Dental Anxiety

Prevalence, measurements and consequences

Lisa Svensson

Department of Behavioral and Community Dentistry
Institute of Odontology
Sahlgrenska Academy, University of Gothenburg

UNIVERSITY OF GOTHENBURG

Cover illustration: Street art in Barcelona. Photograph: Lisa Svensson

"Tiden du ger är som en bra bedövning,
väntar du in effekten går allt lättare"

/Carina Blom
Dental nurse at the Clinic of Oral Medicine, Gothenburg

Dental Anxiety

Prevalence, measurements and consequences

Lisa Svensson

Department of Behavioral and Community Dentistry, Institute of Odontology
Sahlgrenska Academy, University of Gothenburg, Sweden

ABSTRACT

The overall aim of this thesis was to gain knowledge about adults suffering from dental anxiety by studying the current prevalence of dental anxiety and concomitant factors, the impact of dental pain on everyday life among individuals suffering from severe dental anxiety, and to evaluate the validity of a psychometric measurement, the IDAF-4C$^+$, used to measure the level of dental anxiety and to screen for a diagnosis of specific phobia for dentistry. The included studies have a cross-sectional design. Study I includes a Swedish national sample of 3500 individuals, randomly selected and interviewed by a telemarketing company. Data from this study were compared with data from a study performed in 1962, to be able to analyze a possible change in the prevalence of dental anxiety over time. Study II and III include clinical samples of highly dentally anxious individuals examined both clinically and with validated and reliable psychometric measurements. Severe dental anxiety was reported by 4.7%, moderate anxiety by 4.5%, low anxiety by 9.8%, and no dental anxiety by 80.9% of the subjects. The most important factors predicting dental anxiety were gender (women) and irregular dental attendance. A decrease in dental anxiety was seen over time. Dental pain was reported by 77.6% in a sample with severe dental anxiety and the pain intensity was reported to be high. The majority of individuals with dental pain reported a greater impact on their oral health-related quality of life than individuals without dental pain. The agreement between the phobia diagnosis according to the Phobia module of the IDAF-4C$^+$ and the clinical diagnosis of dental phobia according to the ICD-10 was very low, but the validity of the Anxiety and Fear module in relation to other psychometric measures of dental anxiety was good. In conclusion, the prevalence of dental anxiety has decreased over the last 50 years in Sweden, but a significant proportion of the population still reports severe dental anxiety. Individuals with severe dental anxiety are often affected in their everyday life, and individuals with dental pain seem to suffer a greater impact than individuals without dental pain. The IDAF-4C$^+$ is a reliable and valid measure with regard to the Anxiety and Fear module and the Stimulus module offers additive important information, however the Phobia module needs further tests and evaluations.

TANDVÅRDSRÄDSLA HOS VUXNA

Tandvårdsrädsla bör ses som ett folkhälsoproblem då rädslan ofta leder till påtagligt försämrad livskvalitet och dessutom leder till svårigheter för behandlare och kostnader för samhället, men framförallt eftersom tandvårdsrädsla är ett vanligt förekommande fenomen. Avhandlingen består av tre delarbeten och de specifika syftena för respektive delstudie var: I) Att undersöka förekomsten av tandvårdsrädsla bland den vuxna befolkningen i Sverige, att studera relaterade faktorer och att undersöka om det skett någon förändring i förekomst av tandvårdsrädsla över tid. II) Att studera förekomsten av smärta från tänderna bland svårt tandvårdsrädda individer samt om det finns en association mellan tandvärk och oral hälsorelaterad livskvalitet (OHRQoL). III) Att undersöka validiteten för instrumentet the Index of Dental Anxiety and Fear - 4C$^+$ (IDAF-4C$^+$) avseende dess funktion som diagnostiskt test för specifik fobi för tandvård, samt hur väl instrumentet fungerar avseende skattning av tandvårdsrädsla för individer med svår tandvårdsrädsla. Samtliga delarbeten är tvärsnittsstudier och berör vuxna individer. Studie I är en nationell intervjustudie som inkluderade 3500 slumpvist utvalda vuxna individer ur den generella befolkningen i Sverige. Dessa data jämfördes med resultat från en nationell intervjustudie från 1962. Studie II och III består av individer remitterade för svår tandvårdsrädsla som undersöktes kliniskt och med väl etablerade mätinstrument.

Svår tandvårdsrädsla rapporterades av 4.7%, måttlig av 4.5%, låg av 9.8% och 80.9% av de inkluderade individerna rapporterade inte någon tandvårdsrädsla. De viktigaste prediktiva faktorerna var kön (kvinna) och oregelbunden tandvård. En minskning av tandvårdsrädsla sågs över tid. Smärta från tänderna rapporterades av 77.6% bland svårt tandvårdsrädda individer och smärtintensiteten var hög. Majoriteten (85.3%) rapporterade att problem från munnen eller tänderna påverkade vardagslivet. Individer med smärta från tänderna hade lägre OHRQoL jämfört med de som inte rapporterade smärta från tänderna. IDAF-4C$^+$ visade mycket låg validitet som diagnostiskt test för specifik fobi för tandvård, men med avseende att skatta tandvårdsrädsla fungerade IDAF-4C väl.

Tandvårdsrädslan har minskat över en tidsperiod på drygt 50 år, men en betydande andel av den vuxna svenska befolkning lider fortfarande av svår tandvårdsrädsla. En stor andel av svårt tandvårdsrädda individer lider av smärta från tänderna och de har sämre livskvalitet än de som inte rapporterar smärta. IDAF-4C$^+$ är ett instrument som ger mycket information om tandvårdsrädslan som fenomen, användbart både i forsknings- och i kliniska sammanhang, men fobimodulen måste utvecklas ytterligare.

LIST OF ORIGINAL PAPERS

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

I. Svensson, L, Hakeberg M and Wide Boman U. *Dental anxiety, concomitant factors and change in prevalence over 50 years*. Community Dental Health 2016; 33:121–126.

II. Svensson, L, Hakeberg M and Wide U. *Dental pain and oral health-related quality of life in individuals with severe dental anxiety*. Acta Odontologica Scandinavica 2018; 76: 401-406.

III. Svensson, L, Hakeberg M and Wide U. *Evaluating the Validity of the Index of Dental Anxiety and Fear (IDAF4C$^+$) in Adults with Severe Dental Anxiety*. European Journal of Oral Sciences 2020; 128:423-428.

The papers are printed with kind permissions from the publishers.

CONTENT

LIST OF ABBREVIATIONS

α	Level of significance
BT	Behavioral Therapy
CBT	Cognitive Behavioral Therapy
CI	Confidence Interval
DAI	Dental Anxiety Inventory
DAI-S	Dental Anxiety Inventory-Short
DAS	Dental Anxiety Scale
DBS	Dental Belief Survey
DBS-R	Dental Belief Survey-Revised
DCQ	Dental Cognitions Questionnaire
DFRTC	Dental Fear Research and Treatment Clinic
DFS	Dental Fear Survey
DSM-5	Diagnostic and Statistical Manual of Mental disorders, 5th version
FS	Gatchel Fear Scale
HRQoL	Health-Related Quality of Life
ICC	Intraclass correlation
ICD-10	International Statistical Classification of Diseases and Related Health Problems, 10th version
IDAF-4C$^+$	Index of Dental Anxiety and Fear – 4C$^+$
k	Kappa measure of agreement
MDAS	Modified Dental Anxiety Scale

OR	Odds Ratio
OHRQoL	Oral Health-Related Quality of Life
r_s	Spearman's rho correlation
SD	Standard Deviation
SES	Socioeconomic status
SQDA	Single Question of Dental Anxiety
QoL	Quality of Life
VAS	Visual Analogue Scale
WHO	World Health Organization

INTRODUCTION

A significant number of individuals suffering from severe dental anxiety experience a great impact on the many aspects of oral health that affect their everyday life. Although technical advancements in dentistry and the focus on patient involvement in dental care planning, decision-making and communication are more important in today's dentistry, there is still a significant part of the population that feels anxious about dental treatment.

Dental Anxiety

Dental anxiety has been studied scientifically since the 1950s (1). The terms dental fear, dental anxiety and dental phobia are often used interchangeably in the literature to describe the same phenomenon, when individuals show and report different signs and symptoms of anxiety and fear related to dental care. Fear is an emotional reaction to an object or a situation perceived as threatening. The fear response involves strong activation of the sympathetic branch of the autonomous nervous system and involves physical responses. When the threat disappears, the emotional reactions decrease (2). Anxiety is an emotional response and is similar to fear, but anxiety may occur as a reaction to expectations of a potential threat in the future (3). The emotions of anxiety and fear are multidimensional and mostly recognized as being a part of an emotional set of responses with cognitive, behavioral, emotional and physical components. Phobia is an emotional response and described as an unreasonable or excessive, persistent and intense fear triggered by specific objects or situations. It results in an immediate anxiety response that is disproportionate to the actual danger. The individuals avoid or suffer the situation under extreme distress. Phobia is life-limiting and is classified as a clinical mental disorder. Today, there are two international classification systems for psychiatric disorders: the International Statistical Classification of Diseases and Related Health Problems, 10th version (ICD-10), a diagnostic manual issued by the World Health Organization (WHO), which includes all known diseases and psychiatric disorders, and the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5), which is a diagnostic manual issued by the American Psychiatric Association (4, 5). The two diagnostic systems are similar and using one of these for diagnostic purposes of dental phobia makes it possible to compare prevalences and treatment effects from different studies worldwide.

In the following text, the term dental anxiety is used to describe dental anxiety and dental fear. When severe dental anxiety is classified as a specific phobia, the term dental phobia is used.

Assessment

Several measurement techniques are used to assess dental anxiety, such as behavioral rating, physiological measures, self-reported questionnaires and clinical interviews.

The behavioral assessment is more of an objective than a subjective assessment. An individual's behavior may indicate anxiousness, as anxious individuals tend to display more movements generally, and more hand and arm movements specifically, in the waiting room; for instance, before seeing the dentist. In the dentist's office, on the other hand, highly anxious individuals seem to move and talk less and hold their hands clasped together. Just by observing the patient, a great deal of information can be gained about an individual.

An example of a structured behavioral assessment of dental anxiety is the Graded Behavioral Approach Test, which measures the patient's ability before and after treatment in order to illustrate what the patient is prepared to handle in the dental treatment situation. This test starts with the patient entering the room and ends with filling a cavity. The dentist rates the patient's anxiety and behavior at each step (6). Another example is the Dental Operatory Rating Scale, which involves structured grading of the patient's behavior in the treatment situation and quantifies the patient's activity according to the general, specific and postural status (7).

Measures of physiological reactions of anxiety are mostly restricted to research settings and measures skin conductance, heart rate and electromyographic response (8, 9). However, there are limitations to measuring the physiological responses to the anxiety and fear reaction, as no generalized change has been shown between the physiological responses and the dental anxiety (10).

Self-reports can be obtained in two main ways, through clinical interviews or self-reported scales. The clinical interview may serve as the primary diagnostic tool, but self-reported psychometric scales are also essential.

Self-reported scales are commonly used in research settings to estimate prevalence, consequences and treatment effects. Several self-reported psychometric scales to measure dental anxiety have been described in the

literature. A frequently used scale since its development in 1969 is the Dental Anxiety Scale (DAS) (11). Other well-known and commonly used scales to measure dental anxiety are the Dental Fear Survey (DFS) (12), the Modified Dental Anxiety Scale (MDAS), which is derived from the DAS (13), the Single Question of Dental Anxiety (SQDA) (14, 15), the Dental Anxiety Inventory (DAI), a short form of the DAI (S-DAI) (16-18), the Dental Beliefs Scale Revised (DBS-R) (8, 19), and The Index of Dental Anxiety and Fear (IDAF-4C^{+}) (20). These tests range from single-item tests to multiple-item tests including 36 items. A dental anxiety classification based on single-item self-reports or few-item scales are most commonly found in epidemiological or observational studies, while the multiple-item scales are found in clinical research and used in clinical work. These self-reports capture different aspects of the multidimensional nature of the anxiety and fear response, and it is argued that most of them are not considered to provide a perfect assessment of the construct of anxiety and fear (21, 22).

The IDAF-4C^{+} is the most recent contribution to the psychometric measurements of dental anxiety. The IDAF-4C^{+} considers the multidimension-al nature of dental anxiety, it is based on the theory of emotions and said to have a stronger theoretical basis than other existing scales. The scale includes three parts, the first (IDAF-4C) includes eight items covering cognitive, behavioral, emotional and physiological responses to dentistry, where the cognitive dimension is a new aspect of the dental anxiety response. The second part involves screening for dental phobia based on the DSM IV and diagnostic differentials, which were not included in previous scales. The third part is about anxiety and fear response stimuli. The IDAF-4C^{+} has shown good results regarding validity and reliability in epidemiological studies and in clinical studies with non-dentally anxious participants, but has not been evaluated in a clinical population with severe dental anxiety (20, 23-25).

Epidemiological aspects of dental anxiety

The prevalence of dental anxiety among adults has been a subject of investigation globally during the past 60 years (Table 1). The prevalence of dental anxiety varies between 0.9 and 37.0% (Table 1). If reports of dental phobia are excluded, a prevalence of dental anxiety between 3.0 and 37.0% is obtained. However, there are only a few reports on dental phobia prevalence and these studies show less varied results with a reported prevalence of 0.9-4.5%. This indicates that dental phobia is one of the more common specific phobias (26).

A common finding in the population-based prevalence studies is that dental anxiety is more prevalent among women than men (23, 27-42), but there are some reports that show no difference between genders (26, 43). Another commonly reported factor is socioeconomic status (SES), measured as low education, low income and/or low social class. There are several studies that show a negative relationship between SES and dental anxiety (29-31, 33, 44), while other studies do not confirm these results (28, 40, 45).

Changes in dental anxiety in the general population are dependent on different effects, such as cohort, age and time effects. There are studies that indicate an age effect, where the level of dental anxiety decreases among older individuals (28, 30, 31, 33, 38). Longitudinal changes are studied by follow-up measures of a cohort (46, 47). In order to analyze changes in the levels of dental anxiety in the general population at different time points, time effects may be evaluated by using repeated cross-sectional surveys (48).

It is more than half a century since a population-based study of dental anxiety prevalence was conducted in Sweden. There is a need for prevalence studies of the current situation to understand and assess the influence of dental anxiety at community level, for health care planning and education.

Table 1. *Studies on the prevalence of dental anxiety in adult general populations by region, presented in chronological order.*

Author and year	Country	Setting	Design	Participants	Age	Measure-ment	Cutoff	Prevalence, %
	Sweden							
Svensson et al., 2016 (49)	Sweden	Telephone interview	Repeated cross-sectional	3500	≥ 19	SQDA	Severe	4.7
Wide Boman et al., 2012 (50)	Sweden	Questionnaire, clinical examination	Cross-sectional	500 women	38, 50	DFS	≥ 60	10.5
Hägglin et al., 1999 (46)	Sweden	Questionnaire	Longitudinal	375 women	66-82	SQDA	Very afraid /terrified	1968/69:12.8 1996: 5.6
Hägglin et al., 1996 (51)	Sweden	Questionnaire, clinical examination	Cross-sectional	1016 women	38-84	DAS	≥ 15	3.9
Hakeberg et al., 1992 (40)	Sweden	Telephone interview	Cross-sectional	620	≥ 15	FS DAS	≥ 8 ≥ 15	6.7 5.4
Hällström et al., 1984 (44)	Sweden	Face to face interview, clinical examination	Cross-sectional	784 women	38-54	SQDA	Anxiety Phobia	13.4 4.3
Håkanson, 1978 (52)	Sweden	Face to face interview, clinical examination	Cross-sectional	1164	20-60	SQDA	≥ yes, rather much Yes, very much	13.2 6.5
SIFO, 1962 (53)	Sweden	Face to face interview	Cross-sectional	970	15-75	SQDA	High	15.1
	Other Nordic countries							
Liinavuori et al., 2016 (30)	Finland	Face to face interview, clinical examination	Longitudinal	3961	≥ 19	SQDA	Very much	2000: 9.0 2011: 6.0
Åstrøm et al., 2011 (54)	Norway	Mailed questionnaire	Repeated cross-sectional	1997: 736 2007: 1509	25	DAS	≥ 13	1997: 17.5 2007: 16.7
Lahti et al., 2007 (55)	Finland	Face to face interview	Cross-sectional	6857	≥ 30	SQDA	≥ Somewhat afraid	37.0
Viinikangas et al., 2007 (34)	Finland	Questionnaire	Cross-sectional	698	18-87	SQDA MDAS	Very afraid ≥ 19	12.0 8.0

Study	Country	Method	Design	Sample size	Age	Instrument	Cut-off	Prevalence
Schuller et al., 2003 (56)	Norway	Questionnaire, clinical examination	Cross-sectional report but longitudinal design	1295	35-64	DAS	≥ 13	6.6
Ragnarsson et al., 2003 (39)	Iceland	Mailed questionnaire	Cross-sectional report but longitudinal design	1192	27-39	DSM-IV	Anxiety Phobia	8.1 1.8
Haugejorden et al., 2000 (57)	Norway	Mailed questionnaire	Cross-sectional	DAS: 346 MDAS: 358	25	DAS MDAS	DAS ≥ 13 DAS ≥ 15 MDAS ≥ 17 MDAS ≥ 19	17.0 9.0 17.0 12.0
Ragnarsson, 1998 (58)	Iceland	Face to face interview, clinical examination	Cross-sectional	1548	25-74	SQDA	≥ Somewhat afraid ≥ Very/ severe	10.0 5.0
Schwarz et al., 1995 (38)	Denmark vs. China	Face to face interview	Cross-sectional	Danes: 313 Chinese: 881	35-44 and 65-74	DAS	≥ 12 ≥ 17	Danes: 15.0 Chinese: 30.0 Danes: 3.0 Chinese: 4.0
Moore et al., 1993 (59)	Denmark	Telephone interview	Cross-sectional	565	16-96	DAS	≥ 12 ≥ 15	10.2 4.2
Vassend, 1993 (36)	Norway	Face to face interview, questionnaire	Cross-sectional	I: 1288 II: 2382	≥15	I:DAS I:FS II: SQDA	≥ 15 ≥ 8 Yes, very	4.2 7.1 5.4
Neverlien, 1990 (15)	Norway	Face to face interview, questionnaire	Cross-sectional	1351	15-79	DAS SQDA	≥14 Yes, very	8.0 9.0
Other countries in Europe								
Heidari et al., 2015 (60)	UK	Questionnaire, clinical examination	Cross-sectional	10990	≥ 16	MDAS	≥ 19	12.4
Kirova et al., 2010 (61)	Bulgaria	Face to face interview, questionnaire	Cross-sectional	746	18-82	DAS	≥ 13 ≥ 15	29.9 11.7
Humphris, 2009 (62)	UK	Telephone survey	Cross-sectional	963	≥ 18	MDAS	≥ 19	11.6
Oosterink et al., 2009 (26)	Netherlands	Questionnaire	Cross-sectional	1959	18-93	Single question DSM-IV	Fear Phobia	24.3 3.7

Study	Country	Method	Design	N	Age	Instrument	Definition	Prevalence
Nicolas et al., 2007 (63)	France	Mailed questionnaire	Cross-sectional	2725	16-101	DAS	≥ 13 ≥ 15	13.5 7.3
Enkling et al., 2006 (41)	Germany	Face to face interview, questionnaire	Cross-sectional	144	20-60	HAQ	Severe anxiety > 38 Phobia > 38 and > 2 yrs. avoidance	17.0 11.0
McGrath et al., 2004 (64)	UK	Face to face interview	Cross-sectional	1800	≥ 16	DAS	≥ 15	11.0
Nuttall et al 2001 (65)	UK	Interview, clinical examination	Repeated cross-sectional	1998: 3817	≥ 16	Single question (yes/no)	Anxious	1998:32.0 1988: 30.0
Bedi et al., 2000 (66)	UK	Face to face interview	Cross-sectional	973	≥ 60	DAS	≥ 13 ≥ 15	13.0 6.0
Mellor, 1992 (67)	UK	Questionnaire	Cross-sectional	255	17-64	DAS	≥ 13 ≥ 15	20.0 13.3
Stouthard et al., 1990 (42)	Netherlands	Questionnaire	Cross-sectional	648	≥ 16	STAI-S or STAS	Severe anxiety Phobia	17.9 3.9
Schuurs et al., 1985 (68)	Netherlands	Questionnaire	Cross-sectional	620	30-40	DAS	≥ 15	7.0
North America								
Bell et al., 2012 (69)	US	Face to face interview, clinical examination	Cross-sectional	541	≥ 60	DAS	≥ 13	12.4
Locker, 2003 (70)	Canada	Mailed questionnaire	Cross-sectional report but longitudinal design	1207	≥ 18	DAS or FS or SQDA	≥ 12 or ≥ 8 or ≥ very afraid or terrified	11.2
Maggirias et al., 2002 (71)	Canada	Mailed questionnaire	Longitudinal	1422	≥ 18	DAS	≥ 12	1993/94: 15.5 1998/99: 13.0
Doerr et al., 1998 (29)	US	Face to face interview	Cross-sectional	455	≥ 18	DAS-R	≥ 13	10.0
Locker et al., 1997 (72)	Canada	Mailed questionnaire	Cross-sectional report but longitudinal design	1420	≥ 18	DAS or FS or SQDA	≥ 13 ≥ 8 ≥ very afraid or terrified	13.6
Elter et al., 1997 (37)	US	Face to face interview, clinical examination	Cross-sectional report but a	548	≥ 65	DAS	≥ 12	14.0

Reference	Country	Method	Design	N	Age	Scale	Cutoff	Prevalence
Locker et al., 1996 (73)	Canada	Mailed questionnaire	longitudinal design Cross-sectional	2729	≥ 18	DAS FS SQDA	≥ 13 ≥ 8 ≥ very afraid or terrified	10.9 8.2 23.4
Locker et al., 1995 (74)	Canada	Telephone and face to face interview, questionnaire, clinical examination	Longitudinal	272	≥ 50	DAS	≥ 13	1989: 7.0 1992: 5.4
Locker et al., 1991 (35)	Canada	Telephone and face-to-face interview, questionnaire, clinical examination	Cross-sectional report but a longitudinal design	580	50-89	DAS	≥ 13 ≥ 15	8.4 4.4
Gatchel et al., 1989 (27)	US	Telephone interview	Repeated cross-sectional	1989:1882 1983:105	≥ 18	FS	≥ 8	11.2 11.7
Milgrom et al., 1988 (14)	US	Telephone interview, mailed questionnaire	Cross-sectional	1010	18-94	SQDA	≥ very afraid terrified	7.3 3.0
Gatchel, 1983 (75)	US	Telephone interview	Cross-sectional	105	≥ 18	FS	≥ 8	11.7
South America								
Goettems et al., 2014 (76)	Brazil	Interview	Cross-sectional	608 women	16-50	DAS	≥ 15	22.4
Oceania								
Ibrahim et al., 2017 (23)	New Zeeland	Mailed questionnaire	Cross-sectional	253	35-54	IDAF-4C DAS	≥ 3 ≥ 13	13.0 18.6
Armfield et al., 2015 (77)	Australia	Mailed questionnaire	Cross-sectional	596	18-94	IDAF-4C	≥ 2.5	21.4
Armfield, 2010 (78)	Australia	Mailed questionnaire, telephone interview	Cross-sectional	1084	≥ 18	IDAF-4C+ DAS SQDA	≥ 3 Phobia ≥ 13 ≥ moderate anxiety	14.6 0.9-4.9 18.1 18.8

Reference	Country	Method	Design	Sample	Age	Measure	Cut-off	Prevalence (%)
Armfield et al., 2009 (79)	Australia	Telephone interview, clinical examination	Cross-sectional	5364	18-91	SQDA	≥ very afraid extremely afraid	9.5 / 4.4
Thomson et al., 2009 (80)	New Zeeland	Questionnaire, clinical examination	Longitudinal	828	15-32	DAS	≥ 13	15 yrs. 10.4 / 32 yrs. 18.4
Armfield et al., 2006 (31)	Australia	Telephone interview	Cross-sectional	7312	≥5	SQDA	≥ yes, quite Yes, very	16.1 / 11.3
Locker et al., 2001 (81)	New Zeeland	Questionnaire, face to face interview, clinical examination	Cross-sectional report but a longitudinal design	805	18	DAS / DSM-III-R	≥ 13 / ≥ 15 / Phobia	12.5 / 4.5 / 1.0
Thomson et al., 2000 (82)	New Zeeland	Questionnaire, clinical examination	Longitudinal	790	18, 26	DAS	18 yrs. ≥ 13 / 26 yrs. ≥ 13	12.5 / 21.1
Thomson et al., 1999 (83)	New Zeeland	Mailed questionnaire	Cross-sectional	249	≥ 15	DAS	≥ 13	20.5
Thomson et al., 1996 (28)	Australia	Telephone interview, mailed questionnaire	Cross-sectional	1010	18-90	DAS	≥ 13	14.9

DAS: Dental anxiety scale
DAS-R: Dental anxiety scale-revised
DFS: Dental fear survey
FS: Gatchel fear scale
HAS: Hierarchical anxiety scale
IDAF-4C[+]: Index of dental anxiety and fear
MDAS: Modified dental anxiety scale
STAI-S: Spielberger's State Anxiety Inventory
STAS: State-Trait Anger Scale
SQDA: Single question of dental anxiety
VAS: Visual analogue scale

Etiology

The onset of dental anxiety often occurs during childhood or adolescence (84). Locker et al. reported an onset during those years in 72.9% of patients, and Hällström et al. in as much as 88% (44, 85). Klingberg et al. have illustrated this multidimensional nature of dental anxiety with a model shown in Figure 1. The model may explain how factors (individual, external and dental) interact to contribute to the development of dental anxiety (86).
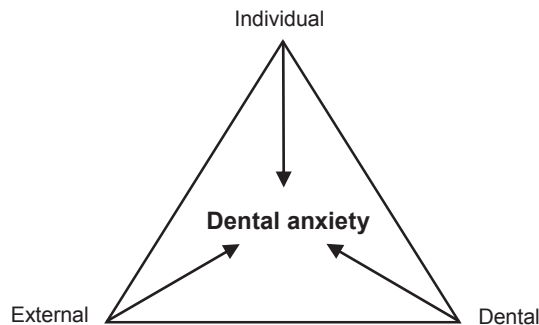

Individual

Dental anxiety

External   Dental

Figure 1. Etiological model of dental anxiety (86). Reproduced with permission from John Wiley & Sons – Books. G. Koch & S. Poulsen. 2009. Pediatric dentistry: A clinical approach page 34.

The most common **dental factor** contributing to the development of dental anxiety is a negative dental treatment experience. There are several dental factors that could contribute to an overall negative experience of dental care. The most frequently reported experience is pain, and other experiences are perceived lack of control, rough dentist, violation of personal space and discomfort.

Classical conditioning or direct learning is a part of learning theory (87). This theory is useful to explain the correlation between experiencing negative events in dental care and dental anxiety (88). Reporting negative events in dental situations early in life is overrepresented among dentally anxious individuals (89), and several negative events predispose even more for dental anxiety (89, 90). A majority of individuals with dental anxiety report experience of painful treatment, usually in combination with lack of control (91).

Individual factors affect the way the individual perceives an experience. Individuals with other fears and psychological disorders are overrepresented

in populations with severe dental anxiety (81, 92-94). Overall, high dental anxiety is strongly positively correlated to high levels of other specific phobias, depression, mood disorders and other psychiatric disorders and symptoms (95). This is seen in both observational and clinical studies.

Other individual factors related to dental anxiety are temperament and, possibly, genetic factors. Temperaments shown to be associated with dental anxiety are shyness, inhibition, negative emotionality and the personality trait of neuroticism (96-98).

It is more probable that you inherit a genetic vulnerability to anxiety than the phobia itself (3, 88, 91). Adult onset of dental anxiety has been shown to be influenced by individual factors more often than childhood onset (85).

External factors may be seen as social transmission from siblings or friends, social environment attitudes, the cultural context and social situations. Through vicarious experiences, the individual develops a fear response by seeing fear responses in others, often in their own family. Another way to learn the response is through transmission of negative information, where the individual develops a fear response through receiving information about the danger from others (3, 88, 91). Experiencing different traumas (torture, sexual abuse, and assault) has also been shown to contribute to individual vulnerability and to the development of dental anxiety (99-101).

Individual and external factors together explain the individual's vulnerability to the exposure and experience of dental treatment. Dental factors are those that the dental profession may alter in order to prevent or even treat dental anxiety.

Maintenance and consequences of dental anxiety

In 1984, Berggren explained how dental anxiety is maintained, using the model illustrated in Figure 2. He called the model the *vicious circle of dental phobia*. When an individual with dental anxiety starts to avoid dental treatment due to anxiety, the avoidance provides instant relief, but will lead, in time, to a deteriorated dentition with resulting feelings of shame, guilt and embarrass-ment in social and dental situations for the affected individual (102). This behavior is believed to create a feedback loop (vicious circle) that maintains the dental anxiety. The effects will increase with time (103, 104).
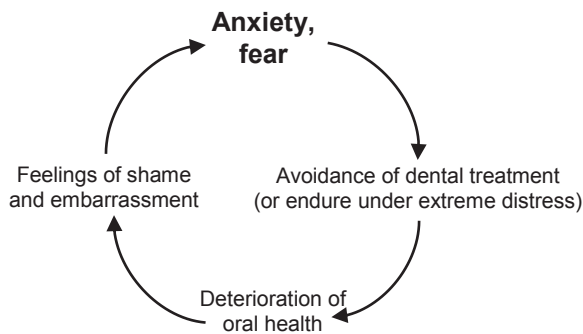
Figure 2. *The vicious circle of dental phobia. Modified from Berggren, 1984.*

Berggren's model has been studied and discussed in the literature and there is evidence to confirm but also to justify further development of the model (105-107). Armfield has shown that 38.5% of individuals with high or moderate dental anxiety fit the vicious circle of dental anxiety (105). Armfield (107) focused on symptom-driven treatment as a consequence of avoidance and deterioration of the dentition as the third step in the circle where Berggren and Hakeberg highlight the psychosocial consequences of dental anxiety (102, 103). De Jongh et al. reported that when controlling for deterioration of the dentition, the psychosocial consequences become less pronounced (106). These results strengthen Berggren's model of maintenance of dental anxiety.

Avoidance

The first step in Berggren's circle is avoidance of dental care. Dentally anxious individuals more often avoid or attend dental care only occasionally than non-anxious individuals (27-29, 32, 45, 47, 48).

Measurement of avoidance of dental attendance is mostly done through self-reported single questions about the last dental visit or the frequency of regular dental visits. There is strong support in the literature for an association between high dental anxiety and avoidance of dental care, independently of country and culture, but there is, of course, a variability in the degree of this avoidance behavior. There is a span from highly dentally anxious individuals who attend dental care regularly, but with severe mental suffering, to individuals who are irregular attenders or who seek dental care in an emergency or occasionally for check-ups, and those who completely avoid dental care (10).

What all dental health caregivers have to remember is that most dentally anxious individuals attend dental care regularly, in spite of their dental anxiety but with severe mental suffering (36, 40, 45, 51, 108). The vicious circle of dental anxiety does not include those individuals. The international diagnostic manuals ICD and DSM have changed their classification for specific phobias during the last decades. None of these systems now includes the criterion of total avoidance of the specific subject or situation, but a criterion of avoidance **or** endurance under extreme distress. It would be reasonable to amend the vicious circle of dental anxiety in the same way as the diagnostic manuals have been modernized.

Oral health

The consequences of avoidance behavior may affect the individual severely. A consequence of avoidance behavior due to high dental anxiety for the majority of individuals is poor oral health (79, 93, 109-111).

In 2012, WHO defined oral health as *"a state of being free from mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal (gum) disease, tooth decay, tooth loss and other diseases and disorders that limit an individual's capacity for biting, chewing, smiling, speaking and psychosocial well-being."* In other words, the concept of oral health entails both the physical and psychosocial aspects of oral disease (112).

Studies show that dentally anxious patients have more missing teeth, more caries lesions, more apical periodontitis and fewer filled teeth than controls (44, 56, 79, 113, 114). Results for the association between periodontitis and dental anxiety are contradictory. There are results indicating greater attach-ment loss among highly dentally anxious individuals than among controls (113), but others have not found this relationship between high dental anxiety and periodontitis (79, 114-116). Except for periodontitis, findings indicate a gradient relationship between dental anxiety and oral health; the higher the dental anxiety levels, the greater the negative effect on the dentition (44, 79, 116).

Furthermore, dentally anxious individuals who report regular dental visiting habits show a significantly healthier dentition, a dental status similar to those with no dental anxiety, and less severe psychosocial consequences than avoiders of dental care (45, 110, 111, 117).

The most commonly used and widely accepted definition of pain is the definition by the International Association of the Study of Pain (IASP, 1979): *"Pain is an unpleasant sensory and emotional experience associated with*

actual or potential tissue damage." This definition highlights the subjective aspect of the nature of pain. Dental pain may be defined as pain that originates from the innervated tissues within the tooth or immediately adjacent to it (118), and is often seen as a subcategory of the broader term orofacial pain. The most common origin of dental pain is dental caries.

A review of dental pain prevalence from 2003 found five definitions of dental pain: toothache, pain in teeth when ingesting hot/cold or sweet things, pain and discomfort requiring medication or treatment, pain or discomfort of the teeth or gums, and orofacial pain. The prevalence of dental pain varied greatly (7-66%) and the authors highlighted the methodological limitations of the included studies (119). From a Swedish point of view, there is a report from 1989 in which the prevalence of head, neck and mouth pain was estimated at 14.6%, but dental pain was not specified (120). Hägglin et al. estimated in 1996 the dental pain prevalence to be 16.0% among adult women and 17.0% among highly dentally anxious women (51).

The prevalence of dental pain and its effect on quality of life among populations suffering from dental anxiety are unknown, although the correlation between dental anxiety and poor oral health is well established. Armfield has described symptom-driven dental treatment as a consequence of avoidance and deteriorated dental health as the third step in the vicious circle of dental anxiety (107). Dental pain could also be seen as an additional path in the vicious circle of dental anxiety that aggravates the psychological consequences of the condition.

Psychological and social consequences

Long-standing dental anxiety may produce severe psychological consequences in those affected. Deteriorated oral health is associated with shame and feelings of inferiority, and negative social consequences, which may lead to impaired quality of life. In 1993, Berggren reported psychosocial consequences due to dental anxiety and avoidance behavior, and it was shown that the participants reported a range of negative effects on their social life, where the dimensions of emotional reactions and effects on everyday life were considered to be the most affected (121). A majority of the participants experienced an impact on their relations to other people, but feelings of loneliness/isolation and of being easily upset or losing their temper were also frequent. Locker showed that more than 93% of the individuals reported one or more psychosocial problems due to their dental anxiety (70). Others confirm these negative effects (45, 111, 122, 123). Highly dentally anxious individuals reported emotional consequences due to dental anxiety, which made them angry, ashamed and

depressed. The social effects reported were interference with family relationships, intimate relationships and relations to friends and working life (93). A reduction of negative psychosocial effects after behavioral treatment has been reported (124). An important part of the psychological consequences of dental anxiety seems to be related to avoidance behavior and the impact on oral status; thus, regular attenders, often with favorable dental status, do not report as severe psychosocial consequences as avoiders (111, 121).

Individuals with severe dental anxiety have reported high levels of psychosomatic symptoms like headache, stomach problems, sleep disturbances, and frequent use of alcohol and sedatives (121).

The concept of oral health-related quality of life (OHRQoL) brings a very important aspect to clinical dental care and research, where the focus is on the patient rather than the oral cavity. The multidimensional and complex nature of the concept has made it hard to define, and there is still no consensus on the definition, but all definitions in use today originate from WHO's definition of health from 1948 (125). Although there are several different definitions of the concept, there are areas of consensus. Overall, there is consensus about the multidimensional nature of the quality of life (QoL) concept and that QoL is a dynamic concept, which changes with the individual's perception of health-related quality of life (HRQoL) over time. HRQoL includes multiple overlapping related domains of functioning and the focus is on the individual's assessment of how these different factors of functioning affect overall well-being (126).

Inglehart and Bagramian explained the concept of OHRQoL as the individual's assessment of how function, experience of pain and discomfort, psychological and social aspects affect overall well-being (Figure 3) (127).
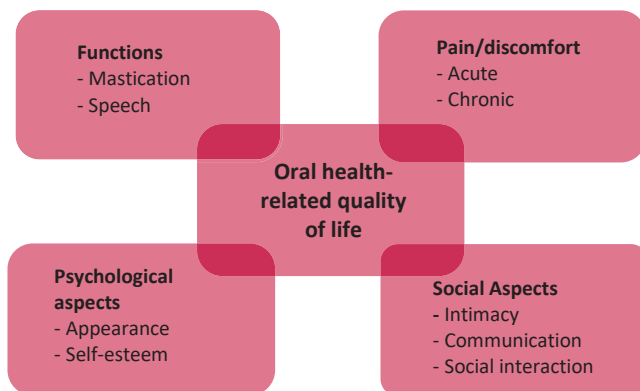
Figure 3. *The main components of OHRQoL according to Inglehart and Bagramian (127). Reproduced by permission from Quintessence Publishing. Inglehart & Bagramian. 2002. Oral Health-Related Quality of Life page 3.*

In 2007, Mehrstedt, comparing a population with dental anxiety with a sample from the general population, showed a significant impact of OHRQoL on the population with dental anxiety. The population with dental anxiety showed a greater impact due to symptoms affecting function, stress levels, self-consciousness, embarrassment and dissatisfaction with life, in particular (128). This correlation has been shown in other studies as well (114, 129) and a gradient relationship has also been shown, where the degree of impairment is related to the extent of the dental anxiety (116). A clinical trial of behavioral treatment of dental anxiety showed an improvement in OHRQoL and oral health due to treatment. Especially the reduction in dental anxiety levels predicted an improvement in OHRQoL (130).

In a recent study, the impact of disease on a highly dentally anxious sample was compared with the impact on a sample of a general population, measured with both OHRQoL and general HRQoL measures. Highly dentally anxious individuals showed significantly more impact measured with both the specific (OHIP-14) and the generic scale (EQ-5D-5L). Highly dentally anxious individuals reported a greater impact on all domains than the controls, and the most severely affected domains were psychological discomfort, psychological disability and physical pain. An important difference was seen in reported HRQoL, where 48.7% of the controls but no more than 7.9% of the patients reported excellent HRQoL (131).

Treatment

Adult patients suffering from severe dental anxiety may be referred to specialized clinics. The treatment methods offered are usually adapted conventional dental treatment, treatment using different sedatives and behavioral interventions to treat the dental anxiety. Sedatives (conscious sedation, deep sedation via intravenous sedation, general anesthesia) are common when treating dentally anxious patients to help them cope with the dental treatment or to prevent anticipatory anxiety, and to facilitate a dental appointment (132-134). Sedatives are useful when dental treatment is the primary goal, for example, in emergency dental care, but the effect on dental anxiety is limited (135, 136).

Behavioral therapy (BT) and cognitive behavior therapy (CBT) are the most widely accepted psychological treatments for specific phobias and there is evidence of the efficacy of the treatment on dental anxiety/phobia specifically (137). CBT is a broad form of psychotherapy and includes both BT, such as exposure, systematic desensitization and relaxation, and cognitive interventions (reconstruction of negative thoughts and beliefs). CBT is often based on learning theory and on a cognitive-behavioral model of emotions. It includes general and disorder-specific treatment methods and is structured and action-oriented, with the aim to address the patient's problems (138). In a review of psychological treatment from 2013, Wide Boman et al. found that there is support in the literature for behavioral interventions to treat severe dental anxiety and that CBT/BT improves patient acceptance of dental treatment (139). Gordon et al. found that CBT techniques delivered in a variety of formats, modalities and quantities are effective in reducing dental anxiety and avoidance (140). Both studies highlight the methodological limitations of the included studies and the need for good quality studies (139, 140).

Psychological behavioral treatment is the treatment of choice when the purpose of treating dental anxiety is to reduce dental anxiety levels in the short and long term and to make conventional dental treatment possible.

Two out of three studies in this thesis are based on clinical data from patients referred to the Dental Fear Research and Treatment Clinic (DFRTC) in Gothenburg, which is a part of the Clinic of Oral Medicine, Public Dental Service, Region Västra Götaland. Dental phobia treatment and research have been conducted at the clinic since 1975. Patients at the clinic are referred from dental or general caregivers or are self-referrals (141).

Within the DFRTC, there are interdisciplinary teams treating severely dentally anxious individuals. The teams include dentists, dental nurses, dental hygienists and psychologists experienced in CBT. The dental phobia treatment is integrated with the dental treatment and both a psychologist and a dentist are involved in the dental phobia assessment. The dental phobia treatment is given as CBT and performed by the psychologist at the clinic and, as a final part, dental treatment is provided by the dental team to demonstrate what the patient has learned and to ensure better oral health. The goal of the dental phobia treatment is to treat the dental phobia and make conventional dental treatment possible in the future and, eventually, to refer patients to general dental care outside the DFRTC (142). The clear structure of the treatment is described in a manual used today in multicenter clinics in the region in order to increase the accessibility of dental care and treatment of dental anxiety (143).

Dental phobia treatment may be covered by the national health insurance system in Sweden, if the patient and caregivers fulfil the criteria that must be approved for each individual case (141, 142).

AIM

The overall aim of this thesis was to gain knowledge about adults suffering from dental anxiety by studying the current prevalence of dental anxiety and concomitant factors and the impact of dental pain on everyday life among individuals suffering from severe dental anxiety. A further aim was to evaluate the validity of the psychometric measurements used to study dental anxiety and dental phobia.

Specific aims

Study I

The specific aims of this study were:

- to analyze the prevalence of dental anxiety;
- to study risk indicators for dental anxiety;
- to analyze changes in dental anxiety prevalence over time.

Study II

The specific aims of this study among severely dentally anxious individuals were:

- to analyze the prevalence and intensity of dental pain;
- to study the relationship between dental pain, oral health-related quality of life, and dental anxiety.

Study III

The specific aim of this study among severely dentally anxious individuals was:

- to evaluate a new psychometric dental anxiety scale (IDAF-4C+) specifically with regard to its phobia module.

MATERIALS AND METHODS

Study I

Design and participants

Study I is a cross-sectional study based on 3500 randomly selected participants from the general adult population (≥ 19 years) in Sweden in 2013. The randomization procedure and the data sampling were performed by TNS-SIFO, a Swedish telemarketing company performing public opinion and marketing surveys. The participants were randomized from the Swedish Personal Address Register (SPAR), which includes all residents in Sweden and is updated daily with data from the Swedish Population Register. Fixed and mobile phone numbers were used in the inclusion process. Subjects who did not speak Swedish were excluded. The study sample was assessed through a telephone survey based on a questionnaire including a total of 38 questions. The response rate was 49.7%. The study was approved by the Regional Ethical Review Board in Gothenburg (reg. no. 801-12).

Measures

A selection of questions from the questionnaire used in the telephone survey was used to study dental anxiety in relation to other factors. Dental anxiety was measured using the SQDA, "Are you anxious about going to the dentist", with the response options: "no, "a little", "yes, quite" and "yes, very". The SQDA is commonly used in epidemiological studies about anxiety, is easy to administer and has shown good validity and reliability in relation to other measures of dental anxiety (14, 15, 34, 46).

Education was measured with a question about the highest level of education achieved and was used as a proxy for SES.

Oral and general health were measured with single questions. One question was about the importance of good oral health in relation to general well-being and one question was about satisfaction with teeth esthetics.

Oral and general health-related behavior was measured with a sequence of single questions covering tooth brushing frequency, use of interdental brushes/toothpicks, dental flossing, dental attendance, physical activity/exercise and smoking.

The prevalence study from 1962

A cross-sectional population-based study from 1962 (53) was used to be able to analyze the prevalence of dental anxiety over time and to study attendance patterns and gender distribution. SIFO performed the randomization using systematic random sampling based on the Swedish Population Register. The data sampling was conducted through face to face interviews. Individuals aged 12-75 years were asked to participate. Questions about dental care were asked individuals aged 15 years or older. Individuals who did not speak and understand Swedish or suffered from deafness or severe illness were excluded. A total of 970 participants were included in the analysis, giving a participation rate of 78.1%.

The data collected related to demographic variables (age, gender, place of residence and social class) and dental care (dental care visits, removable dentures, dental attendance, prevalence and impact of anxiety on dental attendance). We had no access to the original data, only to the data published in the report from 1962 (53). The variables used in the analysis were gender, prevalence of anxiety and dental attendance.

Study II and III

Design and participants

Studies II and III had a cross-sectional design and the participants were consecutively recruited among adult patients with dental anxiety referred to the Clinic of Oral Medicine in the Public Dental Service, Gothenburg, Region Västra Götaland. Severe dental anxiety was defined as DAS ≥ 13. In study II, the criterion DFS ≥ 60 was added. The two studies were approved by the Regional Ethical Review Board in Gothenburg (reg. no. 395-10).

As a part of the standard procedure at the clinic, new patients complete a battery of scales measuring demographic variables, dental attendance, and dental anxiety. Study II included 219 participants, 35 of whom declined participation, and 14 were excluded, which left a total study sample of 170 participants. Study III included 193 participants, 46 of those had one or more incomplete psychometric scales and were excluded, leaving a study sample of 147 participants.

Measures

The measures and questions included in Study II and III are shown in Table 2.

Table 2. *Measures and questions included in Study II and III, respectively.*

Measurement	Study II	Study III
DAS	x	x
DFS	x	x
MDAS		x
IDAF-4C+		x
OIDP	x	
Dental pain	x	
Self-rated oral and general health	x	
Clinical variables of oral status	x	
Clinical diagnosis of dental phobia (ICD-10)		x

The DAS was first described in 1969 and developed to assess dental anxiety (11), and is one of the most commonly used scales. The scale consists of four items about imagined dental situations and answers rated on a five-point Likert scale from one to five, but the wording of the response options differs between the first and the following three questions (Appendix I). A total sum of scores between 4 and 20 is given. A score of ≥ 13 indicates dental anxiety and ≥ 15 indicates severe dental anxiety (17, 144). Population mean scores have been reported between 7 and 10 (23, 38, 51, 69, 70, 76). The DAS measures trait anxiety and partially state anxiety. The scale has shown good reliability and validity and has been translated into several languages (17, 21).

The Dental Fear Survey (DFS) was developed in 1973 and has been frequently used since then (12). The DFS measures anticipation anxiety, avoidance, physiological arousal and fear of specific stimuli and ends with an item about dental fear in general (17) (Appendix II). The scale consists of 20 items with answers rated on a five-item Likert scale scored from 1-5 on each item, giving a sum score between 20 and 100, where a higher score indicates more anxiety. A sum score ≥ 60 indicates high levels of dental anxiety (48, 50, 90, 145) and ≥ 70 is reported for individuals with severe anxiety (17, 146). The scale has shown good validity and reliability and is widely used (146). Normative mean scores have been reported to be 49.1 in a population of middle-aged Swedish

women (50) and mean scores among 18-year-old Norwegians have been reported to be 43.6 in 1996 and 34.2 in 2006 (48, 90).

The Modified Dental Anxiety Scale (MDAS) (Appendix III) is derived from the DAS and includes a question about local anesthetics. It was first described in 1995 (13). The MDAS includes five questions covering imagined dental situations, and responses are given on a five-point Likert scale graded from 1 (not anxious) to 5 (extremely anxious), giving a total maximum sum score of 25. Scores ≥ 19 indicates high levels of dental anxiety. The scale has shown good reliability and validity scores (13). Normative mean scores between 10 and 11 have been reported for a UK population (33, 62).

The Index of Dental Anxiety and Fear (IDAF-4C^{+}) is the most recent psychometric measurement of dental anxiety (Appendix IV) (20). The IDAF-4C^{+} includes the multidimensional nature of anxiety and is based on the theory of emotions, considering the cognitive, behavioral, emotional and physiological components of the fear and anxiety response. The scale includes three parts, the first being the module about dental anxiety and fear (IDAF-4C). This module includes eight items, where two items each cover the cognitive, behavioral, emotional and physiological responses to dentistry (4C). Answers to each item are given on a five-point Likert scale from one (disagree) to five (strongly agree). A mean sum score is often calculated (range 1-5) and ≥ 3 indicates a high level of anxiety (20). Normative mean average scores between 1.8 and 1.9 have been reported (23, 77, 147). The second part is a screening tool for dental phobia including five items, where the first three items are related to diagnostic specifiers and the following two are diagnostic differentials, with the possible answers of yes or no. Affirmative answers to the three first questions and negative answers to the latter two, together with a mean sum score ≥ 3 on the first part of the scale (IDAF-4C), indicate a strict diagnosis of specific phobia based on DSM IV. Armfield also describes a relaxed diagnosis of dental phobia, where an affirmation of the criterion that the fear should be excessive or unreasonable is not needed. The third part of the IDAF-4C^{+} is about anxiety and fear response stimuli (IDAF-S). This part, as well as the phobia module, are not seen as parts of a scale but as additional information about the individual's dental anxiety response. Items are graded on a five-point Likert scale from 1 (not at all) to 5 (very much) (20). The IDAF-4C^{+} has shown good validity and reliability scores and has been translated into several different languages (20, 24, 25, 148).

OHRQoL was captured using the OIDP administered as a structured interview by a dentist (Appendix V). The original OIDP version contains eight items but was later developed into a nine-item scale as well (149). This scale was

developed to be used in conjunction with normative measures to evaluate the treatment needs of a population and in dental health care planning. The scale measures the behavioral impacts of oral disease and the ability to perform physical, psychological and social tasks with items covering impacts of pain, discomfort, functional limitation and dissatisfaction with appearance. These areas of impact are supposed to capture the disability and handicap concepts of the international classification of impairments, disabilities and handicaps (ICIDH) model, issued by the WHO and modified for oral health and dentistry by Locker (150). The OIDP measures both the frequency and severity of each performance. A total score is the sum of the scores of all performances. Commonly, the prevalence of one or more confirmed oral impact is reported. The scale has shown good validity and reliability (149, 151, 152). The normative OIDP total score (OIDPsc) of a Swedish adult population has been estimated to 4.5 (mean), and 40% of the population reported that they had at least one oral impact (151).

Self-rated oral and general health and SES were captured with single questions. Self-rated oral and general health were rated on a 100mm Visual Analogue Scale (VAS), graded from the worst possible (0) to the best possible (100). A question was asked about the highest level of education, with the following alternatives: elementary school, high school, and university.

Dental pain experience was measured using a questionnaire in the form of a structured interview about pain in the orofacial region, administered by the dentist: "Did you have toothache during the past month?", "Did you feel pain when eating or drinking hot and/or cold food/beverages during the past month?", "Did you feel pain when chewing food during the past month?" (Appendix VI). The response options were "yes" and "no" and if yes, the individual rated their pain intensity on a 100mm VAS graded from 0 (no pain) to 100 (extreme pain). This way of reporting dental pain has been used before (51).

The clinical and radiological examination included the number of missing teeth, root remnants, decayed, filled, root-filled teeth and the number of teeth with apical periodontitis. Three dentists performed the examinations and were calibrated before the studies.

Furthermore, to understand how prevalent the most severe form of dental anxiety was in the study sample, a licensed psychologist at the clinic examined a subsample of 93 participants in order to assess whether they fulfilled the diagnostic criteria for dental phobia according to the ICD-10 (5).

Statistical methods

The statistical analysis consisted of descriptive statistics, means, medians, proportions, standard deviations (SD) and 95% confidence intervals (CI). Bivariate associations were tested for statistical significance using the t-test between continuous variables that showed normal distribution, and the Mann–Whitney U-test and Spearman's correlations for ordinal variables and for variables with skewed distributions. The Chi-square test and logistic regression were used to analyze differences between groups for categorical variables. The Kruskal-Wallis test was used to analyze differences between three or more independent groups. Before conducting each study, a power analysis was made to estimate the minimum number of participants needed ($\alpha = 0.05$, and power > 0.8).

In Study III, an analysis of agreement between the scales was performed using Spearman's rho correlation, the Kappa measure of agreement and the Intra Class Correlation (ICC) coefficient.

All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS), version 21-24. The level of statistical significance was set to $\rho < 0.05$.

RESULTS

Study I

Of the 3500 individuals comprising the study sample, 4.7% reported severe dental anxiety, 4.5% moderate, 9.8% low and 80.9% reported no dental anxiety. Women generally had a higher prevalence of dental anxiety than men (Figure 4). Severely dentally anxious individuals were more often avoiders of dental care, but the majority (72.9%) were regular dental attenders.
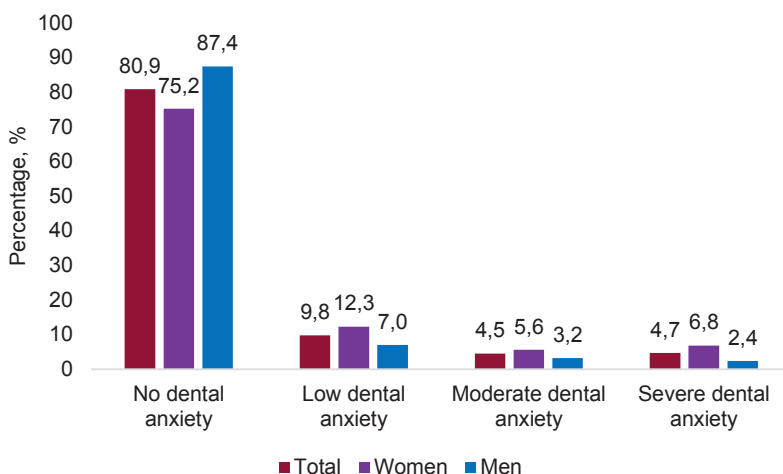

Figure 4. *Dental anxiety prevalence for the total sample and for women and men, respectively.*

The peak prevalence of severe dental anxiety was seen between 31 and 35 years of age, it was relatively consistent during middle adulthood and decreased after 60 years of age.

Significant bivariate relationships were revealed between high dental anxiety and the following independent variables: lower self-rated oral health, lower self-rated general health, less satisfaction with dental esthetics, lower education, smoking, and less physical exercise. However, and interestingly, the impact of oral health on general wellbeing was rated as important for the large majority, regardless of level of dental anxiety.

The multivariable logistic regression analysis revealed that gender and irregular dental attendance were the strongest predictors for high dental anxiety with OR: s of 4.04 and 3.20, respectively.

A participation analysis was conducted comparing the sample with the general population in Sweden. The analysis showed that the sample consisted of somewhat higher educated and fewer foreign-born individuals, and slightly more women.

A statistically significant decrease in dental anxiety was seen between the years 1962 and 2013. The greatest change was seen between the groups reporting no dental anxiety, but a significant decrease in dental anxiety was seen in general. (Figure 5).
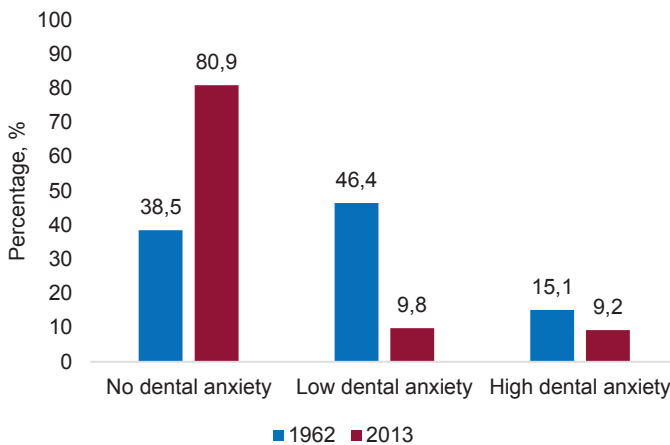

Figure 5. *Dental anxiety prevalence in 1962 and 2013. A statistically significant change was seen between 1962 and 2013 for all categories.*

The proportion of regular attenders among highly dentally anxious individuals increased from 1962 to 2013 (41.7% vs. 80.2%). High dental anxiety was more prevalent among women than men in both populations, but a greater difference was seen in the sample from 2013.

Study II

The study revealed a high prevalence of dental pain (77.6%) in the total sample, and those suffering from dental pain reported a high intensity of pain (VAS scores 49.0-61.0). Dental pain was associated with poor self-reported

oral health but not with clinical variables of dental status. There was no significant difference between genders with regard to dental pain.

Table 3. *Prevalence (%) of OIDP items affected, by presence/absence of dental pain and for the total group.*

	No dental pain		Dental pain	Total
Eating/enjoying food	38.8	*	75.8	67.1
Speaking/pronouncing words	5.3		18.2	15.3
Going shopping/meeting someone	7.9		18.9	16.5
Cleaning of teeth	15.8	*	48.5	41.2
Sleeping/relaxing	10.5	*	43.2	35.9
Smiling/laughing/exposing teeth	39.5	*	60.6	55.9
Keeping one's emotional state/ not getting irritated	13.2	*	40.2	34.1
Working/keeping up with social life	15.8	*	32.6	28.8
Appreciating human contact	15.8		29.5	26.5

* $p < 0.05$

The participants reported a high prevalence of affected daily performance due to oral health measured by the OIDP. Negative consequences for at least one daily performance was reported by 85.3% of the participants and were associated with higher age, a larger number of decayed and root-filled teeth and teeth with apical periodontitis. Individuals reporting dental pain showed an even higher prevalence on all the items included in the OIDP than individuals not reporting dental pain (Table 3).

Participants who reported negative consequences scored very high on the frequency and severity dimensions. The OIDP scale score was 27.0 (SD 25.6) for the total group and significantly higher for participants reporting dental pain, compared with those who did not report pain (31.3, SD 25.3 vs. 12.3, SD 19.0, $p < 0.001$).

The multivariable analysis revealed dental pain to be the strongest factor associated with the probability of having at least one negative consequence affecting daily activities as described by the OIDP (OR 8.21, CI 2.97-22.65).

Study III

The study sample had high levels of dental anxiety according to the DAS = 17.5, the DFS = 80.9, the MDAS = 20.1, and the IDAF-4C = 4.0. A subgroup

of 93 participants was examined according to the ICD-10 diagnostic criteria for dental phobia and 94.6% of these individuals were assessed as having dental phobia. No difference was found in the levels of dental anxiety according to the IDAF-4C between the subgroup assessed to have a dental phobia and the rest of the study sample (4.0 SD = 0.7 and 4.1 SD = 0.7, respectively).

The study revealed very poor agreement between the phobia diagnosis according to the IDAF-P and the clinical diagnosis of dental phobia according to the ICD-10 (κ = 0.02). A majority (68.7%) of the participants reported comorbid anxiety (panic disorder and/or social anxiety), as captured by the IDAF-P.

The correlation between the included scales measuring dental anxiety and the Dental Anxiety and Fear module of IDAF (IDAF-4C) was high, with r_s ranging between 0.68 and 0.78. The ICC between all four scales (DAS, DFS, MDAS and IDAF-4C) was 0.90 (95% CI 0.87-0.93), and the ICC between each scale and the IDAF-4C was 0.72 for the DAS (95% CI = 0.44-0.84), 0.83 for the DFS (95% CI = 0.77-0.88), and 0.83 for the MDAS (95% CI = 0.76-0.88).

The correlation between the four subscales of the IDAF-4C and the IDAF-4C total showed coefficients between r_s = 0.64 and 0.83.

GENERAL DISCUSSION

Study I

This study found a decrease in dental anxiety prevalence among adults over a 50-year period of time. There are repeated cross-sectional reports in the scientific literature, but none with more than 20 years' follow-up (27, 33, 48, 54, 65). A study from the UK reported a decrease in dental anxiety over a ten-year period from 60% to 32%, and recently, Strøm et al. reported a decrease in dental anxiety prevalence from 19% to 8% among 18-year-olds in Norway over a 20-year period (48, 153). These reports indicate that there may be a time effect with regard to the finding of the lower prevalence of dental anxiety over time. However, one may also argue that a cohort effect cannot be ruled out, but we believe that the time span of 50 years in our study and the large sample sizes with randomly selected participants point towards the time effect as the main explanatory factor for the decrease in the prevalence of dental anxiety.

One may also speculate that technical advancement and a greater focus on subjective values have developed in dentistry in the last decades, as well as the focus on preventive care, together with dentistry seeing a large proportion of the population at an early age - in Sweden as early as from the age of three, when oral health problems are mostly infrequent. Today's population has better oral health than the population 50 years ago, which results in less invasive dental treatment. A large proportion of the population also attends dental care for years before treatment is needed, which may prevent dental anxiety.

However, even if there is an actual decrease in dental anxiety prevalence over time there is still an important part of the population that suffers from high or severe dental anxiety. The results in Study I showed the smallest decrease among those reporting high dental anxiety. A smaller decrease among highly dentally anxious individuals has been reported before (153). One reason could be that some of the highly dentally anxious individuals have a more complicated disorder with severe comorbidity (92, 124). Such comorbidity conditions may be panic syndrome and/or social phobia. Another reason why there is still a relatively large proportion of highly dentally anxious individuals may be related to negative experiences of dental care, such as experience of pain, poor communication and negative behavior on the part of dental professionals.

Moreover, as a methodological aspect, Bandelow et al. discussed the difficulty of finding a possible change in the prevalence of anxiety disorders, mainly due to the imprecise measures before the introduction of the DSM-III (154). There is one study, the National Comorbidity Survey (NCS) from the US, which is repeated with the same cross-sectional design over an eleven-year period and shows no increase in the life-time prevalence of a specific phobia during this period (11% vs. 12.5%) (155, 156). In our present study, we used a single question to measure the level of dental anxiety with similar scoring and wording of the response alternatives. The SQDA was used to measure dental anxiety, mainly to be able to compare results from 1962 and making it possible to study change over time. This question has been chosen several times before by others, to capture dental anxiety in populations in epidemiological studies of dental anxiety (14, 30, 31, 34, 36, 46, 52, 58, 73). It has often been discussed how well this question captures the concept of dental anxiety, but it has shown acceptable validity in several studies (15, 34, 46, 59). To be able to make comparisons between the results of this study and the results from 1962, the four response alternatives of the SQDA used in this study were converted into three response alternatives. The categories "no dental anxiety" and "somewhat anxious," had the same wording in both studies, and the categories "quite anxious" and "very anxious" from this study became highly anxious, to match the categories from the study conducted in 1962. This may be questionable but in order to be able to compare the results, we considered this way to be the most reasonable.

The results of the present study show that around 20% of the population report some level of dental anxiety. Due to the high prevalence, dental anxiety should be considered a public health problem and there is still a need for preventive policies and action, and more evidence-based treatments for those suffering from severe dental anxiety.

Study I is a population-based cross-sectional study of adult individuals randomly selected from the population of Sweden. The large national population-based sample strengthens the representativeness of the results and makes it possible to generalize the results. The cross-sectional design has been shown to be useful in identifying associated factors of interest, but the design has no capacity to prove causal relationships (157). The randomization procedure was performed by a telemarketing company that was also responsible for the interviews, which may be considered a strength of the study design.

The response rate was 49.7%, which is considered acceptable in studies like this, with this kind of methodology (158, 159). The response rates in

epidemiological studies are decreasing and it will become harder to study population prevalence in the future, unless we come up with methodological alternatives (160). The decrease in participation rates will give rise to questions about the representativeness of epidemiological studies. A participation analysis was carried out to ensure the representativeness of this study, and showed some, although minor, differences between the study population and the general population of Sweden at the same point in time, with regard to age, education and place of birth. Although the differences were small, it cannot be excluded that they may have influenced the results. However, no difference was seen in dental anxiety levels between native-born and foreign-born individuals. Although dental anxiety is associated with avoidance of dental care and a deteriorated dentition, individuals with high dental anxiety do not seem to be underrepresented in oral epidemiological surveys (161). The study from 1962 reported a high response rate (78.1%) and a participation analysis did not reveal any difference between the study sample and the general population according to gender (162).

Study II

Study II showed a high prevalence of dental pain (77.6%) in a clinical sample of individuals with severe dental anxiety. The pain intensity was high, indicating widespread suffering and a substantial need for treatment.

From a clinical perspective, especially with regard to the treatment of patients with severe dental anxiety, it is well recognized that many of these patients suffer from dental pain. However, and surprisingly, to the best of our knowledge, there are no previous studies of dental pain prevalence in clinical populations with severe dental anxiety. Population-based studies investigating the prevalence of dental pain report a considerably lower prevalence, even when individuals with and without dental anxiety are compared. A study by Hägglin et al. from 1996 showed a dental pain prevalence of 16.0% among adult Swedish women, and in this study, the pain prevalence was similar in individuals with high dental anxiety (17.0%) (51). In 1988, Milgrom reported a toothache prevalence of 30.9% among individuals with high dental anxiety, while a lower prevalence (19.9%) was reported among non-anxious/low dentally anxious individuals (14). In another study, Thomson et al. reported a prevalence of toothache of 18.5% among the highly dentally anxious participants (28).

In the present study, the large majority (85%) reported at least one negative impact on their daily life due to their oral health, also defined as impaired OHRQoL, as measured with the OIDP.

Previous population-based studies of OHRQoL using the OIDP have reported considerably better OHRQoL (60, 151, 152). In a Swedish study, 40% of the individuals with regular dental attendance reported one or more oral impacts affecting their everyday life and a total mean OIDP score of 4.5 (151), as compared with 85% and a mean score of 27.9 in the present sample. The study by Heidari et al. (60) found poorer OHRQoL in a subsample with high dental anxiety, although not as poor as in the present sample (49% vs. 85%). The present study indicates a strong association between dental pain and affected OHRQoL.

In this study, dental pain was the strongest predictor of an impact on OHRQoL. Pain has an essential effect on QoL (126, 163, 164), but research showing the effect of oral or dental pain in relation to OHRQoL is scarce. Adulyanon has shown oral pain to be the most important factor to influence daily activities in a low-disease Thai population (165), Srisilapanan showed dental pain to be the most common symptom affecting OHRQoL (166) and Nuttall et al also reported oral pain to be the most commonly experienced impact to affect OHRQoL in a population-based study in UK (167). Thus, the results from the present study illuminate one of the key aspects of the vicious circle of dental anxiety, namely that poor oral health and symptoms mediate the psychological and social dimensions of severe dental anxiety (102).

The strength of Study II is the large clinical sample of severely dentally anxious participants, studied with both validated psychometric measurements and clinical variables. The clinical variables were recorded in an adapted clinical examination (using two mirrors) and/or on the basis of panoramic radiographs. These examination methods may underestimate the actual oral status, but in most cases, this is the only way to obtain clinical data about highly dentally anxious individuals. Although some patients declined participation, the sample must be considered representative. Adding a non-dentally anxious control group to the study design would have facilitated the interpretation of the results.

Study III

The most recently developed measure of dental anxiety, the IDAF-4C^{+}, was constructed by Armfield, in order to improve and modernize the dental anxiety assessments in both clinical and research settings (20). The IDAF-4C^{+} has been translated into several languages and evaluated (23-25, 148, 168); however, this is the first time the IDAF-4C^{+} has been tested in a clinical sample of individuals with severe dental anxiety/phobia. The present study shows advantages of the IDAF-4C^{+}, as the scale includes all four components of

anxiety, and the stimulus module adds information about the precise dental anxiety-provoking stimuli (20). However, the new IDAF-4C$^+$ dental phobia module did not perform well and needs further improvement before it can be used as intended.

The results revealed that very few individuals were classified as having a dental phobia diagnosis according to the IDAF-4C$^+$ and showed very poor agreement with the clinical diagnosis according to the ICD-10. In previous studies in non-highly dentally anxious samples, individuals classified with a dental phobia diagnosis according to the IDAF-4C$^+$ also reported higher levels of dental anxiety (20, 24, 148). This is not, however, a test of the specific phobia classification.

Possible explanations for the poor agreement may be the interpretation/wording of the included items and the construction of the IDAF-4C$^+$ dental phobia classification. A large majority of the participants responded negatively to the item "dental anxiety being disruptive/interfering with life," compared with the item about distress related to dental anxiety. A study using a qualitative approach could provide insight into why so few participants answered "yes" on this item. One may speculate about the role of denial, as part of the avoidance behavior pattern in phobic anxiety. The other important aspect is the comorbid anxiety disorders that may occur with dental anxiety. The phobia module of the IDAF-4C$^+$ is constructed to screen for social anxiety and panic disorder, and individuals reporting either one of these are excluded from a dental phobia diagnosis. This may be questioned, as a high prevalence of psychiatric comorbidity among highly dentally anxious individuals has been reported before (95). The present study sample showed a high prevalence of comorbid panic disorder and social anxiety captured by the IDAF-4C$^+$.

However, the strength of the IDAF-4C$^+$ is the first module of the measurement (IDAF-4C), because it adds the cognitive aspects of the anxiety and fear reaction, which were not included in previous measurements. In addition, the IDAF-4C showed good congruence with the DAS, DFS and MDAS in this sample, which is in agreement with reports by others (20, 24, 25, 148). Similar to earlier reports, the cognitive component showed a weaker correlation with the other included dental anxiety scales. However, this was not surprising as these measures do not include an explicit cognitive component, and this result strengthens the argument that the IDAF-4C adds a relevant aspect when measuring dental anxiety (24, 25).

Including the cognitive component of dental anxiety is important from more than one aspect. When measuring a phenomenon like dental anxiety it is

important to cover all relevant dimensions of the underlying theoretical construct (for anxiety: behavioral, emotional, physical, and cognitive components) to ensure good validity. Severely dentally anxious individuals have several extremely negative cognitions, such as negative thoughts, beliefs and self-statements, but also about what might happen during the dental treatment (169, 170). It has also been shown that these individuals are less able to control negative cognitions than non-dentally anxious individuals (170). Negative cognitions seem to play an important role in the anxiety response, and individuals with several negative cognitions will not easily comply with techniques such as relaxation, aimed at reducing the anxiety reaction. As described above, the evidence-based treatment of severe dental anxiety/phobia is cognitive behavioral therapy, a treatment targeting all components of anxiety, including the cognitive component (138).

The strengths of the study are the large clinical sample of severely dentally anxious individuals, including a relatively large subgroup with a clinical diagnosis of dental phobia according to the ICD-10 diagnostic criteria, and the inclusion of other well-known and commonly used psychometric measurements of dental anxiety. A limitation of the study is the lack of validated screening measures for comorbid anxiety disorders to evaluate further the construction of the phobia module of the IDAF-4C^{+}. It would also be interesting to add a measurement with the focus on the cognitive aspect of dental anxiety, like the Dental Cognitions Questionnaire (DCQ) (169), in order to study the relation to the dental anxiety and fear module of the IDAF-4C^{+}. Also, a test-retest analysis could have been included to evaluate the reliability further.

ETHICAL CONSIDERATIONS

The included studies were approved by the Regional Ethical Review Board in Gothenburg, Sweden (reg. no. 801-12 and 395-10). Answering questionnaires about dental anxiety may be upsetting. However, there is a report showing that answering the dental anxiety questionnaire MDAS, did not increase dental anxiety or result in other adverse reactions (171). The participants filled in the questionnaires at the clinic and if an unexpected reaction developed during or after responding, the dental care team was present and it would have been possible to see a psychologist, if necessary.

CONCLUSION AND CLINICAL APPLICATION

This thesis highlights the fact that over a 50-year time span, the proportion of highly dentally anxious individuals in the population is still substantial, and dental anxiety must thus be seen as a public health problem. However, a considerable proportion of the highly dentally anxious individuals reports regular dental visiting habits.

Oral health-related quality of life is affected in individuals with severe dental anxiety, and dental pain is a strong predictor of poor OHRQoL. An important finding of this thesis is the fact that individuals with high dental anxiety/phobia often report dental pain of high intensity.

Good psychometric measurements are an important tool for researchers and clinicians to estimate prevalence, consequences and treatment effects. A screening instrument for dental phobia is missing and although this module is included in the IDAF-4C^{+}, this module needs further development and evaluation before being used in clinical and research settings.

From a clinical perspective, severely dentally anxious individuals commonly attend general dental clinics. Dentists will meet and treat these patients on a daily basis and, thus, the dentists need to be on the alert in order to identify patients with high dental anxiety. The most feared stimuli reported by severely dentally anxious individuals in this study were pain and not being in control. For a dentist, these two stimuli are relatively easy to control, and if we do, we engage in preventive dental care as well as treatment in order to alleviate severe dental anxiety.

FUTURE PERSPECTIVES

There is a need to develop and validate the IDAF-4C$^+$ further in a highly dentally anxious population, with the focus on screening for a potential dental phobia diagnosis. The ability to screen for dental phobia according to existing international criteria is important as a complement to the scales measuring the level of dental anxiety, as it limits the range of variation between populations from different countries and cultures, which will make the results more generalizable.

It is also important to study additional factors and pain that may contribute to the negative consequences on OHRQoL among highly dentally anxious individuals; however, this should be done in a case control study to strengthen the association between severe dental anxiety and poor OHRQoL further, as well as the association between pain and other factors for an impact on OHRQoL.

Finally, population-based cross-sectional studies to analyze possible changes in the prevalence of dental anxiety and related factors in the future would be of interest for policymakers and educational curricula in dentistry.

ACKNOWLEDGEMENTS

Firstly, I wish to extend my sincere gratitude to all the patients who made my research possible and to all patients signing up for clinical research; your contribution are very important.

My special thanks go to **Professor Ulla Wide** and **Professor Magnus Hakeberg**, my supervisors and co-authors, for believing in me and in my genuine interest when we first met seven years ago. I will always be grateful to you both for giving me this opportunity and for introducing me to science. Thank you for all your encouragement, advice and support over the years. To Ulla, for your expertise in the field of psychology, both clinically and in research, and for your methodical approach, which has given me something to rely on when other aspects of learning science have been hard to grasp. To Magnus, for your knowledge in the field of odontology, research and statistics, for inviting me to learn statistics, and for encouraging me to trust my new knowledge. Above all, thank you both for instilling your passion for research in me.

I wish to extend my gratitude to the following friends and colleagues:

To research coordinator **Birgitta Ahlström**, for all your skills, expertise and support with posters, tables, figures and for helping me editing my thesis. Thanks for all the nice talks during breaks and for being such a positive person.

To **Helene Werner**, my colleague and friend. Thank you for making my work joyful and for all our interesting and inspiring discussions about psychology, research and life, and, not to forget, all the fun we have had over the years. I hope we will work together for many more years.

To **Jennie Hagman**, my colleague and friend, for nice chats, a great travelling company to research conferences and the most important, for keeping my body and brain fit for all important challenges!

To my former and present friends and doctoral student colleagues in the "*coupé of soughs and joy*" for many interesting discussions, for understanding the roller-coaster of scientific research and the puzzle to make it compatible with normal life. A special thank you to **Lotta** and **Nettan** for the inclusive atmosphere you provided when I took my first trembling steps into the world of science. You gave me the best start anyone could wish for. I will never forget that!

To all my colleagues and friends at **the Department of Behavioral and Community Dentistry** for all your support and encouragement, but also for fun and interesting discussions.

To the former head of the Clinic of Oral Medicine, **Per-Olof Rödström** and the present head of the clinic, **Maria Westin** for giving me the opportunity to work with highly dentally anxious individuals at the clinic. To Maria, for believing in my clinical commitment, I look forward to my next challenge!

To **Lena Bergstrand** for your knowledge and genuine interest in patients suffering from dental anxiety. I have learned a lot from you, and you improve my ongoing study at the clinic with your methodical way to approach things. I really enjoy working with you.

To all my colleagues and friends at **the Clinic of Oral Medicine**, who participated in the enrolment of patients and data sampling and for providing a fun and stimulating atmosphere.

To **Cia:** we have known each other since dental school and in a month or so it is ten years since we graduated. We had great plans for this celebration, but life chose other adventures first. But we will celebrate! We do not see each other so often nowadays but you are always close to my heart. Thank you for cheering me on and encouraging me along the road of my doctoral studies.

To **Gabriella and Tina**, hardworking as you are, but always up to do something fun. I love that and look forward to all the adventures yet to come.

To **Tjejligan,** for being just who you are. We have known each other since childhood and your friendship is invaluable. I love that you are not a part of odontology and research, but of my life and everything that comes with it. You all inspire me.

To **all my friends,** for always being there and filling my life with life and joy, which are so important to me.

To **my mother and father,** for being who you are. You have done the toughest job there is, to raise a child, and you have done it twice! Thank you for all the support and endless love you have given me and my sister, for always believing in me and letting me know that I can do whatever I want to do.

To the best sister in the world, **Sara,** for always being by my side, always doing everything you can to help out. You are one in a million, and I am so grateful

that you are my sister. Thank you for loving Malte the way you do and giving him so much of your time.

To **Tomas**, for standing by my sister's side. You are one of the best role models for Malte, thank you for wanting to be such a great part of our family, for all the support and for being there for Malte all the times when I needed help.

To **Malte**, for coming into my life and giving me perspective. I love being a part of your world.

To my beloved husband **Micke**. It is because of you that I am here today. You found the note about a PhD and encouraged me to apply. Thank you for all your support and for understanding all the hard work from day one and for being realistic when I am an incurable optimist.

Research funding:

REFERENCES

1. Freidson E, Feldman JJ. *The public looks at dental care*. J Am Dent Assoc. 1958;57(3):325-35.
2. Raadal M, Skaret E. *Background description and epidemiology*. In: Öst L-G, Skaret E, editors. *Cognitive behaviour therapy for dental phobia and anxiety*. West Sussex: John Wiley & Sons; 2013. p. 21-31.
3. Starcevic V. *Anxiety Disorders: Introduction*. In: *Anxiety disorders in adults: A clinical guide*. Oxford: Oxford University Press. 2005. p. 1-13.
4. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub; 2013.
5. World Health Organization. *International statistical classification of diseases and related health problems, 10th revision*. 2019. Available from: https://icd.who.int/browse10/2019/en#/ F40-F48. Accessed August 4, 2020
6. Haukebø K, Skaret E, Öst L-G, Raadal M, Berg E, Sundberg H, et al. *One-vs. five-session treatment of dental phobia: a randomized controlled study*. J Behav Ther Exp Psychiatry. 2008;39(3):381-90.
7. Kleinknecht RA, Bernstein DA. *The assessment of dental fear*. Behav Ther. 1978;9(4):626-34.
8. Milgrom P, Weinstein P, Getz T. *The Assessment Process in the Office*. In: *Treating fearful dental patients: a patient management handbook*. 2nd ed. Washington. University of Washington, Continuing Dental Education; 1995. p. 57-82
9. Haukebø K, Vika M. *Assessment of dental phobia and anxiety*. In: Öst LG, Skaret E, editors. *Cognitive Behaviour Therapy for Dental Phobia and Anxiety*. West Sussex: John Wiley & Sons; 2013. p. 33-44.
10. Hakeberg M, Lundgren J. *Symptoms, clinical characteristics and consequences.* In: Öst L-G, Skaret E, editors. *Cognitive behavioral therapy for dental phobia and anxiety*. West Sussex: John Wiley & Sons; 2013. p. 3-19.
11. Corah NL. *Development of a dental anxiety scale.* J Dent Res. 1969;48(4):596.
12. Kleinknecht RA, Klepac RK, Alexander LD. *Origins and characteristics of fear of dentistry*. J Am Dent Assoc. 1973;86(4):842-8.
13. Humphris GM, Morrison T, Lindsay SJ. *The Modified Dental Anxiety Scale: validation and United Kingdom norms*. Community Dent Health. 1995;12(3):143-50.
14. Milgrom P, Fiset L, Melnick S, Weinstein P. *The prevalence and practice management consequences of dental fear in a major US city*. J Am Dent Assoc. 1988;116(6):641-7.
15. Neverlien PO. *Assessment of a single-item dental anxiety question*. Acta Odontol Scand. 1990;48(6):365-9.
16. Stouthard ME, Hoogstraten J, Mellenbergh GJ. *A study on the convergent and discriminant validity of the Dental Anxiety Inventory*. Behav Res Ther. 1995;33(5):589-95.
17. Schuurs AH, Hoogstraten J. *Appraisal of dental anxiety and fear questionnaires: a review*. Community Dent Oral Epidemiol. 1993;21(6):329-39.

18. Stouthard ME, Mellenbergh GJ, Hoogstraten J. *Assessment of dental anxiety: A facet approach*. Anxiety Stress Coping. 1993;6(2):89-105.
19. Coolidge T, Heima M, Coldwell SE, Weinstein P, Milgrom P. *Psychometric properties of the revised dental beliefs survey*. Community Dent Oral Epidemiol. 2005;33(4):289-97.
20. Armfield JM. *Development and psychometric evaluation of the Index of Dental Anxiety and Fear (IDAF-4C+)*. Psychol Assess. 2010;22(2):279-87.
21. Newton JT, Buck DJ. *Anxiety and pain measures in dentistry: a guide to their quality and application*. J Am Dent Assoc. 2000;131(10):1449-57.
22. Armfield JM. *How do we measure dental fear and what are we measuring anyway?* Oral Health Prev Dent. 2010;8(2):107-15.
23. Ibrahim H, Lyons KM, Armfield JM, Thomson WM. *Performance of the Index of Dental Anxiety and Fear in a population-based sample of adults*. Aust Dent J. 2017;62(4):478-84.
24. Wide Boman U, Armfield JM, Carlsson SG, Lundgren J. *Translation and psychometric properties of the Swedish version of the Index of Dental Anxiety and Fear (IDAF-4C(+))*. Eur J Oral Sci. 2015;123(6):453-9.
25. Tolvanen M, Puijola K, Armfield JM, Lahti S. *Translation and validation of the Finnish version of index of dental anxiety and fear (IDAF-4C(+)) among dental students*. BMC Oral Health. 2017;17(1):85.
26. Oosterink FM, de Jongh A, Hoogstraten J. *Prevalence of dental fear and phobia relative to other fear and phobia subtypes*. Eur J Oral Sci. 2009;117(2):135-43.
27. Gatchel RJ. *The prevalence of dental fear and avoidance: expanded adult and recent adolescent surveys*. J Am Dent Assoc. 1989;118(5):591-3.
28. Thomson WM, Stewart JF, Carter KD, Spencer AJ. *Dental anxiety among Australians*. Int Dent J. 1996;46(4):320-4.
29. Doerr PA, Lang WP, Nyquist LV, Ronis DL. *Factors associated with dental anxiety*. J Am Dent Assoc. 1998;129(8):1111-9.
30. Liinavuori A, Tolvanen M, Pohjola V, Lahti S. *Changes in dental fear among Finnish adults: a national survey*. Community Dent Oral Epidemiol. 2016;44(2):128-34.
31. Armfield JM, Spencer AJ, Stewart JF. *Dental fear in Australia: who's afraid of the dentist?* Aust Dent J. 2006;51(1):78-85.
32. Schuurs AH, Duivenvoorden HJ, Thoden van Velzen SK, Verhage F, Makkes PC, Eijkman MA. *Anxiety and dental attendance*. Community Dent Health. 1985;2(3):203-11.
33. Humphris G, Crawford JR, Hill K, Gilbert A, Freeman R. *UK population norms for the modified dental anxiety scale with percentile calculator: adult dental health survey 2009 results*. BMC Oral Health. 2013;13:29.
34. Viinikangas A, Lahti S, Yuan S, Pietila I, Freeman R, Humphris G. *Evaluating a single dental anxiety question in Finnish adults*. Acta Odontol Scand. 2007;65(4):236-40.
35. Locker D, Liddell A. *Correlates of dental anxiety among older adults*. J Dent Res. 1991;70(3):198-203.
36. Vassend O. *Anxiety, pain and discomfort associated with dental treatment*. Behav Res Ther. 1993;31(7):659-66.

37. Elter JR, Strauss RP, Beck JD. *Assessing dental anxiety, dental care use and oral status in older adults*. J Am Dent Assoc. 1997;128(5):591-7.
38. Schwarz E, Birn H. *Dental anxiety in Danish and Chinese adults--a cross-cultural perspective*. Soc Sci Med. 1995;41(1):123-30.
39. Ragnarsson B, Arnlaugsson S, Karlsson KO, Magnusson TE, Arnarson EO. *Dental anxiety in Iceland: an epidemiological postal survey*. Acta Odontol Scand. 2003;61(5):283-8.
40. Hakeberg M, Berggren U, Carlsson SG. *Prevalence of dental anxiety in an adult population in a major urban area in Sweden*. Community Dent Oral Epidemiol. 1992;20(2):97-101.
41. Enkling N, Marwinski G, Johren P. *Dental anxiety in a representative sample of residents of a large German city.* Clin Oral Investig. 2006;10(1):84-91.
42. Stouthard ME, Hoogstraten J. *Prevalence of dental anxiety in the Netherlands.* Community Dent Oral Epidemiol. 1990;18(3):139-42.
43. Fredrikson M, Annas P, Fischer H, Wik G. *Gender and age differences in the prevalence of specific fears and phobias.* Behav Res Ther. 1996;34(1):33-9.
44. Hällström T, Halling A. *Prevalence of dentistry phobia and its relation to missing teeth, alveolar bone loss and dental care habits in an urban community sample.* Acta Psychiatr Scand. 1984;70(5):438-46.
45. Hägglin C, Hakeberg M, Ahlqwist M, Sullivan M, Berggren U. *Factors associated with dental anxiety and attendance in middle-aged and elderly women*. Community Dent Oral Epidemiol. 2000;28(6):451-60.
46. Hägglin C, Berggren U, Hakeberg M, Hällström T, Bengtsson C. *Variations in dental anxiety among middle-aged and elderly women in Sweden: a longitudinal study between 1968 and 1996.* J Dent Res. 1999;78(10):1655-61.
47. Liinavuori A, Tolvanen M, Pohjola V, Lahti S. *Longitudinal interrelationships between dental fear and dental attendance among adult Finns in 2000-2011.* Community Dent Oral Epidemiol. 2019;47(4):309-15.
48. Strøm K, Skaare AB, Willumsen T. *Dental anxiety in 18-year-old Norwegians in 1996 and 2016.* Acta Odontol Scand. 2020;78(1):13-9.
49. Svensson L, Hakeberg M, Boman UW. *Dental anxiety, concomitant factors and change in prevalence over 50 years.* Community Dent Health. 2016;33:1-6.
50. Boman UW, Wennstrom A, Stenman U, Hakeberg M. *Oral health-related quality of life, sense of coherence and dental anxiety: an epidemiological cross-sectional study of middle-aged women.* BMC Oral Health. 2012;12:14.
51. Hägglin C, Berggren U, Hakeberg M, Ahlqwist M. *Dental anxiety among middle-aged and elderly women in Sweden. A study of oral state, utilisation of dental services and concomitant factors.* Gerodontology. 1996;13(1):25-34.
52. Håkansson J. *Dental care habits, attitudes towards dental health and dental status among 20-60 year old individuals in Sweden* (Diss). Lund: Lund Univ.; 1978.
53. The Swedish Institute of Public Opinion Research (SIFO). *Tandläkarbesök - Intervjuundersökning för Tandvärnet.* SIFO, 1962.
54. Åstrøm AN, Skaret E, Haugejorden O. *Dental anxiety and dental attendance among 25-year-olds in Norway: time trends from 1997 to 2007*. BMC Oral Health. 2011;11:10.

55.   Lahti S, Vehkalahti MM, Nordblad A, Hausen H. *Dental fear among population aged 30 years and older in Finland*. Acta Odontol Scand. 2007;65(2):97-102.

56.   Schuller AA, Willumsen T, Holst D. *Are there differences in oral health and oral health behavior between individuals with high and low dental fear?* Community Dent Oral Epidemiol. 2003;31(2):116-21.

57.   Haugejorden O, Solveig Klock K. *Avoidance of dental visits: the predictive validity of three dental anxiety scales.* Acta Odontol Scand. 2000;58(6):255-9.

58.   Ragnarsson E. *Dental fear and anxiety in an adult Icelandic population.* Acta Odontol Scand. 1998;56(2):100-4.

59.   Moore R, Birn H, Kirkegaard E, Brodsgaard I, Scheutz F. *Prevalence and characteristics of dental anxiety in Danish adults.* Community Dent Oral Epidemiol. 1993;21(5):292-6.

60.   Heidari E, Banerjee A, Newton JT. *Oral health status of non-phobic and dentally phobic individuals; a secondary analysis of the 2009 Adult Dental Health Survey.* Br Dent J. 2015;219(9):E9.

61.   Kirova DG, Atanasov DT, Lalabonova CK, Janevska S. *Dental anxiety in adults in Bulgaria.* Folia Med (Plovdiv). 2010;52(2):49-56.

62.   Humphris GM, Dyer TA, Robinson PG. *The modified dental anxiety scale: UK general public population norms in 2008 with further psychometrics and effects of age.* BMC Oral Health. 2009;9(1):20.

63.   Nicolas E, Collado V, Faulks D, Bullier B, Hennequin M. *A national cross-sectional survey of dental anxiety in the French adult population.* BMC Oral Health. 2007;7:12.

64.   McGrath C, Bedi R. *The association between dental anxiety and oral health-related quality of life in Britain.* Community Dent Oral Epidemiol. 2004;32(1):67-72.

65.   Nuttall N, Bradnock G, White D, Morris J, Nunn J. *Dental attendance in 1998 and implications for the future.* Br Dent J. 2001;190(4):177-82.

66.   Bedi R, McGrath C. *Factors associated with dental anxiety among older people in Britain.* Gerodontology. 2000;17(2):97-103.

67.   Mellor AC. *Dental anxiety and attendance in the north-west of England.* J Dent. 1992;20(4):207-10.

68.   Schuurs AH, Duivenvoorden HJ, Thoden van Velzen SK, Verhage F, Makkes PC, Eijman MA. *Dimensionality of dental anxiety measurements.* Community Dent Oral Epidemiol. 1985;13(3):152-5.

69.   Bell RA, Arcury TA, Anderson AM, Chen H, Savoca MR, Gilbert GH, et al. *Dental anxiety and oral health outcomes among rural older adults.* J Public Health Dent. 2012;72(1):53-9.

70.   Locker D. *Psychosocial consequences of dental fear and anxiety.* Community Dent Oral Epidemiol. 2003;31(2):144-51.

71.   Maggirias J, Locker D. *Five-year incidence of dental anxiety in an adult population.* Community Dent Health. 2002;19(3):173-9.

72.   Locker D, Shapiro D, Liddell A. *Overlap between dental anxiety and blood-injury fears: psychological characteristics and response to dental treatment*. Behav Res Ther. 1997;35(7):583-90.

73.   Locker D, Shapiro D, Liddell A. *Who is dentally anxious? Concordance between measures of dental anxiety.* Community Dent Oral Epidemiol. 1996;24(5):346-50.

74. Locker D, Liddell A. *Stability of Dental Anxiety Scale scores: a longitudinal study of older adults*. Community Dent Oral Epidemiol. 1995;23(5):259-61.

75. Gatchel RJ, Ingersoll BD, Bowman L, Robertson MC, Walker C. *The prevalence of dental fear and avoidance: a recent survey study*. J Am Dent Assoc. 1983;107(4):609-10.

76. Goettems ML, Schuch HS, Demarco FF, Ardenghi TM, Torriani DD. *Impact of dental anxiety and fear on dental care use in Brazilian women*. J Public Health Dent. 2014;74(4):310-6.

77. Armfield JM, Ketting M. *Predictors of dental avoidance among Australian adults with different levels of dental anxiety*. Health Psychol. 2015;34(9):929-40.

78. Armfield JM. *The extent and nature of dental fear and phobia in Australia.* Aust Dent J. 2010;55(4):368-77.

79. Armfield JM, Slade GD, Spencer AJ. *Dental fear and adult oral health in Australia*. Community Dent Oral Epidemiol. 2009;37(3):220-30.

80. Thomson WM, Broadbent JM, Locker D, Poulton R. *Trajectories of dental anxiety in a birth cohort*. Community Dent Oral Epidemiol. 2009;37(3):209-19.

81. Locker D, Poulton R, Thomson W. *Psychological disorders and dental anxiety in a young adult population*. Community Dent Oral Epidemiol. 2001;29(6):456-63.

82. Thomson WM, Locker D, Poulton R. *Incidence of dental anxiety in young adults in relation to dental treatment experience*. Community Dent Oral Epidemiol. 2000;28(4):289-94.

83. Thomson WM, Dixon GS, Kruger E. *The West Coast Study ll: Dental anxiety and satisfaction with dental services*. N Z Dent J. 1999;95:44-8.

84. Öst L-G. *Age of onset in different phobias*. J Abnorm Psychol. 1987;96(3):223.

85. Locker D, Liddell A, Dempster L, Shapiro D. *Age of onset of dental anxiety*. J Dent Res. 1999;78(3):790-6.

86. Klingberg G, Raadal M, Anrup K. *Dental fear and behavior management problems.* In: Koch G, Poulsen S, editors. *Pediatric Dentistry: A Clinical Approach*. 2nd ed. Oxford: John Wiley & Sons; 2009. p. 32-43

87. Watson JB, Rayner R. *Conditioned emotional reactions*. J Exp Psychol. 1920;3(1):1.

88. Carter AE, Carter G, Boschen M, AlShwaimi E, George R. *Pathways of fear and anxiety in dentistry: A review*. World J Clin Cases. 2014;2(11):642-53.

89. Davey GC. *Dental phobias and anxieties: evidence for conditioning processes in the acquisition and modulation of a learned fear*. Behav Res Ther. 1989;27(1):51-8.

90. Skaret E, Raadal M, Berg E, Kvale G. *Dental anxiety among 18-yr-olds in Norway. Prevalence and related factors*. Eur J Oral Sci. 1998;106(4):835-43.

91. Willumsen T, Haukebø K, Raadal M. *Aetiology of dental phobia*. In: Öst L-G, Skaret E, editors. *Cognitive Behaviour Therapy for Dental Phobia and Anxiety*. West Sussex: John Wiley & Sons; 2013. p. 45-61.

92. Roy-Byrne PP, Milgrom P, Khoon-Mei T, Weinstein P, Katon W. *Psychopathology and psychiatric diagnosis in subjects with dental phobia*. J Anxiety Disord. 1994;8(1):19-31.

93. Boman UW, Lundgren J, Berggren U, Carlsson SG. *Psychosocial and dental factors in the maintenance of severe dental fear*. Swed Dent J. 2010;34(3):121-7.

94. Pohjola V, Mattila AK, Joukamaa M, Lahti S. *Anxiety and depressive disorders and dental fear among adults in Finland.* Eur J Oral Sci. 2011;119(1):55-60.

95. Halonen H, Nissinen J, Lehtiniemi H, Salo T, Riipinen P, Miettunen J. *The Association Between Dental Anxiety and Psychiatric Disorders and Symptoms: A Systematic Review.* Clin Pract Epidemiol Ment Health. 2018;14:207-22.

96. Klingberg G, Broberg AG. *Dental fear/anxiety and dental behaviour management problems in children and adolescents: a review of prevalence and concomitant psychological factors.* Int J Paediatr Dent. 2007;17(6):391-406.

97. Frazer M, Hampson S. *Some personality factors related to dental anxiety and fear of pain.* Br Dent J. 1988;165(12):436-9.

98. Hägglin C, Hakeberg M, Hällström T, Berggren U, Larsson L, Waern M, et al. *Dental anxiety in relation to mental health and personality factors: A longitudinal study of middle-aged and elderly women.* Eur J Oral Sci. 2001;109(1):27-33.

99. Willumsen T. *The impact of childhood sexual abuse on dental fear.* Community Dent Oral Epidemiol. 2004;32(1):73-9.

100. Walker EA, Milgrom PM, Weinstein P, Getz T, Richardson R. *Assessing abuse and neglect and dental fear in women.* J Am Dent Assoc (1939). 1996;127(4):485-90.

101. De Jongh A, Fransen J, Oosterink-Wubbe F, Aartman I. *Psychological trauma exposure and trauma symptoms among individuals with high and low levels of dental anxiety.* Eur J Oral Sci. 2006;114(4):286-92.

102. Berggren U. *Dental fear and avoidance: a study of etiology, consequences and treatment* (Diss) Gothenburg: Gotheburg Univ.; 1984.

103. Hakeberg M. *Dental anxiety and health: A prevalence study and assessment of treatment outcomes* (Diss) Gotheburg: Gothenburg Univ.; 1992.

104. Carlsson SG, Jern S. *Paradigms in psychosomatic research: A dialectic perspective.* Scand J Psychol. 1982;23:151-7.

105. Armfield JM. *What goes around comes around: revisiting the hypothesized vicious cycle of dental fear and avoidance.* Community Dent Oral Epidemiol. 2013;41(3):279-87.

106. De Jongh A, Schutjes M, Aartman IH. *A test of Berggren's model of dental fear and anxiety.* Eur J Oral Sci. 2011;119(5):361-5.

107. Armfield JM, Stewart JF, Spencer AJ. *The vicious cycle of dental fear: exploring the interplay between oral health, service utilization and dental fear.* BMC Oral Health. 2007;7(1):1.

108. Eitner S, Wichmann M, Paulsen A, Holst S. *Dental anxiety--an epidemiological study on its clinical correlation and effects on oral health.* J Oral Rehabil. 2006;33(8):588-93.

109. Agdal ML, Raadal M, Skaret E, Kvale G. *Oral health and oral treatment needs in patients fulfilling the DSM-IV criteria for dental phobia: Possible influence on the outcome of cognitive behavioral therapy.* Acta Odontol Scand. 2008;66(1):1-6.

110. Pohjola V, Lahti S, Vehkalahti MM, Tolvanen M, Hausen H. *Age-specific associations between dental fear and dental condition among adults in Finland.* Acta Odontol Scand. 2008;66(5):278-85.

111. Henning Abrahamsson K, Berggren U, Hakeberg M, Carlsson SG. *Phobic avoidance and regular dental care in fearful dental patients: a comparative study.* Acta Odontol Scand. 2001;59(5):273-9.
112. World Health Organization. *Oral health fact sheet No. 318*. April 2012, 7(03):2012.
113. Hakeberg M, Berggren U, Grondahl HG. *A radiographic study of dental health in adult patients with dental anxiety.* Community Dent Oral Epidemiol. 1993;21(1):27-30.
114. Heidari E, Andiappan M, Banerjee A, Newton JT. *The oral health of individuals with dental phobia: a multivariate analysis of the Adult Dental Health Survey, 2009.* Br Dent J. 2017;222(8):595-604.
115. Locker D, Liddell A. *Clinical correlates of dental anxiety among older adults.* Community Dent Oral Epidemiol. 1992;20(6):372-5.
116. Ng SK, Leung WK. *A community study on the relationship of dental anxiety with oral health status and oral health-related quality of life.* Community Dent Oral Epidemiol. 2008;36(4):347-56.
117. Bernson JM, Elfstrom ML, Hakeberg M. *Dental coping strategies, general anxiety, and depression among adult patients with dental anxiety but with different dental-attendance patterns.* Eur J Oral Sci. 2013;121(3 Pt 2):270-6.
118. Sharav Y, Leviner E, Tzukert A, McGrath PA. *The spatial distribution, intensity and unpleasantness of acute dental pain.* Pain. 1984;20(4):363-70.
119. Pau AK, Croucher R, Marcenes W. *Prevalence estimates and associated factors for dental pain: a review.* Oral Health Prev Dent. 2003;1(3):209-20.
120. Brattberg G, Thorslund M, Wikman A. *The prevalence of pain in a general population. The results of a postal survey in a county of Sweden.* Pain. 1989;37(2):215-22.
121. Berggren U. *Psychosocial effects associated with dental fear in adult dental patients with avoidance behaviours.* Psychol Health. 1993;8(2-3):185-96.
122. Henning Abrahamsson K, Berggren U, Carlsson SG. *Psychosocial aspects of dental and general fears in dental phobic patients.* Acta Odontol Scand. 2000;58(1):37-43.
123. Moore R, Brodsgaard I, Rosenberg N. *The contribution of embarrassment to phobic dental anxiety: a qualitative research study.* BMC Psychiatry. 2004;4:10.
124. Kvale G, Raadal M, Vika M, Johnsen BH, Skaret E, Vatnelid H, et al. *Treatment of dental anxiety disorders. Outcome related to DSM-IV diagnoses.* Eur J Oral Sci. 2002;110(2):69-74.
125. World Health Organization. *Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, No.2, p.100) and entered into force on 7 April 1948.*
126. Cimprich B, Paterson AG. *Helath-Related Quality of Life: Conceptual Issues and Research Applications.* In: Inglehart MR, Bagramian R, editors. *Oral health-related quality of life.* USA: Quintessence Publishing Co, Inc.; 2002. p. 47-53.
127. Inglehart MR, Bagramian R. *Oral Helath-Related Quality of Life: An introduction.* In: *Oral health-related quality of life.* USA: Quintessence Publishing Co. Inc.; 2002. p. 1-6.

128. Mehrstedt M, John MT, Tönnies S, Micheelis W. *Oral health-related quality of life in patients with dental anxiety.* Community Dent Oral Epidemiol. 2007;35(5):357-63.

129. Pohjola V, Lahti S, Suominen-Taipale L, Hausen H. *Dental fear and subjective oral impacts among adults in Finland.* Eur J Oral Sci. 2009;117(3):268-72.

130. Vermaire JH, de Jongh A, Aartman IH. *Dental anxiety and quality of life: the effect of dental treatment.* Community Dent Oral Epidemiol. 2008;36(5):409-16.

131. Vermaire JH, van Houtem CM, Ross JN, Schuller AA. *The burden of disease of dental anxiety: generic and disease-specific quality of life in patients with and without extreme levels of dental anxiety.* Eur J Oral Sci. 2016;124(5):454-8.

132. Ogle OE, Hertz MB. *Anxiety control in the dental patient.* Dent Clin North Am. 2012;56(1):1-16, vii.

133. Donaldson M, Gizzarelli G, Chanpong B. *Oral sedation: a primer on anxiolysis for the adult patient.* Anesth Prog. 2007;54(3):118-29.

134. Savanheimo N, Sundberg SA, Virtanen JI, Vehkalahti MM. *Dental care and treatments provided under general anaesthesia in the Helsinki Public Dental Service.* BMC Oral Health. 2012;12(1):45.

135. Berggren U. *Long-term effects of two different treatments for dental fear and avoidance.* J Dent Res. 1986;65(6):874-6.

136. Hakeberg M, Berggren U, Carlsson SG, Grondahl HG. *Long-term effects on dental care behavior and dental health after treatments for dental fear.* Anesth Prog. 1993;40(3):72-7.

137. Roth A, Fonagy P. *Anxiety Disorders I. Specific Phobia, Social Phobia, Generalized Anxiety Disorder, and Panic Disorder with and without Agoraphobia.* In: *What Works for Whom? A Critical Review of Psychotherapy Research.* New York: Guilford Press; 2004. p. 150-197.

138. Öst L-G, Clark DM. *Cognitive Behaviour Therapy: Principles, Procedures and Evidence Base.* In: Öst L-G, Skaret E, editors. *Cognitive Behavioral Therapy for Dental Phobia and Anxiety.* West Sussex: John Wiley & Sons; 2013. p. 91-107.

139. Wide Boman U, Carlsson V, Westin M, Hakeberg M. *Psychological treatment of dental anxiety among adults: A systematic review.* Eur J Oral Sci. 2013;121(3 PART2):225-34.

140. Gordon D, Heimberg RG, Tellez M, Ismail AI. *A critical review of approaches to the treatment of dental anxiety in adults.* J Anxiety Disord. 2013;27(4):365-78.

141. Hägglin C, Boman UW. *A dental phobia treatment within the Swedish National Health Insurance.* Swed Dent J. 2012;36(2):71-8.

142. Lundgren J, Wide Boman U. *Multimodal cognitive behavioural treatment.* In: Öst L-G, Skaret E, editors. *Cognitive behaviour therapy for dental phobia and anxiety.* West Sussex. John Wiley & Sons; 2013. p. 109-118.

143. Hakeberg M, Wide U. *Individulas with severe dental anxiety - classification, diagnosis and psychological treatment.* J Calif Dent Assoc. 2019;47(8):9.

144. Corah NL, Gale EN, Illig SJ. *Assessment of a dental anxiety scale.* J Am Dent Assoc. 1978;97(5):816-9.

145. Milgrom P, Vignehsa H, Weinstein P. *Adolescent dental fear and control: prevalence and theoretical implications.* Behav Res Ther. 1992;30(4):367-73.

146. Kvale G, Berg E, Nilsen CM, Raadal M, Nielsen GH, Johnsen TB, et al. *Validation of the dental fear scale and the dental belief survey in a Norwegian sample.* Community Dent Oral Epidemiol. 1997;25(2):160-4.

147. Armfield JM. *Australian population norms for the Index of Dental Anxiety and Fear (IDAF-4C).* Aust Dent J. 2011;56(1):16-22.

148. Carrillo-Diaz M, Crego A, Armfield JM, Romero M. *Adaptation and psychometric properties of the Spanish version of the Index of Dental Anxiety and Fear (IDAF-4C+).* Oral Health Prev Dent. 2012;10(4):327-37.

149. Adulyanon S, Sheiham A, Slade G. *Oral impacts on daily performances.* In: Slade G, editor. *Measuring oral health and quality of life.* Chapel Hill: University of North Carolina, Dental Ecology; 1997. p. 151-161.

150. Locker D. *Measuring oral health: a conceptual framework.* Community Dent Health. 1988;5(1):3-18.

151. Östberg AL, Andersson P, Hakeberg M. *Cross-cultural adaptation and validation of the oral impacts on daily performances (OIDP) in Swedish.* Swed Dent J. 2008;32(4):187-95.

152. Åstrøm A, Haugejorden O, Skaret E, Trovik T, Klock K. *Oral Impacts on Daily Performance in Norwegian adults: validity, reliability and prevalence estimates.* Eur J Oral Sci. 2005;113(4):289-96.

153. Hill KB, Chadwick B, Freeman R, O'Sullivan I, Murray JJ. *Adult Dental Health Survey 2009: relationships between dental attendance patterns, oral health behaviour and the current barriers to dental care.* Br Dent J. 2013;214(1):25-32.

154. Bandelow B, Michaelis S. *Epidemiology of anxiety disorders in the 21st century.* Dialogues Clin Neurosci. 2015;17(3):327.

155. Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S, et al. *Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: results from the National Comorbidity Survey.* Arch Gen Psychiatry. 1994;51(1):8-19.

156. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. *Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication.* Arch Gen Psychiatry. 2005;62(6):593-602.

157. Kazdin AE. *Observational Research - Case-Control and Cohort Designs.* In: Pascal R, editor. *Research Design in Clinical Psychology.* 4th ed. Boston, MA: Allyn and Bacon; 2010. p. 233-264.

158. Dillman DA, Phelps G, Tortora R, Swift K, Kohrell J, Berck J, et al. *Response rate and measurement differences in mixed-mode surveys using mail, telephone, interactive voice response (IVR) and the Internet.* Soc Sci Res. 2009;38(1):1-18.

159. Manfreda KL, Bosniak M, Berzelak J, Haas I, Vehovar V. *Web surveys versus other survey modes - A meta-analysis comparing response rates.* Int J Mark Res. 2008;50(1):79-104.

160. Galea S, Tracy M. *Participation rates in epidemiologic studies.* Ann Epidemiol. 2007;17(9):643-53.

161. Armfield JM, Slade GD, Spencer AJ. *Are people with dental fear under-represented in oral epidemiological surveys?* Soc Psychiatry Psychiatr Epidemiol. 2009;44(6):495-500.

162. Central Bureau of Statistics (SE). *Statistical abstract of Sweden.* Stockholm, Sweden; 1962.

163. Katz N. *The impact of pain management on quality of life.* J Pain Symptom Manage. 2002;24(1):S38-S47.

164. Niv D, Kreitler S. *Pain and quality of life.* Pain pract. 2001;1(2):150-61.

165. Adulyanon S, Vourapukjaru J, Sheiham A. *Oral impacts affecting daily performance in a low dental disease Thai population.* Community Dent Oral Epidemiol. 1996;24(6):385-9.

166. Srisilapanan P, Sheiham A. *The prevalence of dental impacts on daily performances in older people in Northern Thailand*. Gerodontology. 2001;18(2):102-3.

167. Nuttall N, Steele J, Pine C, White D, Pitts N. *The impact of oral health on people in the UK in 1998*. Br Dent J. 2001;190(3):121-6.

168. Alsanawi EA, Abusaris R, El-Metwally AA. *Cross-cultural adaptation and validation of the Arabic version of the Index of Dental Anxiety and Fear (IDAF-4C).* J Oral Sci. 2019;61(2):229-37.

169. De Jongh A, Muris P, Schoenmakers N, Ter Horst G. *Negative cognitions of dental phobics: reliability and validity of the dental cognitions questionnaire.* Behav Res Ther. 1995;33(5):507-15.

170. De Jongh A, Muris P, Ter Horst G, Van Zuuren FJ, De Wit C. *Cognitive correlates of dental anxiety.* J Dent Res. 1994;73(2):561-6.

171. Humphris G, Clarke H, Freeman R. *Does completing a dental anxiety questionnaire increase anxiety? A randomised controlled trial with adults in general dental practice.* Br Dent J. 2006;201(1):33-5.