caries. Thus, in order to make the entire study more feasible, a shorter questionnaire was used. The modified version of CFSS-DS was constructed, and questions related to fear of pain and suction used in the mouth were added. Fear of dental treatment causing pain was included in the questionnaire because it has been shown to be common and to be related to dental fear (Maggirias & Locker 2002). It was also the most common fear in our study.

Children were advised to fill out the questionnaire with the help of their parents, if needed. Although parents have been reported to assess their child's dental anxiety reliably (Alwin *et al.* 1991), for the younger age groups the ratings of children's fear might have been affected by their parents' opinions. On the other hand, children estimated their family member's dental fear, which in turn might among the older age groups have affected the validity of the results

concerning family members' dental fear. However, it was considered that the child was aware of the family member's approximate level of dental fear regardless of its origin. A methodological aspect of indirect acquisition of dental fear is that modelling involves learning by direct observation of behaviour or verbal memory (Bandura 1969, Rachman 1977). In this study, children may not have directly observed family members' fear in the dentist's office during their dental appointment. Instead, an informational pathway or other pathway, e.g. child-parent relationship (Venham *et al.* 1979a), for the contribution of a family member's dental fear on child's dental fear may have occurred. However, based on the study design it is not possible to determine who provided the information to the study (child, parent or both), which makes theoretical assessment of the observational modelling pathway vs. the informational pathway difficult. Moreover, the studies did not control the other possible determinants of child's fearful behaviour, e.g. the parent-child dyad (Venham *et al.* 1979a, de Oliveira *et al.* 2006, Freeman 2007), which might be more important in acquisition of fear than the above-mentioned pathways.

The age-specific internal consistencies were high for the total set of questions and the subscales 'Treatment of dental decay' and 'Attending dentist', which indicates that the questionnaire was reliable for each age.

The children were examined clinically by two calibrated dentists. The inter-examiner kappa values were high. However, the earlier treatment procedures had not necessarily been done by the same dentists. Thus, there might have been inconsistencies in the patient records. Part of the dentists' salary in public health care is based on the number of procedures done, which strengthens the reliability of the data on earlier treatment procedures. The codings of Finnish dental records have been found by Helminen *et al.* (1998) and Hausen *et al.* (2001) to be acceptable for scientific studies.

A shortcoming of the study (Paper IV) is that we recorded the number of treatment procedures only during the three years preceding the examination. This was due to the fact that this study was not primarily designed for studying dental fear. If the treatment procedures had been available for each subject's whole dental history, the results might have been different. We did not examine the subject's own experiences and interpretations of the treatment situation, only the numbers of procedures. In Paper IV, number of treatment procedures during the three preceding years were dichotomized for logistic regression analyses as: 0 = no previous treatment procedures, 1 = 1 or more treatment procedures. This dichotomization was chosen because each individual treatment procedure was

considered to be potential negative experience for the child, although not necessarily painful, and could lead to dental fear. As suggested by ten Berge *et al.* (2002a), the association between a child's fear and subjective experiences of earlier treatment might have been stronger than that of the child's fear and the number of earlier invasive treatment procedures recorded from the patient records. As the recollection of experiences may vary over time (Kent 1985a) and also includes a cognitive component, the comparison between experiences and indirect factors would have been complex.

### *Among Italian study population*

In the questionnaire, a single question was used to measure the child's and his/her parent's fear of dentist. As indicated by the results of this thesis and also by Locker *et al.* (1996), a single question may not capture all types of dental fear. By combining different measures, such as use of scales, assessment by a dentist or even physiological measures, the internal validity could have been increased. As our concern was not the prevalence but rather the association between dental fear and problems during the first dental visit, the single item that focused on parent's perceptions was used. It was not asked whether the parent's dental fear was mother's or father's dental fear.

The cross-sectional design was a shortcoming which might have affected, in particular, recollection of experiences. Over time it becomes harder to recall events that were experienced earlier in life (Kent 1985a). Even though parents have been reported to assess their child's dental anxiety reliably (Alwin *et al.* 1991), parental perception may have affected the results. As parents evaluated both their child's and their own dental fear, it cannot be concluded whether the association between dental fear found in parents and children is actually caused by modelling, informational pathway or other factors (see p. 63). Reliability was not tested because, due to the data collection procedures, we had no possibility to test and then retest.

### **6.1.3 Statistical analyses**

The overall number of Finnish children in each age group who were eligible for the study was about 300 (Papers II–IV). The Italian data included 369 children.

In the Italian data there were only a few (0 to 5) missing values for each item taken into the analyses (Paper I). Among Finnish children (Papers II–IV), the

percentage of missing values/no experience of the matter for specific items were on average, 6% and 20% for independent and dependent variables, respectively. The numbers of missing values/no experience of the matter were lower in the older groups than in the younger ones. Among the dependent variables, values were more often missing or marked as 6 = no experience of the matter among items related to invasive treatment procedures, such as fear of injection or drilling, which may be due to the fact that many of the subjects had no experience of such items and thus did not reply. Slightly more of the values were missing (1–10% depending on the age group) for some of the items in the city of Jyväskylä. However, the minor differences between cities should not have had affected the data analyses. Before the analysis (Papers II–IV), the missing values/no experience of the matter were coded as 1 (not afraid at all). The coding of missing values to 1 naturally affected the mean values (Tables 5 and 7). The coding of missing values might have tended to decrease the percentages and mean summary values, thus decreasing the dichotomized values for ‘Treatment of dental decay’ and ‘Attending dentist’.

To examine the underlying constructs for dental fear among Finnish children, explorative factor analyses were performed for each age group. It was found that the constructs were rather similar at different ages. The two factors explained over 60% of the total variance among each age group. When different methods of rotation were compared, they seemed to result in similar solutions. Varimax rotation was used in the final solution because in this way the coefficients load high on one group of items and very low on other items (Armitage & Berry 1994).

In literature on dental fear, only a few multivariable logistic regression analyses with interaction terms have been conducted considering both direct and indirect determinants of dental fear (ten Berge *et al.* 2002a, Milsom *et al.* 2003). To my knowledge, this study was the first to compare different measures of dental fear in children of different ages with a relatively large study population. The logistic regression analyses were performed with the manual backward method. In Paper IV, to obtain a more parsimonious and well fitting model, criteria for including a term into model  $p < 0.02$  was used for interaction terms and  $p < 0.05$  for main effects. All these statistically significant interactions were interpreted in the same direction even though the 95% confidence intervals would have been narrower if another interpretation had been used. This enabled us to make a comparison of girls and boys in the logistic regression analyses. The multivariable analyses revealed some interactions that previous studies may not have been able

to capture. This should be taken into account when these effects are interpreted, and the effects should be interpreted with caution.

## **6.2 Results**

In the literature, multifactorial and multidimensional models have been employed in explaining the determinants of dental fear and anxiety (Shoben & Borland 1954, Freeman 1985, Davey 1989, Murray *et al.* 1989, Corkey & Freeman 1994, Milgrom *et al.* 1995a, Locker *et al.* 1996, Aartman 1998, Kruger *et al.* 1998, Locker *et al.* 1999, Townend *et al.* 2000, ten Berge *et al.* 2002a, Raadal *et al.* 2002, Karjalainen *et al.* 2003, Milsom *et al.* 2003, Klingberg & Broberg 2007). Although the field has been widely examined, many of the earlier studies do not give a broad perspective of the acquisition of dental fear. Different theories on the acquisition of dental anxiety have been used, however, supporting rather than contradicting each other. In this thesis the theoretical perspective will be discussed in relation to earlier dental and developmental models.

### **6.2.1 Construct of the modified CFSS-DS**

Different aspects of dental fear were found to be prevalent in childhood and adolescence. Children of different ages have different types of individual fears related to dental treatment. The earlier factor analyses done with CFSS-DS (Alvesalo *et al.* 1993b, Milgrom *et al.* 1994, ten Berge *et al.* 1998, ten Berge *et al.* 2002c, Nakai *et al.* 2005) as well as the factor solutions reached in Paper III show that children's dental fear can be divided into similar types of structures that can be revealed even with different questionnaires.

For the 10 items, a two-factor solution was obtained for children at different ages, while previous studies on CFSS-DS with 15 items have resulted in three- or four-factor solutions. The third factor obtained from CFSS-DS has differed in previous studies (Alvesalo *et al.* 1993b, Milgrom *et al.* 1994, ten Berge *et al.* 1998, ten Berge *et al.* 2002c, Nakai *et al.* 2005) but is missing in this study, probably because the questionnaire contained fewer questions; we did not include questions related to general fears, such as fear of having someone look at you, having a stranger touch you or people in white uniforms. The fear of dental treatment causing pain was included in the questionnaire because it has been shown to be common and clearly related to dental fear (Maggirias & Locker 2002) and it turned out to be important with regard to the fear of 'Treatment of



dental decay'. The factor structures obtained in this study were relatively similar to previous findings with CFSS-DS (Alvesalo *et al.* 1993b, Milgrom *et al.* 1994, ten Berge *et al.* 1998, ten Berge *et al.* 2002c, Nakai *et al.* 2005). The factor structure of 'Treatment of dental decay' was at each age similar to the factor structures reported in previous studies (Alvesalo *et al.* 1993b, Milgrom *et al.* 1994, ten Berge *et al.* 1998, Nakai *et al.* 2005), except that of ten Berge *et al.* (2002c), who studied highly anxious children. The factor structure of the second factor in the study by ten Berge *et al.* (1998) was similar to ours but differed from that of Alvesalo *et al.* (1993b). These differences between studies may be due to differences in the ages of the study subjects (Alvesalo *et al.* 1993b, Milgrom *et al.* 1994, ten Berge *et al.* 1998, ten Berge *et al.* 2002c, Nakai *et al.* 2005).

The validity of the modified CFSS-DS was good, as the factor structures were rather similar at different ages and were also comparable to other factor structures revealed in other studies (Alvesalo *et al.* 1993b, Milgrom *et al.* 1994, ten Berge *et al.* 1998, Nakai *et al.* 2005). Among 9-year-olds, the percentage of common variance explained by 'Attending dentist' was higher than in children of other ages. This may be due to the concrete operational development stage of 9-year-olds (Piaget 1986). At that age, children are starting to learn logical reasoning but may still be anxious about the unknown, like dental treatment, that they have not experienced. A bias is also possible as the percentage of common variance was rather different from other age groups, even though the factors were relatively similar to other age groups. The finding that among 6-year-olds the 'Treatment of dental decay' explained most of the common variance might be due to the fact that the questionnaire was filled out by the parents. They may have replied on the basis of observed fear-related behaviour or on the basis of their own experiences rather than those of their children. This assumption is also supported by the fact that 68% of the 6-year-olds were caries-free compared to the 42%, 38% and 30% among 9-, 12- and 15-year-olds, respectively, and thus the 6-year-olds had very little experience of the treatment of dental caries. On the other hand, 6-year-olds might have heard stories about dental treatment.

Despite the fact that different individual fears form categories similar to those shown in previous studies, in this thesis it was revealed how similar the patterns of dental fear are between different age groups (Paper III). It is remarkable that the patterns remain relatively similar even though younger children do not have the experiences of dental treatment that older children do. The developmental stages differ significantly among 6- to 15-year-olds. It can be suggested that children already at 6-years of age have expectations or perceptions of dental

treatment although they may not have experiences of treatment itself. They have sufficient cognitive abilities to differentiate between different types of fears. They may have learned attitudes as well as behaviours, for example related to oral health, from their environment. On the other hand, the temperamental dispositions, such as sensitivity, have developed before the age of 6 and may remain fairly stable when children grow.

### **6.2.2 Occurrence of different aspects of dental fear and correlations among them**

The percentages of children who were quite or very afraid of different situations related to dental treatment varied among age groups. In general, the items reported most often were fear of pain, drilling and local anaesthesia. Percentages of children who were quite or very afraid of something in dental treatment ('Peak value for dental fear') were similar at different ages, except for 3-year-olds.

The mean values of single items among Finnish 12- and 15-year-olds were in accordance with the findings of Alvesalo *et al.* 1993a-b, who studied 10 to 14-year-old Finnish children; but the mean values were slightly lower than in other studies on younger children (Milgrom *et al.* 1995a, ten Berge *et al.* 1998, ten Berge *et al.* 2002a), which indicates the validity of the data. When missing values/no experience of the matter were replaced with the mean value of the corresponding item, as had also been done by ten Berge *et al.* (2002c), the mean values were similar to those reported in previous studies for younger children (Milgrom *et al.* 1995a, ten Berge *et al.* 1998, ten Berge *et al.* 2002a,c) and were slightly higher than in the study of Alvesalo *et al.* (1993b) for older children. Replacement of the missing values/no experience of the matter with the mean value did not change the results of the factor analysis. In addition, the total scores were lower among older children than among younger children when missing values were replaced with 1 or with mean values.

The percentages of Finnish and Italian children who were afraid of dental treatment in general or afraid of dentist correspond to those found in earlier studies (Klingberg *et al.* 1995b, Bolin *et al.* 1997, Desiate *et al.* 1997, Wogelius *et al.* 2003). In the present studies the percentages of parents who reported dental fear were slightly higher than in previous studies, which might be due to differences in the culture or measure used (Klingberg *et al.* 1994b, Locker *et al.* 1996, Desiate *et al.* 1997, Humhris *et al.* 2000, Schuller *et al.* 2003).

Differences in treatment experiences at different ages might explain the differences in mean values for fear measures. 'Peak value for dental fear' had higher mean values than 'Fear of dental treatment in general' because 'Peak value for dental fear' measures any specific fear towards something in dental treatment. 'Fear of dental treatment in general', in turn, may reflect more the general fears towards dental treatment. Mean values for 'Treatment of dental decay' were higher in older children than in younger ones. The lower mean values for 'Attending dentist' among older children than among younger children might indicate accommodation to less invasive dental treatment situations that every Finnish child experiences during childhood, which has been explained earlier in the literature as the latent inhibition theory (Davey 1989, de Jongh *et al.* 1995a, ten Berge *et al.* 2002c).

Although the patterns of dental fear remained relatively the same among different age groups, the age-specific prevalences and correlations differed among fear measures, thus suggesting that they all measure a different type of dental fear. Although the same individuals may be categorized as fearful with not only one but several measures of fear (Locker *et al.* 1996), the variation in dental fear according to different measures was shown here. Therefore, it is recommended that in studies of children's dental fear in order to see the actual changes in the fear at different developmental stages, not only total scales should be used when addressing dental fear/anxiety but also subscales.

What would be a correct measure for detecting children who are vulnerable to developing dental fear? The questionnaire in this study was used to examine dental fears among 3-, 6- 9-, 12- and 15-year-old Finnish children. The results indicated that dental fear can be studied in these age groups with the same questionnaire. The factor constructs were quite similar across ages and comparable to previous research. This questionnaire included also a question on fear of pain which is an important aspect of children's dental fear. However, it is important to state that the questionnaire detects only current fear and does not capture the vulnerability to dental fear in the future. Aartman *et al.* (1998) proposed that questionnaires on children's fear should measure the behavioral aspects related to dental treatment more than the cognitive ones. The Dental Cognitions Questionnaire (de Jongh *et al.* 1995b) has been developed to categorize patients with negative cognitions related to dental treatment, however, it has not been validated with children. Children scoring high on the questionnaire, although they are not yet fearful of dental treatment, might be vulnerable to acquiring dental fear if negative experiences occur.

### **6.2.3 Determinants of dental fear in relation to theoretical models**

The logistic regression analyses (Paper IV) showed that different aspects dental fears have different associations with earlier experiences, family characteristics and oral health suggesting different aetiologic background. As mentioned in section 6.2.2, prevalences and correlations among fear measures were also different in children of different ages. These findings are important when theoretical models are interpreted. It should be borne in mind that dental fear may also change within subsequent developmental stages.

#### ***Characteristics of earlier treatment***

In the literature, the role of direct conditioning in the acquisition of dental fear has received well-established support (Kleinknecht *et al.* 1973, Davey 1989, Kruger *et al.* 1989, Locker *et al.* 1996, Locker *et al.* 1999, Townend *et al.* 2000, Raadal *et al.* 2002, Karjalainen *et al.* 2003, Klingberg & Broberg 2007). Also in this research the direct-conditioning pathway was shown to contribute to dental fear. The earlier dental experiences measured either by the number of treatment procedures (Paper IV), dmfs/DMFS (Paper II) or experience of treatment (Paper I) were shown to be associated with dental fear in children of different ages. Early treatment experiences seem to play an important role in the acquisition of dental fear. The fact that the number of subsequent visits after a problematic first dental visit modified the association between dental fear and problematic first visit has not been reported previously. These results suggest that, despite negative experiences during the first dental visit, subsequent dental visits, probably with positive experiences, might help a child to cope with dental fear later. Another explanation could be that children with very negative first dental experiences have developed an avoidance pattern and later visit the dentist only when in pain. This observation of the association between ‘Fear of dentist’ and earlier experiences corresponds to the latent inhibition theory proposed by Davey (1989).

The treatment procedures from the three preceding years were not very strong predictors of any of the measured fears (Paper IV). In contrast, mother’s, father’s or sibling’s dental fear was more strongly associated with the fear measures ‘Treatment of dental decay’ and ‘Peak value for dental fear’ than earlier treatment procedures, except for 12-year-olds. ‘Fear of dental treatment in general’ was associated with family characteristics, but not with earlier treatment procedures, apart from 12-year-olds. In addition, ‘Attending dentist’ was associated only with

the number of treatment procedures or family characteristics among 12- and 15-year-olds, respectively. The finding that the associations among 12-year-olds were different from others may be due to a developmental stage where the ability to abstract thinking has taken place and higher number of treatment experiences. The possible effect of environmental influences may be more important at this phase of development, i.e. some children may be highly influenced by the stories of peers and friends but do not yet have the needed ability to filter information and realise the individual differences in the experiences of other children and the stories of dental treatment.

In conclusion, 'Attending dentist' and 'Fear of dental treatment in general' may reflect more indirect or perhaps other factors related to dental fear, whereas 'Treatment of dental decay' and 'Peak value for dental fear' may describe more direct conditioning of dental fear. However, in this study a population with relatively low fear was examined, possibly influencing the results. In a highly fearful study population stronger associations with previous treatment might have been observed.

### *Child- and family-related characteristics*

The role of direct and indirect conditioning in the acquisition of children's dental fear has been approached with controversial propositions (Holst & Crossner 1987, Milgrom *et al.* 1988, Murray *et al.* 1989, Corkey & Freeman 1994, de Jongh *et al.* 1995a, Klingberg *et al.* 1995b, Milgrom *et al.* 1995a, Townend *et al.* 2000, Locker *et al.* 2001, Raadal *et al.* 2002, Milsom *et al.* 2003, Freeman 2007). Methods used in some previous studies may not have been able to show the relationships between the indirect and direct contributors to fear at different ages. The importance of indirect aspects in the acquisition of dental fear was shown in this thesis.

Children at different developmental stages may experience different aspects of fear in a treatment situation (ten Berge *et al.* 2002a); this might explain, for example, the effect of gender on the role of candy limitation in our logistic regression models. The limitation on eating candies can be considered a good way of learning oral health habits, and per se it is not an indicator of dental fear but may reflect the family's attitudes towards oral health and fears related to it. Young girls might be more prone than boys to be influenced by indirect negative information such as associating the limitation on eating candies to dentistry with a commonly used threat: "If you eat candies, you will be drilled!". Fifteen-year-old

girls were more likely to report dental fear than boys of the same age were. A similar finding has been reported by Holst & Crossner (1987) and by Neverlien (1994). However, because this study was cross-sectional, we cannot conclude that negative family attitudes at young age may make girls to be fearful in adolescence.

The importance of the contribution of indirect and non-dental factors to children's dental fear has been suggested in the literature (Venham *et al.* 1979a–b, Winer 1982, Holst & Crossner 1987, Milgrom *et al.* 1988, Murray *et al.* 1989, Corkey & Freeman 1994, de Jongh *et al.* 1995a, Milgrom *et al.* 1995a, Klingberg & Broberg 1998, Locker *et al.* 2001b, Milsom *et al.* 2003, Freeman 2007, Klingberg & Broberg 2007). The question has been posed as to why there are individuals who do not acquire fear after negative, painful experiences during treatment (Davey 1989, Locker *et al.* 2001b). Some studies have reported that fearful patients are more likely to expect and experience pain during dental treatment than non-fearful patients are (Maggirias & Locker 2002, van Wijk & Hoogstraten 2005). ten Berge *et al.* (2002a) emphasized the same dilemma by suggesting that dental fear was more often associated with the subject's own recent experience and interpretation of a dental visit than with the treatment procedure that he/she had received in the past. The psychoanalytic approach of the child-mother dyad approaches the dilemma by suggesting that the mother-child dyad is more important than the actual modelling or information from the parents (de Oliveira *et al.* 2006, Freeman 2007). The results of Venham *et al.* (1979a) support these findings; young children's stress tolerance and coping skills during dental treatment were facilitated when they had secure, structured home environment with responsive parents who set positive and negative rewards and limits to children. Even though our results support most of Rachman's model of fear acquisition (Rachman 1977, Rachman 1991), it seems plausible to assume that other non-dental factors also contribute to the acquisition and maintenance of dental fear (see Chapter 2.5).

### *Cognitive-behavioural model*

Children under three years of age have been considered to be unable to cope with dental treatment (Rud & Kiesling 1973). According to the cognitive-behavioural theory of development, the coping skills of the children develop in the concrete operational stage, i.e. from the age of 5 onwards. At this stage the child is able to think abstractly and can cope with dental situations (Folayan *et al.* 2004). Later in

the formal operational stage (Piaget 1986) (from about 11 years onwards) when logical reasoning commences, the child will be better able to distinguish between different treatment phases and may be able to worry about more sophisticated things related to treatment, e.g. the dentist's competency or may have negative cognitions that affect their memory of earlier treatment (Kleinknecht *et al.* 1973, Winer 1982, Kent 1985b, ten Berge *et al.* 2002a). In our study, fears related to 'Treatment of dental decay' were more prevalent among older children than among younger ones. This may be due to the fact that older children have more experiences of dental treatment and are better at expressing their fears related to different treatment phases. This suggestion is based on the fact that 'Fear of dental treatment in general' was less prevalent in older than younger age groups, i.e. older children may be more afraid of single aspects of treatment than of the treatment itself. They may be able to realize that dental treatment is not always unpleasant but that some situations are more adverse than others. Although several studies have indicated that dental fear is lower in older than in younger children, our study showed that the objects of fear, not necessarily the occurrence, differ depending on the measure used.

The cognitive model of the predisposing factors of anxiety (Beck *et al.* 1985) can also be utilized in explaining dental fear. Mechanisms leading to dental fear may function as a system where fear is acquired through not only one but several pathways simultaneously. Finally, conditioning through direct experiences may be more likely if there is insufficient resilience or lack of coping ability, indirect negative information, vicarious learning, attitudes towards oral health, psychopathology, genetic predisposition or perhaps a certain type of parent-child dyad or temperament that predisposes a child to experience dental treatment negatively. For example, threatening parental behaviours have been shown to predict sensitivity to anxiety (Scher & Stein 2003). Resilience (Sroufe 1997) or coping ability protects the individual in these kinds of stress situations. The parent's capacity to respond appropriately to the child's emotional and internal world has been suggested to be essential in determining the way the child copes during dental treatment (de Oliveira *et al.* 2006, Freeman 2007). This theory may not apply to very young children who experience painful treatment and do not yet have the necessary coping abilities (Piaget 1986, Rud & Kiesling 1973, Folayan *et al.* 2004). Even though the cognitive model takes into account many of the previously mentioned factors and developmental stages, this theory lacks a more thorough explanation of system and the interaction between environment and society.

### *Further theoretical considerations*

Engel (1977) proposed a model that explains disease as a result of somatic and psychosocial factors. For example, although genetic factors and biochemical deviation are found to be determinants of schizophrenia, disease requires other explanations i.e. psychological, social and cultural factors. Similarly, children's dental fear should not be considered as multidimensional only in the sense of psychological, developmental or somatic, e.g. biochemical differences in pain experiences, but should be further evaluated as part of social and cultural characteristics including micro and macro environment. It has been suggested that children with dental fear know other people who are afraid of dental treatment, and these children perceive that dental anxiety is widespread and thus might perceive their fear as a commonly-held social norm which might also make them more resistant to change (Corkey & Freeman 1994).

Similarly to cognitive and biopsychosocial models, dynamic systems theory could be utilized in understanding dental fear. According to the theory, all components of life affect the state of the psyche during a stressful event (Fogel 1993, Thelen & Smith 1994, Oyama 2000). The previously mentioned multiple pathways of Rachman (1977, 1991) and other contributors related to dental treatment, i.e. dental factors, operate as a system that is a natural part of a complex larger system that includes the individual's stage of development, family, upbringing, social group and environment as well as psychopathology and genetic predisposition. If the system develops in the direction of a negative attitude towards dental treatment, the child is more at risk to acquire dental fear if exposed to painful dental treatment. On the other hand, negative experiences during treatment may also change the system's balance in relation to dental treatment and fear, possibly also the functioning of other events of everyday life. The latent inhibition theory and findings reported in Paper I suggest that the positive effect of bad treatment experiences on dental fear may subside if the whole system is able to rebound after the stressful experience. This may include positive dental visits after the negative experience as well as other positive life events that improve the child's resilience. Eventually, the system plays a vital role in determining how the treatment procedures or pain during treatment are experienced and how resilient or able to cope with the treatment the child is. This approach may help us to understand why the treatment of dental fear is complex and long-term because factors other than dental ones also affect the persistence of fear.



The whole system of life events can affect the development and maintenance of dental fear. For example, children at the age of 12 have usually good coping abilities to manage their behaviour in the dental chair. This is indicated by the prevalence of dental behaviour management problems which is lower among older than younger children (Klingberg & Broberg 2007). Our study showed that treatment related aspects of dental fear are relatively common also among older children. However, sometimes 12- and 15-year-old children do not express these fears during dental treatment. At this age the behavioural expectations from the parents, peers or other people in their environment may encourage some children to behave in a good manner during the treatment session. However, the children may experience significant fear that they will not express unless questioned. Even though dentists may not observe dental fear related behaviours, the fear may have a significant influence on the child's well-being. If the fear is unattended it may be easily maintained. Thus, each child should be treated as a child who is likely to have dental fear or has a vulnerability to develop dental fear.

#### **6.2.4 Clinical applications**

When evaluating and treating children's dental fear dentists should understand that factors related to children's dental fear vary at different ages and according to aspects of dental fear. Dentists using different questionnaires for assessing children's dental fear should be acquainted with the type of fear each scale is measuring. Besides using total scores of the scales, also subscales and individual items of questionnaires should be taken into account before approaching fearful children in dental settings.

It has been suggested that the functionality of the family and the ability of the parents to form positive, consistent, and nurturing interactions with their children is essential for the child's ability to cope with dental treatment (Versloot *et al.* 2004, de Oliveira *et al.* 2006, Freeman 2007). Thus, information on the importance of indirect experiences on the development of dental fear together with a positive approach to oral health should be more often provided to families at their first dental visits. This information could be easily provided and may decisively help in preventing and decreasing dental fear in children. A more holistic approach should be taken in treating children with dental fear. In pediatric dental clinics, the family should not be excluded from the treatment of child's dental fear. It is apparent that the family is vital in the genesis and maintenance of child's dental fear, for example by supporting negative attitudes towards oral

health, but also in the prevention of the fear. The issue of dental fear should be discussed more often with families, e.g. by asking if the parents are willing to change also their attitudes on oral health to help their fearful child with the treatment. Other health personnel should be consulted more frequently and involved during the treatment of dental fear in the family.

### **6.2.5 Main limitations of the study**

The studies were performed to 3- to 15-year-old children in Finland and in Italy. They revealed valuable information on the construct and aspects of dental fear among children at different ages. However, the cross-sectional designs in the studies are a shortcoming. The associations must not be interpreted as causal but should be approached as differences between age groups. Therefore, to see actual differences in the acquisition and maintenance of dental fear at growing children, longitudinal studies are needed.

The dental fear questionnaires were not validated and test-retested before the studies. However, most of the fear-related questions in the Finnish questionnaire were drawn from the valid and reliable Finnish version of the CFSS-DS (Alvesalo *et al.* 1993a–b). In this study, the mean values of single fear related items were comparable to the same items in CFSS-DS in Finland (Alvesalo *et al.* 1993a–b) and elsewhere (Milgrom *et al.* 1995a, ten Berge *et al.* 1998, ten Berge *et al.* 2002a,c).

Based on the study design it is not possible to determine who provided the information on dental fear to the study (child, parent or both), which makes theoretical assessment of the observational modelling pathway vs. the informational pathway difficult. Moreover, the studies did not control the other possible determinants of child's fearful behaviour, e.g. the parent-child dyad (Venham *et al.* 1979a, de Oliveira *et al.* 2006, Freeman 2007), which might be more important in acquisition of fear than the above-mentioned pathways.

Another shortcoming of the study (Paper IV) is that we checked the number of treatment procedures only during the three years preceding the examination. First, if the treatment procedures had been available for each subject's whole dental history, the results might have been different. Second, we did not examine the subject's own experiences and interpretations of the treatment situation, only the numbers of procedures.

The emphases of the Finnish dental care have changed from the late 1980's and even from 1990's when the children of this study received dental care. The

decrease in caries occurrence has levelled off and emphasis on preventive care has declined during the past decade (Nordblad *et al.* 2004). This might have an influence also on the dental fear of children's in the 21<sup>st</sup> century. Although, the levels of dental fear were relatively similar in 1993 (Alvesalo *et al.* 1993a–b) and in this study conducted in 1998 (Paper III), the findings of this study may not reflect the present situation in Finland. Thus, a new study using probability sample should be performed in Finland to see if there have been changes in dental fears of Finnish child population since 1990's.

### **6.3 Implications for further studies**

At present, dental treatment is not completely painless. In dental fear research, the experience of pain during treatment has not been widely studied. The importance of fear of pain and experience of pain should also be examined more among children. Furthermore, dentists have to treat children who are afraid of pain and cannot even bear the use of needles. How can we improve their ability to cope with a little pain in order to apply local anaesthesia? How is a stable and strong coping ability constructed during childhood? Even though pedodontics and psychology have already considered the above-mentioned questions, they are essential in treating children who are afraid of dental treatment.

In the future, more emphasis should be also placed on different aspects of indirect pathways in children at different ages. Among these are parent-child dyad, upbringing and information from the environment that may form the basis for proneness to acquisition of dental fear. An understanding of these aspects may help us to prevent dental fear.

Because of the multidimensional nature of dental fear, the dental fear research is in a difficult position. How can we collect a vast population with information about developmental, non-dental and dental determinants and different aspects of dental fear into a study? What is the correct way to interpret the results concerning child patients? What is the importance of genetic variance? In the future, different designs and qualitative and quantitative methods to study dental fear should be used simultaneously. A longitudinal study should be performed including indirect and direct dental factors as well as non-dental factors that may contribute to dental fear, such as indirect negative information, modelling, psychopathology, cognitive components, genetic predisposition, upbringing and temperament. All of these may affect the resilience or coping of a child in dental treatment situations throughout his/her development.



## 7 Conclusion

### 7.1 Main results

- A total of 21 to 36% of Finnish children were quite or very afraid of something in dental treatment.
- The prevalence of dental fear among Finnish children was not lower among older children but rather fluctuated at different ages.
- Instead, the characteristics of dental fear differed among children at different ages.
  - At younger ages, the dental fear was abstract, commonly related to attending dentist.
  - At older ages, dental fear was often related to invasive treatment, such as fear of local anaesthesia and drilling.
  - Fear of pain was common among all age groups.
- Among Italian children, the first dental experiences were strong determinants of dental fear.
- Among Finnish children, dental fear in the family was stronger determinant of dental fear than the treatment experiences were. Gender differences were found only among 15-year-old, the girls having more often fear than the boys had.
- The results indicated that dental fear is not solely based on direct conditioning but rather consists of child, family and environmental determinants.



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## Appendix 1 The Children's Fear Survey Schedule- Dental Subscale (CFSS-DS) questionnaire.

Items	Not afraid at all 1	A little afraid 2	A fair amount 3	Pretty much afraid 4	Very afraid 5
1. Dentists	—	—	—	—	—
2. Doctors	—	—	—	—	—
3. Injections (shots)	—	—	—	—	—
4. Having somebody examine your mouth	—	—	—	—	—
5. Having to open your mouth	—	—	—	—	—
6. Having a stranger touch you	—	—	—	—	—
7. Having somebody look at you	—	—	—	—	—
8. The dentist drilling	—	—	—	—	—
9. The sight of the dentist drilling	—	—	—	—	—
10. Noise of the dentist drilling	—	—	—	—	—
11. Having somebody put instruments in your mouth	—	—	—	—	—
12. Choking	—	—	—	—	—
13. Having to go to the hospital	—	—	—	—	—
14. People in white uniforms	—	—	—	—	—
15. Having the nurse clean your teeth	—	—	—	—	—





# Appendix 2 The Finnish questionnaire used in Papers II–IV.

1

JYVÄSKYLÄN SOSIAALI- JA TERVEYSPALVELUKESKUS  
HAMMASHUOLTO

Jyväskylä,

Lasten ja nuorten hammaserveystutkimus

Tutkimukseen osallistuneiden kesken arvotaan Jyväskylässä 1 kpl 500 mk:n ja 10 kpl 100 mk:n lahjakortteja.

Vastaa huolellisesti kaikkiin kysymyksiin ympyröimällä oikea vaihtoehto (vain yksi vaihtoehto, ellei toisin mainita) tai kirjoittamalla vastaus sille varattuun tilaan.

Esimerkki:  
Käytkö hammaslääkärillä säännöllisesti?

1. Kyllä  
 2. Ei

1. Kuinka usein harjaat hampaasi?

1. Kaksi kertaa päivässä tai useammin
2. Kerran päivässä
3. Harvemmin kuin kerran päivässä
4. Kerran viikossa tai harvemmin
5. Ei koskaan

2. Käytätkö hampaiden puhdistamiseen harjauksen lisäksi hammaslääkettä?

1. Kaksi kertaa päivässä tai useammin
2. Kerran päivässä
3. Harvemmin kuin kerran päivässä
4. Kerran viikossa tai harvemmin
5. Ei koskaan

3. Oletko kuluneen viikon aikana käyttänyt fluoritabletteja (Fluorilette tai Fludent) ainakin viitenä päivänä?

1. Kyllä
2. Ei

4. Kuinka kauan olet asunut nykyisellä asuinpaikkakunnallasi?

1. Syntymästani saakka
2. Yhtäjaksoisesti vuodesta \_\_\_\_\_ alkaen
3. Olen asunut välillä muualla, mutta yhteensä \_\_\_\_\_ vuotta nykyisellä asuinpaikkakunnallani.

5. Kotonani asuu itseni lisäksi

1. \_\_\_\_\_ siskoa
2. \_\_\_\_\_ veljeä
3. äiti
4. isä
5. joku muu, kuka: \_\_\_\_\_

6. \_\_\_\_\_

7. \_\_\_\_\_

6. Mitä seuraavista valmisteista olet käyttänyt viimeisten 30 päivän aikana? Koulussa ja/tai hammashoitolassa tapahtunutta käyttöä ei ilmoiteta tässä. (Rengasta jokaiselta riviltä yksi numerovaihtoehto.)

	Päivittäin	Viikottain	Harvemmin kuin viikottain	Ei lainkaan
Fluorihammastahna	1	2	3	4
Ei fluoripitoinen hammastahna	1	2	3	4
Fluoritabletti tai fluori-imeskelytabletti	1	2	3	4
Fluoripitoinen purskuteluliuos (esim. natriumfluoridiliuos, Meridol)	1	2	3	4
Fluorigeeli (esim. Elmex)	1	2	3	4
Klorheksidiiniiliuos tai -geeli tai klorheksidiinifluoriliuos tai -geeli (esim. Corsodyl tai Oral-B antibakteerinen suuvesi)	1	2	3	4

7. Mikä on huoltajiesi koulutus? (Rengasta kunkin huoltajan ylin koulutusaste.)

	Äiti	Isä	Muu huoltaja, kuka: _____	Muu huoltaja, kuka: _____
Kansakoulu, keskikoulu tai peruskoulu	1	1	1	1
Ammattikoulu tai vastaava	2	2	2	2
Ylioppilastutkinto	3	3	3	3
Opiotason tutkinto	4	4	4	4
Korkeakoulututkinto	5	5	5	5

8. Mikä on huoltajiesi pääammatti, -toimi tai -toiminta? MERKITSE AMMATTI MAHDOLLISIMMAN TARKASTI. Esimerkiksi koneasentaja, peruskoulun luokanopettaja, rakennustyömies, konekirjoittaja. Vältä ylimalkaisia nimikkeitä, kuten työmies tai opettaja, sekä oppiainvoja ja arvonimiä, kuten merkonomi, maisteri, kunnallisneuvos. Jos huoltajasi on eläkkeellä tai työtön, merkitse myös ammatti (esim. eläkkeellä, peltiseppä tai työtön, rakennusinsinööri).

1. Äiti, ammatti \_\_\_\_\_

2. Isä, ammatti \_\_\_\_\_

3. Muu huoltaja, kuka: \_\_\_\_\_

Ammatti \_\_\_\_\_

4. Muu huoltaja, kuka: \_\_\_\_\_

Ammatti \_\_\_\_\_

Jos joku huoltajasi on itsenäinen maanviljelijä, merkitse hänen omistamiensa peltohehtaarien määrä \_\_\_\_\_ ha.

9. Kuinka suuret olivat perheesi yhteenlasketut vuositulot vuonna 1998 veroja vähentämättä?

1. 0 - 50 000 mk
2. yli 50 000 - 100 000 mk
3. yli 100 000 - 150 000 mk
4. yli 150 000 - 200 000 mk
5. yli 200 000 mk

10. Onko perheessäsi sovittu siitä, että syöt makeisia vain yhtenä päivänä viikossa eli nk. karkkipäivänä?

1. Kyllä
2. Ei

11. Noudatanko jotakin erityisruokavaliota? Voit rengastaa useita vaihtoehtoja.

1. En noudata mitään erityisruokavaliota
2. Diabetesruokavalio
3. Keliakiaruokavalio
4. Laktoositon ruokavalio
5. Erityisruokavalio ruoka-aineyliherkkyyden vuoksi. Mikä ruoka-aineyliherkkyys: \_\_\_\_\_
6. Kolesterolia alentava ruokavalio
7. Verenpainetta alentava ruokavalio
8. Erityisruokavalio laihduttajille
9. Muu erityisruokavalio, mikä: \_\_\_\_\_

12. Seuraavana on lueteltu aterioita ja ruoka-aineita. Arvioi mahdollisimman tarkasti, kuinka usein niitä syöt ja rengasta kyseinen numerovaihtoehto. Älä jätä vastaamatta yhteenkään kohtaan.

	3 - 4 kertaa päivässä	kaksi kertaa päivässä	yhden kerran päivässä	2 - 3 kertaa viikossa	yhden kerran viikossa	kaksi kertaa kuukau- dessa	harvemmin tai ei koskaan
Lämpimiä aterioita	1	2	3	4	5	6	7
Välipalaksi voileipää tai puuroa	1	2	3	4	5	6	7
Sokerikuorrutettuja muroja tai myslää	1	2	3	4	5	6	7
Makeutettua jugurttia tai viiliä	1	2	3	4	5	6	7
Vanukkaita (esim. suklaavanukkaat, Nami Nami)	1	2	3	4	5	6	7
Kuivattuja hedelmiä (esim. rusinat)	1	2	3	4	5	6	7
Jäätelöä tai pehmistä	1	2	3	4	5	6	7
Tuoremehuja	1	2	3	4	5	6	7
Tavallista limsaa (esim. Jaffa, Coca cola)	1	2	3	4	5	6	7
Sokeroituja mehuja	1	2	3	4	5	6	7
Kaakaomaittojuomia tai pirtelöitä	1	2	3	4	5	6	7
Urheilujuomia	1	2	3	4	5	6	7
Pullaa tai kakkua tai keksejä tai pikkuleipiä	1	2	3	4	5	6	7
Makeisia	1	2	3	4	5	6	7
Sokeria teehen	1	2	3	4	5	6	7
Sokeria kahviin	1	2	3	4	5	6	7
Tavallista purukumia	1	2	3	4	5	6	7
Ksyyliotipurukumia	1	2	3	4	5	6	7

Jyväskylä,

**Lasten ja nuorten hammasterveystutkimus  
Hammashoitopelko**

Yhtenä tutkimuksemme kohteena on hammashoitopelon vaikutus hammashoidossa käymiseen ja suun terveyteen. Seuraavassa on muutamia kysymyksiä hammashoitopelosta.

Vastaa huolellisesti kaikkiin kysymyksiin ympäröimällä oikea vaihtoehto (vain yksi vaihtoehto, ellei toisin mainita) tai kirjoittamalla vastaus tälle varattuun tilaan.

	En pelkää lainkaan	Pelkään aivan vähän	Pelkään jonkin verran	Pelkään melko paljon	Pelkään hyvin paljon	Ei kokemusta asiasta
1. Hammaslääkärinä	1	2	3	4	5	6

	En pelkää lainkaan	Pelkään aivan vähän	Pelkään jonkin verran	Pelkään melko paljon	Pelkään hyvin paljon	Ei kokemusta asiasta
1. Hammashoittoa yleensä	1	2	3	4	5	6
2. Kun suu täytyy avata	1	2	3	4	5	6
3. Hammaslääkärinä	1	2	3	4	5	6
4. Kun hammaslääkäri tai -hoitaja puhdistaa hampaistani	1	2	3	4	5	6
5. Kun hammastani porataan	1	2	3	4	5	6
6. Kun hammastani puudutetaan	1	2	3	4	5	6
7. Kun kuulen hammasporan äänen	1	2	3	4	5	6
8. Jos en saa kunnolla hengitettyä	1	2	3	4	5	6
9. Kun joku laittaa suuhuni instrumenttejä	1	2	3	4	5	6
10. Kun suustani imuroidaan sylkeä	1	2	3	4	5	6
11. Kun hammashoito aiheuttaa kipua	1	2	3	4	5	6

Kotonasi saattaa asua henkilöitä, jotka pelkäävät hammashoittoa. Arvioi seuraavassa kuinka paljon he hammashoittoa pelkäävät.

	Ei pelkää lainkaan	Pelkää aivan vähän	Pelkää jonkin verran	Pelkää melko paljon	Pelkää hyvin paljon	Ei kokemusta asiasta
12. Äiti	1	2	3	4	5	6
13. Isä	1	2	3	4	5	6
14. Sisarukset	1	2	3	4	5	6
15. Joku muu, kuka: _____	1	2	3	4	5	6



# Appendix 3. English version of the questionnaire used in Paper I.

We would like you to answer each of the following questions by circling the most appropriate choice (only one choice) or by writing the answer to the space reserved for it.

Example:

How often does your child visit a dentist?

2 times a year	Once a year	Once in two years	Once in three years	Less often than once in three years
-------------------	----------------	-------------------------	---------------------------	---

1) Child's age

3–5 years      6–9 years      10–12 years      13 years or more

2) How many times has your child visited a dentist?

none      once      2–3 times      4–5 times      6 times or more

3) Did your child have any problems with his/ her first dental visit?

YES      NO

If you answered yes, what kind of problems did occur during the first dental visit?

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---



---

4)Is your child afraid of dentist?

Not afraid	Is afraid just a bit	Is afraid in some amount	Is afraid quite a lot	Is afraid very much
---------------	-------------------------	--------------------------------	-----------------------------	------------------------

5)Are You afraid of dentist?

Not afraid	Afraid just a bit	Afraid in some amount	Afraid quite a lot	Afraid very much
---------------	----------------------	-----------------------------	--------------------------	---------------------

6)If you have any other comments about child's first dental visit or dental anxiety, kindly indicate them here?

---

---

---

---

Return the questionnaire to the dentist or the nurse treating your child, thank you.

Thank you for your help!



# Appendix 4. Approval letter from the Ethics committee of the University of Kuopio.



**KUOPION YLIOPISTOLLINEN KESKUSSAIRAALA**  
Kuopion yliopiston ja Kuopion yliopistollisen  
keskussairaalan eettinen toimikunta

**LUPA-ANOMUS/SUOSTUMUS/PÄÄTÖS**  
**TUTKIMUSTYÖN SUORITTAMISEKSI**

<p>Tutkimuksen nimi, tutkijat ja taitos/kieliosa</p> <p><b>JUOMAVEDEN LIIORAKSEN LOPETTAMISEN VAIKUTUKSET HAMMASTERVEYTEEN, HOITOKÄYTÄNTÖIHIN JA HAMMASHOITON KUSTANNUKSIIN KUOPIOSSA.</b> Liisa Seppä<sup>1</sup>, Henna Hausen<sup>2</sup>, Lea Pihlänen<sup>3</sup>, Peavo Luukkonen<sup>4</sup>, Harri Sinonen<sup>5</sup> <sup>1</sup>Eläkkeeseen hammaslääketieteen ja kariologian laitos, <sup>2</sup>Kuopion tutkimuksen tarkoitus yliopisto, <sup>3</sup>Sosiaalihanterveyslaitos, Kuopion yliopisto, <sup>4</sup>Kuopion terveyskeskus, <sup>5</sup>Jyväskylän terveyskeskus, <sup>6</sup>Kuopion yliopisto.</p>
<p>Tutkimuksen tarkoituksena on selvittää juomaveden fluorauksen lopettamisen vaikutuksia.</p> <p><b>Yhteenveto tutkimussuunnitelmasta, jolloin lääketutkimuksessa maininta aikaisemmista farmakologisista, toksikologisista ja kliinisistä tutkimuksista (osio 1, 2 vai 3)</b></p> <p>Vuoden 1992 syksystä alkaen tarkastetaan Kuopiossa ja Jyväskylässä 3 vuoden välein 80 iältään 3-, 6-, 9-, 12- ja 15-vuotiaista lasta (aikasarja). Jyväskylä on valittu vertailukaupungiksi, jotta voitaisiin selvittää, mitkä muutokset ovat muutoksia ajassa, mitkä fluorauksen lopettamisen seurauksia. Tarkastus tehdään ainakin kolmeesti niin että ensimmäisen ja viimeisen tarkastuskerran välillä on 6 vuotta. Lisäksi v. 1992 tutkitut 12-vuotiaat valitaan kiinteäksi kohortiksi, jota seurataan vuoden ajan.</p> <p>Lapsille tehdään kliininen tarkastus, jossa tutkitaan karies, parodontiumin tila sekä mahdollinen fluorosin esiintyminen. Kiinteään kohorttiin kuuluvilta määritetään mutans streptokokkitaso syljistä sekä plakkin streptokokkien hapontuottokyky puolen uoden välein. Kaikki tutkittavat (tai heidän huoltajansa) täyttävät hammasterveys- -kysely- ja ravintotottumuksia koskevan kyselykaavakkeen.</p> <p>Mahdollisia muutoksia hammashoitokäytännössä ja hammashuollon kustannuksissa tutkitaan potilaskertomuksiin tehtyjen merkintöjen perusteella.</p>
<p><b>Tutkimusaineiston suuruus ja kokoamistapa</b></p> <p>400 satunnaisotoksella valittua 3 - 15-vuotiasta/tarkastuskerta</p>
<p><b>Tutkimuksen ajoitus (aikainen, kestoaika) ja suorittamistapa (lääketutkimuksessa ilmoitus lääkintöhallitukseen 2 kk ennen aloittamista)</b></p> <p>Tarkastukset tehdään vuosina 1992 - 1993, 1995 ja 1998</p>
<p><b>Tutkimustulosten tulkinta (erityisesti tavanomaiseen diagnostiikkaan tai hoitoon kuulumattomat toimenpiteet tai tutkimukset, joihin saattaa koitua vaaraa, kipua tai tuskaa)</b></p> <p>Kaikki toimenpiteet kuuluvat tavanomaiseen diagnostiikkaan, eikä niistä aiheudu vaaraa tai kipua.</p>
<p><b>Suunnitellusta tutkimuksesta tutkittavalle mahdollisesti koitava hyöty 1)</b></p> <p>Tarkastuslomakkeet ja röntgenkuvat annetaan lapsia terveyskeskuksessa hoitavien hammaslääkärien käyttöön.</p> <p>Lasten vanhemmilta pyydetään suostumus tarkastukseen.</p>

KYKS 81028-9

Tarkka kuvaus siitä, miten suostumus pyydetään

Suostumus pyydetään kirjeellä, jossa selvitetään tutkimuksen tarkoitus ja lapselle tehtävät tarkastukset.

Lääkeainetutkimuksissa selvitys varotoimista/toimenpiteistä sivuvaikutusten sattuessa ja mahdollisten vahinkojen korvaamisesta

Tutkijan tai tutkijoiden kokemus ko. tutkimusalueella

Kaikilla tutkijoilla on riittävä kokemus klinisestä tutkimuksesta.

Allekirjoitus ja nimen selvitys

Vastuuhenkilö Liisa Seppä *Liisa Seppä*  
Päiväys Kuopio 5.11.1991 Virka-asema vt. professori Puh. 162 237

Yhteyshenkilö (ei! sama)

Laitoksen/klinikan esimiehen suostumus

Olen antanut suostukseni yllämainitun tutkimuksen suorittamiseen

5.11.1991 Helena Markkanen *Helena Markkanen*  
Päiväys Virkän tai laitoksen johtajan allekirjoitus ja nimen selvitys  
varadekaani

Liitteet: Lyhennätön tutkimus suunnitelma  
Tutkimukseen liittyvää muuta aineistoa  
(kopio tutkittavalle lähetettävästä kirjeestä, selvitys potilaalle mahdollisesti maksettavista palkkioista jne.)

1) Lapsiin tai vajeavaltaisin kohdistuvissa tutkimuksissa seuraavat tiedot:

a) Jos tutkimus hyödyttää lasta tai vajeavaltaista, aiotaanko pyytää suostumus lapsen vanhemmilta tai hoitajalta?

b) Ellei tutkimus tule hyödyttämään kohteena olevaa lasta tai vajeavaltaista:  
— pidettävätkö vaaroja mitättöminä?  
— miten hankitaan vanhempien tai hoitajan suostumus?

Ote eettisen toimikunnan pöytäkirjasta 13.11.1991

Tutkimussuunnitelma on käsitelty Kuopion yliopiston ja Kuopion yliopistollisen keskussairaalan eettisen toimikunnan kokouksessa 12.11.1991, jolloin tutkimussuunnitelma on hyväksytty.

Kuopio 13.11.1991

*Erkki Voutilainen*  
Eettisen toimikunnan sihteeri Erkki Voutilainen

## Original papers

- I Rantavuori K, Zerman N, Ferro R & Lahti S (2002) Relationship between children's first dental visit and their dental anxiety in the Veneto Region of Italy. *Acta Odontol Scand* 60: 297–300.
- II Rantavuori K, Lahti S, Hausen H & Seppä L (2004) Dental fear and oral health and family characteristics of Finnish children. *Acta Odontol Scand* 62: 207–213.
- III Rantavuori K, Lahti S, Hausen H & Seppä L (2005) Dental fear of Finnish children in the light of different measures of dental fear. *Acta Odontol Scand* 63: 239–244.
- IV Rantavuori K, Lahti S, Tolvanen M, Seppä L & Hausen H (2008) Factors associated with different measures of dental fear among children at different ages. *J Dent Child*. In press.

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