DENTAL ANXIETY IN A SWEDISH CITY POPULATION OF WOMEN

A cross-sectional and longitudinal study of prevalence, dental care utilisation and oral and mental health factors

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Göteborg University
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2000

Self-portrait of one of my old patients before treatment

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AKADEMISK AVHANDLING

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Catharina Hägglin
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Avhandlingen baseras på följande delarbeten:

I 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;13:25-34.

II 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. In press (2000;28:00-00).

III Hägglin C, Berggren U, Hakeberg M, Hällström T, Bengtsson C. Variation in dental anxiety among middle-aged and elderly women in Sweden. A longitudinal study between 1968 and 1996. J Dent Res 1999;78(10):1655-1661.

IV Hägglin C, Hakeberg M, Hällström T, Berggren U, Larsson L, Waern M, Palsson S and Skoog I. Dental anxiety in relation to mental health and personality factors. A longitudinal study of middle-aged and elderly women. Eur J Oral Sci. Accepted for publication.

V Hakeberg M, Hägglin C, Berggren U and Carlsson S.G. Structural relationships of dental anxiety, mood and general anxiety. Submitted for publication.

ABSTRACT

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Department of Endodontology/Oral Diagnosis, Faculty of Odontology, Göteborg University, Göteborg, Sweden.

The aims of this thesis were to describe the level of dental anxiety and investigate the associations: to dental attendance, oral health, general health and socio-economic factors in a representative sample of middle-aged and elderly women in Göteborg, Sweden; to study variations in dental fear in a longitudinal perspective and its relation to mental health and personality factors; to explore the structural relationships between dental anxiety, general anxiety and mood factors among dental phobic patients.

The cross-sectional study of more than 1000 women aged 38-84 years, showed that although the prevalence rates of dental anxiety were lower in higher age-groups, there was still a considerable proportion of elderly women who experienced negative feelings, ranging from discomfort to severe fear. Higher levels of dental anxiety predicted irregular dental visits. Among subjects high in dental fear a significantly poorer oral status was found for irregular dental attenders compared to regular attenders. The association between dental anxiety, socio-economic factors and general health factors seemed clear when using simple group comparison. However, multivariate logistic regression analyses indicated that these factors were of minor importance.

The longitudinal analyses were based on 778 women investigated in a psychiatric study in 1968-69, and followed up after 6, 24 and 28 years. The prevalence of dental anxiety was lower in older age-groups and was found to be an age-effect rather than based on cohort factors. A high level of dental fear at baseline and a greater number of fears/phobias at follow-up predicted high dental fear at follow-up. Over the study period, dental anxiety increased or decreased with number of other fears. Chronic dental fear was related to psychiatric impairment and neuroticism at baseline, while remission was related to extraversion.

In a clinical study of 220 phobic patients, three dimensions (dental anxiety, general anxiety and mood) were hypothesised and measured indirectly by different psychometric scales. This explorative study used Structural Equation Modeling (SEM) and revealed a structural relationship between these areas. The mood dimensions associated with dental care showed a clear impact on level of dental anxiety. The study also revealed the advantages of using a SEM method in detecting and estimating the variance/covariance structures among multiple measurement models.

Key words: *Aged, Behavioural sciences, Dental anxiety, Health, Longitudinal, Oral status, Personality, Phobias, Structural Equation Modeling, Women.*
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PREFACE

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ABBREVIATIONS

DAS	Corah Dental Anxiety Scale
DBS	Dental Belief Survey
DFS	Dental Fear Survey
DQ	Dental Anxiety Question
DFRTC	Dental Fear Research and Treatment Clinic
DSM-III	Diagnostic and Statistical Manual of Mental Disorders - Third Edition
DSM-III-R	Diagnostic and Statistical Manual of Mental Disorders - Third Edition - Revised
EPI	Eysenck Personality Inventory
FSS-II	Fear Survey Schedule, second version
GFS	Geer Fear Scale
MACL	Mood Adjective Checklist
PWGS	Population Study of Women in Göteborg, Sweden
SEM	Structural Equation Modeling
SF-36	Short–Form-36 items Health Survey
STAI-S	State – Trait Anxiety Inventory /State
STAI-T	State – Trait Anxiety Inventory /Trait
VAS	100 mm Visual Analogue Scale

INTRODUCTION

Fear of dentistry is reported to be one of the most common fears/phobias in the industrialised world [1, 2]. Moreover, dental fear is an important determinant of dental habits [3-5]. Dental care can elicit anything from a slight discomfort or anxiety reaction to extreme fear or phobia. The association between pain, fear and dentistry is deeply rooted. Such traditional images do not easily change in a society, despite technological advances in dentistry and improved dental education [6].

Individuals who experience dental anxiety do not constitute a homogenous group, but differ both with regard to personal background and characteristics and in terms of the origins, age of onset and manifestations of their fear of dental treatment [7-10]. A number of epidemiological studies of dental anxiety have been reported since the end of the 1950s [5, 11-16]. Most studies have been carried out in Scandinavia, the USA and Western Europe, but more recently studies from Asia [17-19] and Australia [20] have also been presented. The majority of research projects have focused on the prevalence, causes and consequences of dental anxiety, while some studies have tried to identify the influence of personality and social background. However, very few epidemiological studies of dental fear have included variables related to general and mental health.

Dental anxiety may create psychological and practical problems both for the patient and for the dental team. Dentally anxious patients take longer to treat and often fail to keep their appointments [21, 22], and severely fearful patients have significantly poorer oral status [23-25]. Furthermore, the higher frequency of avoidance of dental care may lead to acute conditions and treatments that subject both patient and dentist subject to more emotional stress and leave them significantly less satisfied with the dental care performed [26-28]. It has also been shown that many individuals suffering from dental phobia experience a low quality of life with problems such as unemployment, sickness, psychosomatic complaints such as tension headaches, stomach-aches and sleep disturbances, and that they often have interpersonal difficulties [29, 30].

Men and women are known to differ in terms of health-related behaviour. Illnesses (psychiatric, psychosomatic and somatic) may manifest differently in men and women [31-33] and women are more frequent users of health care than men [34, 35]. Moreover, women often express

themselves differently to men when talking about emotions. This also holds for the reporting of fear and anxiety [31, 36]; women are more likely to report high dental fear [5, 15, 16].

While a large number of studies have been performed among children and young or middle-aged adults, so far only a small number of studies of individuals over 50 years of age have been reported. These mainly come from the Ontario Study of Oral Health of Older Adults in Canada [23, 37]. However, life expectancy has increased substantially in most industrial countries and older adults have an increasing number of remaining and often heavily restored teeth [38-40]. Thus, one reason for focusing on older adults in dental anxiety research is that there will be a growing need for dental care among older individuals in the future. There is an obvious need to assess dental anxiety in this population and especially to present longitudinal data because of the lack of knowledge about behavioural aspects of dentistry among older people. Gerry Kent [41] stated that one of the great weaknesses of research in dental anxiety and phobia is the lack of longitudinal data. Knowledge has almost exclusively been built on cross-sectional data and retrospective assessments and little is known about individual and cohort developments.

Research on dental anxiety seems important for several reasons:

1. It can contribute to prevention. A better understanding of this problem can be imparted to dental staff during their training and to patients who seek care, but also to the general public.
2. In order to develop effective treatment methods. Specific treatment strategies suited to specific personalities or diagnoses may lead to higher success rates, shortening treatments and lower drop-out rates. This may have the effect of relieving frustration for both the dentist and the patient.
3. To predict prevalence of dental anxiety. Such predictions are important for planning health service resources.
4. Dental anxiety research is also important because of its relevance for research on fear in general. The dental situation is easily controlled for research purposes; environmental influences are relatively stable and short- and long-term treatment effects can be reliably checked. Moreover, when studying levels of dental anxiety one is not dependent on self-reports, but can also use information about periods of avoidance. It is thus possible to achieve a relatively high degree of scientific precision. Another advantage is that research can be conducted in a natural environment rather than in an experimental situation. Lastly, dental

visits are something which everyone has experience of, and therefore material in this area is not lacking.

In this thesis the terms dental fear and dental anxiety are used synonymously, since they are phenomena that are closely related. However, according to Weiner [42] there is a distinction between the two. Fear is related to a specific external threatening stimulus. Anxiety, on the other hand, represents a subjective state or feeling. However, severe dental anxiety should be considered a specific phobia according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)[43]. A specific phobia is a clinically significant anxiety provoked by exposure to a specific feared object or situation, often leading to avoidance behaviour. Dental phobia often results in complete avoidance of dentistry, but avoidance as a criterion is not necessary to classify fear reactions as phobias according to DSM-IV. For such patients dentistry "is endured with intense anxiety or distress" and the fear "interferes significantly with the person's normal routine, occupational functioning, or social activities or relationships" [43].

Prevalence of dental anxiety

The prevalence of high dental anxiety is reported to be between 2.5% and 20% depending on population, method and measurement [5, 15, 44-46]. Dental fear is reported to be the fifth most common of the most frequent intense fears [1]. Using the Dental Anxiety Scale (DAS) [47, 48] with scores ≥15 to assess extreme dental fear, studies have indicated a range of 4-5% [15, 16, 45] in adult populations. Several cross-sectional studies show that the prevalence of severe dental anxiety in all age-groups has been relatively stable during the past four decades in Sweden as well as in other countries and cultures [12, 15, 37, 46, 48-50].

Age and gender

It has been shown that dental anxiety correlates with background factors such as age, sex and socio-economic status. Dental anxiety peaks in early adulthood and declines with age [51, 52]. Thus, older people have lower scores on dental anxiety measures than younger individuals, particularly after 50 years of age [5, 15, 17, 18, 46, 53, 54]. If this is due to a cohort effect, one would expect dental anxiety among the elderly to be a greater problem in the future than has previously been anticipated. Such effects can only be investigated in longitudinal

studies. However, to our knowledge previous epidemiological studies of adults with dental anxiety have had cross-sectional designs with the exception of three studies, two from Sweden [55, 56] and one from Canada [37].

Lavstedt et al. [55] reported that dental fear did not decrease in a Swedish population of 598 subjects (aged 18-65 years) during a 10-year period between 1970 and 1980. In fact, a slight, but not statistically significant, increase in dental fear was found. On the other hand, Håkansson [56] reported that over the eleven year period between 1974 and 1985 in a similar Swedish population dental anxiety decreased slightly, but not at a statistically significant level. In these two studies, the main focus was to investigate the need for dental care in a normal population. The reports concerning dental anxiety constituted only a minor and secondary part of these studies. The dental anxiety measurements and analyses used seem somewhat uncertain, possibly due to a lack of reported data. The Canadian study was a three year follow-up of older adults by Locker and Liddell [37]. They found that dental anxiety was virtually unchanged during the study period and concluded that dental anxiety is stable in an elderly population over such a short period of time. Even though elderly women reported lower levels of dental anxiety than younger women, 8% aged 50 years and older were found to be highly anxious (DAS≥13) [26].

The age of onset of dental anxiety has received relatively little attention [57], largely because dental anxiety is usually viewed as a fear originating in childhood. However, three studies that have addressed the issue of age of onset do not support this thesis. Öst [57] found that almost 20% of dental phobics reported onset after the age of 14 years. In two population-based studies Milgrom et al [5] and Locker et al [58] reported that 15% and 27%, respectively, became anxious as adults.

Contrary to studies of children, where there are no consistent results with regard to sex differences [59-61], studies of adults have generally reported that women are more likely to report higher levels of dental anxiety than men [5, 12, 15, 16]. In most studies high dental fear is found to be approximately twice as common in women, which is also the case for other specific phobias and agoraphobia [41]. However, in some studies of dental anxiety no gender differences have been found [26, 53, 62].

Also when studying anxiety disorders in general, women show higher prevalence figures than men [2, 63]. Women seem to be at twice the life-time risk of developing specific phobias compared to men. Such gender differences are less marked for social phobia, although

women do still seem to be most at risk [64, 65]. The reported higher levels of fears and phobias among women, can not only be explained by assuming that it is more socially permissible for women to report fear. In a review article about specific phobias it was suggested that social pressure to interact with feared situations has a prophylactic effect for men [66]. Possibly, other predisposing factors (e.g. sex hormones) also play a role in the skewed sex distribution of some specific fears and phobias [66, 67].

A review of the relationships between anxiety disorders and age by Krasucki [63] showed that the higher prevalence of anxiety disorders in women is reduced with increasing age for all anxiety disorders except for generalised anxiety, which appears to be maintained or increase. Further, in accordance with the Krasucki review, Locker and Liddell have later in a retrospective study [10] reported that older individuals (aged 70 years and older) are less likely to have simple conditioned dental phobia but more likely to have a generalised anxiety type of dental anxiety, than younger individuals. They hypothesised that individuals with multiple phobias and generalised anxiety would be more likely to carry dental anxiety into old age, while those with a simple conditioned phobia have a better chance of recovering over time.

Socio-economic factors

Inconsistent results have been found with regard to social class, income, education, and level of dental anxiety. Some studies report a significant negative correlation between economic and social status and dental fear [46, 68], while several other studies do not confirm this result [15, 26, 45, 53]. In a study by Berggren & Meynert [4] a majority of patients referred for treatment at the Dental Fears Research and Treatment Clinic (DFRTC) in Göteborg, Sweden, belonged to the lowest social class. This was mainly seen as an effect of the referral system to the clinic at that time, but possibly also reflects different patterns of dental care behaviour in individuals from high and low social classes. Individuals with high dental fear and high socio-economic status may feel stronger social pressure to seek dental care and they may also have easier access to specialist care, not to mention a better economic situation. In contrast, individuals with high fear and lower socio-economic status may be more likely to avoid dental care [4]. Two studies [26, 69] have found an association between marital status and dental fear. Divorced/separated men and women reported a higher anxiety level, but the association appeared to be weak. Studies of relationships between education and dental anxiety have also revealed

contradictory results. Some studies report that lower educational status is associated with higher dental fear [46, 69]. In contrast, other studies [5, 15, 26, 45, 53] have not found such a correlation.

Etiology of dental fear

Dental fear has been commonly regarded as a conditioned response to negative stimuli in dentistry, especially in childhood. According to Wolpe [70] two types of reactions can be distinguished, the directly (classical conditioning) and the indirectly (cognitive) learned reaction. Fear evoked by classical conditioning may be caused by a single event of high intensity, or it may be progressively built up in a series of related events. Indirectly learned fears have been acquired through information or misinformation about different situations or objects, or by observation of other people in such situations. These reactions are built up by cognitive interpretation. These two models may serve as prototypes, but the origin of dental fear is in most cases multifactorial where both cognitive and conditioned elements are operative in an interactive process [4, 8, 9, 71].

Predisposing and concomitant factors

Kendler et al [72] found in a twin study of the genetic epidemiology of phobias in women that specific phobias seemed to arise from the joint effect of a modest though significant, genetic vulnerability and phobia-specific traumatic events in childhood. The biological explanation suggests that there are individual differences in how patients react to dental care and that they are predisposed to anxiety to different extents. This view can explain why in some patients, anxiety occurs in the absence of any specific negative experience. The predisposition could be related to personality traits such as higher levels of general fearfulness and temperament.

The associations between dental anxiety and general fearfulness [9, 73, 74], and personality factors such as neuroticism [75-78] have been confirmed in several studies. In an epidemiological study 22% of individuals with high dental fear reported two or more other fears, compared to 11% in those with low dental fear [2]. In patients with dental phobia attending the DFRTC in Göteborg, 93% reported at least one extreme fear in addition to their dental fear, while

50% reported five or more extreme fears [73]. The presence of other phobias may thus often complicate the picture of dental fear [9, 73, 74, 79, 80]. Locker et al [58] found in their retrospective study that subjects with adolescent-onset dental anxiety were more likely to have high trait anxiety, while adult-onset subjects were more likely to have multiple severe fears and symptoms indicative of psychiatric problems. Roy-Byrne et al [74] showed in a sample of dental phobics that 40% could be assigned another concurrent psychiatric diagnosis (according to DSM-III-R), such as panic agoraphobia, social phobia and mood disorders.

However, most studies have shown experience and learning processes to be the most important etiological factors. As mentioned above, according to Wolpe (62) this learning can be categorised broadly as a conditioning process or a cognitive process.

Directly learned reactions (the conditioning process)

The conditioning of dental fear through traumatic experiences has been confirmed in several self-report studies [5-7, 46, 77, 81-83]. Many situations in the dental setting can elicit fear. Such potential fear and phobia producing stimuli are loud noises, sharp lights, strong smells, feelings of being closed in, of helplessness and of lacking control, violation of personal space of the face and mouth, and last but not least, pain. The correlation between remembered experience of pain and dental anxiety is well documented [45, 84, 85]. McNeal and Berryman [79] found that fear of pain, closed spaces and mutilation were more likely than other fears to be linked to dental fear.

Also the relationship and communication between dentists and patients may elicit strong negative feelings [86-88]. Eli et al [89] found that the strongest predictor of level of dental fear in their study was the subjects' evaluation of the dentist. Bernstein and Kleinknecht [90] reported in a study among highly fearful individuals that negative dentist behaviours as well as dentists' personal attributes were, for a majority of the subjects, the cause of their fear. This may explain why fearful patients so often express anxiety for perceived belittlement and/or faulty treatment by dentists [4].

The patient-dentist relationship is also strongly related to the patient´s experience of control during a dental visit. The 'lack of control' aspect has been investigated by Kent [91] and Logan et al [92]. Kent showed in a retrospective study that perceived control was lower in highly anxious than less anxious patients. Logan et al found that a combined high desire for control and

a low feeling of control was associated with severe dental distress. If the dentist is informative and communicative, patients may feel a higher degree of control. Studies examining the dentist/patient relationship have shown that patients see the ideal dentist as being communicative, supportive, empathic and friendly [93, 94].

Indirect learned reactions (the cognitive process)

A person may also be influenced by relatives, close friends or the mass media to see dentists and dental treatment in a negative light. Rachman [95] described this indirect pathway to specific phobias and labelled it modeling (e.g. children observing parental reactions during dental treatment) and negative information (e.g. hearing about negative experiences related to dental care). Such social learning and additional negatively interpreted incidents during dental treatment may be the cause of some sorts of dental fear.

A number of studies have shown a positive correlation between anxiety and maternal dental anxiety [96-98]. Bedi et al [99] reported that the number of people known by the child to be afraid of the dentist was one of the two strongest factors that significantly predicted dental anxiety in children. In a retrospective study by Locker et al [58] it was found that a family history of dental anxiety was important for child onset anxiety only, but not for adolescent or adult onset. Their conclusion is in line with findings by Öst [57] who reported that modeling and negative information are associated with an early onset of specific phobias.

Diagnostic systems

The complexity of dental fear and the difficulty of defining the problem in adults may be the reason why no standard diagnostic system exists for dental anxiety. Weiner and Sheehan [42] differentiated endogenous and non-endogenous dental anxiety. The endogenous type is likely to be genetically determined and organic in nature, while non-endogenous anxiety is more likely to develop through learning processes resulting from aversive experiences. Milgrom et al [8] proposed four major diagnostic types, referred to as "the Seattle diagnostic system": (I) conditioned fear of specific painful or unpleasant stimuli (drills, needles, smells, etc.), (II) anxiety about somatic reactions during treatment (panic attacks, fainting, etc.), (III) patients with other complicating trait anxiety or multiphobic symptoms, and (IV) distrust of dental personnel. Moore et al [9] and Roy-Byrne et al [74] tested "the Seattle system" in dental phobic patients and related

it to DSM-III-R criteria. They had broadly similar results concerning prevalence rates. However, Roy-Byrne et al found no evidence that the Seattle categories corresponded to the proposed DSM-III-R criteria. They instead suggested that schemes which classify dentally anxious subjects are distinct from psychiatric diagnostic systems. Locker et al [10] explored the Seattle system in a population-based sample and found a group who could not be categorised (13%). He suggested that these were the "goers but haters" who will attend dental clinics and who are not included in clinical studies whose subjects are usually self-referred and suffer from extreme levels of dental anxiety.

At the DFRTC in Göteborg we use somewhat different criteria compared to "the Seattle system" to differentiate a) general/trait anxiety with or without multiphobic symptoms (Seattle III); b) conditioned specific fear of painful or unpleasant stimuli (Seattle I); and c) cognitively originating fear about dental objects and situations, or about personal interaction with the dentist or auxiliaries [100]. It is our clinical experience that both Seattle type II (anxiety about somatic reactions during treatment) and IV (distrust of dental personnel) may be sub-types within any of these three major categories. This was substantiated in the study by Locker et al [10], where 68% of type II subjects and 61% of type IV, had high scores on one or more of the other diagnostic items compared to none in type I and 31% in type III.

Consequences and maintenance of dental fear

Oral status and dental care behaviour

Fairly large proportions of patients with dental fear receive regular dental care, but with an elevated incidence of missed and cancelled appointments [5, 22, 45]. However, one obvious risk of dental anxiety is phobic avoidance of dental care and irregular dental visiting patterns [5, 7, 16, 44]. Dental patients with phobic avoidance take longer to treat [22] and have significantly poorer oral status [4, 25]. It has been found that edentulous subjects, contrary to what has been hypothesised ("no teeth - no problems"), may be more dentally anxious than dentate subjects [44, 69]. These results suggest that dental anxiety may be a risk factor for losing one's teeth, and that a reduction in anxiety does not necessarily take place when the teeth are indeed lost.

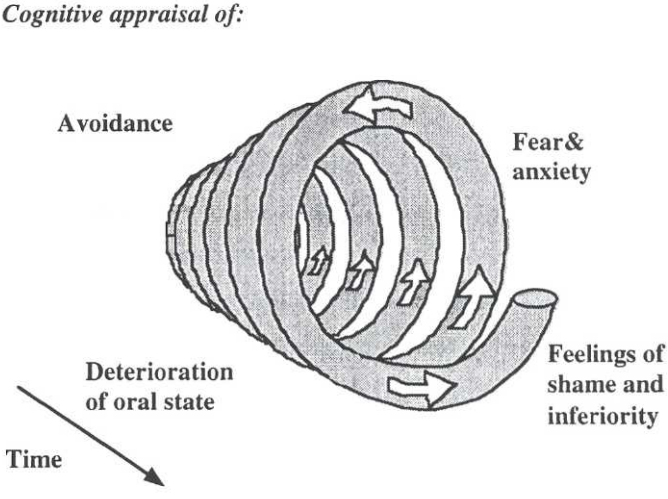
Dental anxiety has no clear influence in the general population on oral status or dental care behaviour since many, maybe the majority of dentally anxious individuals have regular dental care [45]. While, a relationship between dental fear and dental status has been reported in several studies, these relationships may be due to a strong association of these factors in dentally anxious subjects who avoid dental treatment rather than signifying a relationship that concerns the whole population. In an epidemiological study by Lavstedt [68] it was found that in comparison with ordinary dental patients, subjects with dental anxiety had higher frequencies of missing teeth, more decayed and fewer filled teeth, more endodontically treated teeth, and a higher degree of marginal bone loss. Similar results were reported in a study by Hakeberg et al [25] where dental health status was compared in patients with severe dental fear and a matched control group of ordinary dental patients. Most differences between ordinary and fearful patients were more pronounced with increasing age, reflecting unmet needs for dental treatment. The finding that highly anxious individuals have higher frequencies of caries and fewer filled surfaces has also been reported in a Canadian epidemiological study of adults aged 50 years and older [23].

Although a majority of dentally anxious individuals visit the dentist regularly, they are at risk of becoming avoiders [15, 45, 53]. Little is known about the character and magnitude of their dental visiting behaviour problems, while dental phobics are better investigated with regard to negative behaviour effects. However, parallels can not immediately be drawn between the two groups. The usual pattern for many dental phobics is to visit the dentist only when they are in pain. These acute conditions and the emergency treatments subject both patient and dentist subject to more stress and leave them significantly less satisfied with the dental care performed [26-28, 101]. A study by Weinstein et al [102] indicated that dentists provided a qualitatively lower level of dental care to patients who were perceived as not being appreciative. Self-perceived need for dental treatment is higher among individuals with high dental anxiety. They also rate their oral health as poorer, which objectively often is the case in older adults [26], but not necessarily in younger individuals [103]. Thus, Berggren [7] and Moore [6] argued that dental phobics may tend to overestimate the deterioration of their dentition since they are often extremely focused on the problem. This indicates the importance of clinical examinations when investigating oral health among highly anxious individuals.

Maintenance and psychosocial effects

In the light of such negative self-assessments, the maintenance of dental fear in subjects with irregular dental care is easily understood. A decision to put off visiting the dentist results in a short-term reduction of anxiety. However, anxiety increases over time as the patient's (self-assessed) dental health is affected and increases the likelihood of invasive treatment, thus making the patient focus more and more on his or her teeth. Drawing these factors into a model, Berggren [4] has suggested that fearful dental subjects are often caught in a vicious cycle that accounts for the maintenance of dental fear (Fig.1). Fear and anxiety lead to avoidance resulting in the deterioration of dental health and a growing need for dental treatment. This coupled with an inability to accept dental treatment results in feelings of shame, guilt, embarrassment and inferiority, subsequently reinforcing fear and leading to increased anxiety and avoidance behaviour.

Fig. 1. Vicious cycle of dental fear according to Berggren.



As support for this vicious cycle model, it has been shown that individuals suffering from dental anxiety with avoidance behaviour have a lower quality of life, feel less stable and secure, more often feel lonely, report poorer general health, and less comfort and general well-

being than others [29, 30]. Social factors often appear to contribute strongly to the maintenance of dental fear, especially in long-term avoiders [29]. De Jongh [104] has later emphasised the obvious cognitive factors operating in the model, which may contribute to a better understanding of the mechanisms underlying dental anxiety. In this modified model anxiety leads to avoidance, fear then increases over time, giving rise to negative cognitions about dentists and treatment, one's ability to cope and about one's dentition. Again it is necessary to emphasize that this explanatory model relates to long-term avoiders, while little is known about the magnitude and character of the psychosocial factors operating among fearful patients with regular dental care.

Since dental care is not consistently pain-free, a negative experience could easily reconfirm a dentally anxious patient's beliefs that dental treatment can be painful and thus anxiety is maintained [41]. Even if future dental treatment is pain-free, there are still several factors, which can explain the maintenance of anxiety. Kent [105] argued that substantial sub-groups of dental patients assessed pain-free dental treatment experiences as something atypical. He found that dental anxiety after a pain-free experience decreased only in patients who experienced a sizeable discrepancy between expected and experienced pain and who had a high level of confidence in that this would repeat itself in future dental visits. Thus, it is not to be expected that regular dental care and the experience of pain-free dentistry promptly influence fear and avoidance. On the contrary, they seem to be slow in reducing dental anxiety due to the co-variation of cognitive biases based on previous experiences in dentistry or on more general factors [41, 106]. Thus, the common one-year period between dental examinations in regular dental recalls, may not alter a persistent anxiety in patients who require little or pain-free treatment. The exposure to dental treatment that regular attendance implies may consequently not be sufficiently frequent to alter expectations because there is less opportunity for positive experiences to change existing anxiety-dominated negative cognitive schemata [41].

As mentioned above little is known about the group of fearful and anxious individuals who keep up regular dental contacts. This is true also for actions taken to alleviate anxiety among these patients. An abundance of reports have however been published on phobic patients seeking specialised care. However, since treatment of dental fear is beyond the scope of this thesis these aspects will not be reviewed here.

AIMS OF THE INVESTIGATION

The overall aims of this study were to:

- investigate the prevalence of dental fear in a representative sample of middle-aged and elderly women and to analyse concomitant factors;
- in a longitudinal perspective study variations in dental fear over time and the relationships to mental health and personality factors;
- explore the structural relationships between dental anxiety and concomitant factors among dental phobic patients.

The specific aims of this study were to:

- investigate dental fear and its expression in dental attendance, oral health and oral symptoms in a representative sample of middle-aged and elderly women (Paper I);
- investigate the association between dental fear and dental attendance, age, socio-economic factors and general health factors (Paper II);
- investigate how dental anxiety changes with age among middle-aged and elderly women during a 28-year period, to analyse drop-out effects, and to compare and validate the results from three different scales of dental anxiety (Paper III);
- investigate the longitudinal course of dental anxiety in relation to specific fears/phobias, depression, neuroticism, extraversion/introversion and psychiatric impairment among middle-aged and elderly women (Paper IV);
- apply multivariate structural relationship analyses in a multifactorial theoretical framework in order to establish a model of dental fear, general anxiety and mood factors in dental phobic patients (Paper V).

MATERIAL

The Population Study of Women in Göteborg, Sweden (PWGS) (I-IV)

Study area

Göteborg is the second largest city in Sweden and had during the study period, from 1968 to 1996, about 450 000 inhabitants. Dental care is provided by private practitioners and by a public dental services organisation. In 1968-69 there were 400-450 dentists in Göteborg and in 1996 there were 650-700.

Study population, study design and non-participation/drop-out analyses

Medical and dental investigations

In 1968-69 women of different age groups were invited to participate in a longitudinal epidemiological, multidisciplinary study, the Population Study of Women in Göteborg, Sweden (PWGS), including medical, psychiatric and dental examinations [32]. The main objective of the study was to investigate the occurrence of disease over time. The participants were re-examined after six (1974-75), 12 (1980-81), and 24 years (1992-93) [107-109]. No analyses from 1980-81 are included in this thesis as no data regarding dental anxiety were obtained. In 1996 a 28-year follow-up concerning dental anxiety was performed by means of a questionnaire which was sent by mail to previous participants. The general study design is shown in Table 1. The investigation is thus cross-sectional as well as longitudinal covering a period of 24 years (28 years with regard to dental anxiety).

The women included in 1968-69 were 38, 46, 50, 54 and 60 years of age and born on dates of the month divisible by six. The sample was obtained from the Revenue Office Register and consisted of 1622 women who were recorded as residents in Göteborg. New groups of women born 1942 and 1954 participated in the follow-up study in 1980-81 (Table 2). To guarantee a more representative sample of the female population in Göteborg, new women were recruited to the groups born in 1922 and 1930 at the examinations in 1980-81 and 1992-93 respectively (Table 2). These new women had moved to Göteborg since the baseline examination. All new participants fulfilled the initial inclusion criteria. Further details regarding these groups and non-participation have been presented elsewhere [108-110].

Table 1. General design of the Women's Health Survey.

	Age at investigations				
Born	**1968-69**	**1974-75**	**1980-81[4]**	**1992-93**	***1996[1]***
1954[2]	-	-	26	38	*42*
1942[2]	-	-	38	50	*54*
1930[3]	38	44	50	62	*66*
1922	46	52	58	70	*74*
1918	50	56	62	74	*78*
1914	54	60	66	78	*82*
1908[2]	60	66	72	84	-

6 years
12 years
24years
28 years

[1] Mail survey concerning dental anxiety [2] Not included in the psychiatric examinations
[3] Not included in the psychiatric examination in 1992-93 [4] Not included in the thesis

By examining several distinct ages in a population, the relation between age and other variables could be clarified and at the same time it was possible to avoid the variability in broader age strata. When designing the study, special emphasis was placed on the ages around the menopause.

The 1968-69 study.

Of the 1622 women selected initially for examination, 1462 attended the medical part of the survey in 1968-69 (participation rate: 90%) (Table 2). Of the 160 non-participants, 32 had died, moved from Göteborg or were inaccessible and 128 (8%) did not wish to participate (refusers). In the dental part of the study 1418 women participated, corresponding to a participation rate of 87% [32]. The participation rate was lowest in the oldest age groups. There was a significant difference between participants and non-participants regarding marital status (more single women among non-participants) [32]. However, the high participation rate together with the systematic sampling method, ensured that the sample was representative for women of the age-groups studied.

Table 2. Year of birth and number of participants in 1968-69, 1980-81and 1992-93 and participation rates (% of those participating in 1968-69 if nothing else is indicated) in the follow-up studies of the Population Study of Women in Göteborg, Sweden (PWGS).

	1968-69	1980-81		1992-93	
Born	n	n	%	n	%
1954	-	85[1]	91[1]	61[4]	72[2]
1942	-	122[1]	95[1]	92[4]	75[2]
1930	372	308[5]	83	252[5]	68
1922	431	332	77	266[6]	62
1918	398	325	82	220	55
1914	180	140	78	79	44
1908	81	49	60	19	23
Total	1462	1154	79[3]	836	57[3]
Total+ added[4,5,6]		1420		1087	

[1] New groups added and participation rate.
[2] Of those participating in 1980-81
[3] Participation rate for women born 1908-1930 and who participated in 1968-69.
[4] In addition to the numbers in the table, six women born 1942 and eight born in 1954 participated.
[5] In addition to the numbers in the table, a new group of 47 women participated in 1980-81 and of those 26 participated in 1992-93.
[6] In addition to the number in the table, a new group of 58 women participated.

The 1974-75 follow-up study.

In the six-year follow-up there was no dental examination. Among the 1462 women who attended the baseline study, 1302 (89%) participated in the 1974-75 follow-up study. Of 160 drop-outs 92 had died, moved from Göteborg or were inaccessible and 68 were refusers [107]. When excluding deceased women and those who had moved from Göteborg the participation rate was 94.4%. Again single women were over-represented among drop-outs [107].

The 1992-93 follow-up study (I,II)

In the fourth part of the study, in 1992-93, 836 women took part in the medical study and 765 in the dental part of the study (Table 2) [40, 109]. Of those who participated in the 1968-69 medical study, 265 (18%) had died, 89 (6%) women had moved from Göteborg, 2 were inaccessible, and 270 (18%) were refusers. The participation rate was 76% among those who had participated in 1968-69 and who were still alive and had not moved in 1992-93. With the new age-groups of women born 1942 and 1954 and the expanded age-groups 1922 and 1930, the number of women participating in 1992-93 was 1087 in the medical part of the study (Table 2). Of those, 1023 women also took part in the dental examination. The drop-out was mainly due to delays at other stages of the investigative procedure (I).

No difference in survival rate was found between recruited and non-invited women [109]. A comparison of several health variables from the baseline study between women born 1922 who participated in the 1992-93 follow-up and those who only participated in 1968-69 but were alive in 1992-93 showed only small differences [109].

The psychiatric subsample investigation (III, IV)

The papers III and IV of the present thesis are mainly based upon the psychiatric examinations of the PWGS. Since the psychiatric examination was extensive, a subsample was selected in 1968-69. All sampled women born 1908 and women born on certain days of each month in the other age-groups, were excluded from the original selected sample of 1622 women. This randomised procedure gave a representative sample of 899 women [32, 111]. Of those, 99 (11%) failed to attend. The drop-out included 15 women who had moved or died during the interval between selection and proposed examination. Eighty-four (9.3%) refused or were not able to participate. Among the 800 women [111], another 16 were excluded due to psychosis or language difficulties, and 6 did not answer the question concerning dental anxiety in the phobia self-report questionnaire, leaving 778 women for the analyses of dental anxiety at baseline in 1968-69 (III and IV: tables 1). Out of these 778 women, 663 (85%) were re-examined in 1974-75. In 1992-93, 113 women had died, and women born 1930 (N=107) were not included in the psychiatric examination, leaving 558 women eligible for the longitudinal part of this study. Out of these, 41 had moved from the area and 147 refused or were not able to participate. Thus, of women still eligible (not moved or deceased), 72% (n=517) participated in the 24-year follow-up examination. However, 60 (11%) women did not return the phobia questionnaire with the dental anxiety assessment, leaving 310 (participation rate: 60%) participants (IV: table 1). In paper III the number was 307 since three phobia questionnaires had not been transferred to the computer-file (III: table 1).

A non-participation analysis showed that single women, widows and the unemployed were over-represented among non-participants in 1968-69. No difference was found regarding social grouping [111].

In the 6-year follow-up (1968-69 to 1974-75) no statistically significant differences were found at baseline between either the total group of drop-outs or 'drop-outs alive' and those

who participated in the follow-up in terms of education, sick-leave, mental health, personality factors, dental fear or other dental variables.

The drop-out analyses for the 24-year period showed that the drop-outs (alive) were significantly older than those who participated. Baseline data for drop-outs revealed significantly higher dental fear, fewer teeth, more edentulousness, a longer time since last dental visit, more social disability due to phobic disorder, and a higher level of extraversion as compared to participants. However, no significant differences were found for education, depression, number of phobias, EPI neuroticism or level of psychiatric impairment (IV). A separate drop-out analysis concerning the women (n=60) who participated in the psychiatric examination, but who failed to return the phobia questionnaire, did not show any significant differences for any of these variables compared to participants (IV).

The mail survey in 1996 (III)

In 1996 a questionnaire was mailed to the 433 women who participated in both the1968-69 psychiatric examination and the dental survey in 1992-93. Out of the 778 participants in the1968-69 psychiatric examination, 175 (23%) were deceased by the time of this 28-year follow-up (III: table 1). Another 47 women had moved from the city and 123 had dropped out at earlier stages of the PSWG. Consequently, out of women still alive and who had not moved, 375 participated after 28 years, which resulted in a 67% participation rate.

Baseline data revealed that the 375 participants initially had a significantly higher number of teeth, a shorter time since their last visit to the dentist, higher education, and a lower level of psychiatric impairment than the 403 drop-outs. No differences were found for sick-leave, self-reported psychological problems or social disability due to phobic disorder. The level of dental fear at baseline did not differ significantly between the 'drop-out alive'-group and those who participated from 1968-69 to 1996 (III).

Patients and procedures in the DFRTC clinical research project (V)

The subjects of paper V were 220 adult patients who took part in a research project on psychological therapy for dental fear and avoidance at the specialised Dental Fear Research and

Treatment Clinic (DFRTC) at the Faculty of Odontology, Göteborg University, Sweden [71, 112, 113].

This screening only allowed inclusion of patients who

- refused conventional dental treatment, but did not only insist on sedation or general anaesthesia treatments,
- who needed a minimum of two restorations, and
- who were willing to enter the research project.

In order to increase generalisability to general dental (anxious) patients, individuals whose medical history revealed psychiatric conditions and treatments were excluded. The patients were either referred from dental or medical institutions (68 patients; 31%) or self-referred via contacts made directly with the DFRTC by the patient or by relatives and friends (152; 69%). Due to the inclusion criteria excluded individuals differed from included with regard to a higher proportion of referred patients, but not with regard to age or sex. The study was approved by the Ethics Committee at Göteborg University.

METHODS

The Population Study of Women in Göteborg, Sweden (PWGS) (I-IV)

All medical, psychiatric and dental examinations at the PWGS took place at 'Sahlgrenska University Hospital' in Göteborg. Women were invited by mail and were subsequently given an appointment time over the telephone. They were offered a free health examination and the letter also included information about the study. All subjects gave their informed consent for participation in the study. Each study was carried out over a period of about one year. The Ethics Committee at Göteborg University has approved the PWGS longitudinal survey.

Examinations

Participants underwent a series of examinations during one full day, including medical and dental examinations. Interviews regarding psycho-social functioning and information about education and socio-economic factors were collected both by means of written questionnaires and verbally. In 1968-69, 1980-81 and 1992-93 the dental examination included a panoramic radiograph, which was taken by a trained dental assistant and dental care habits were assessed. One dentist examined all the panoramic radiographs [40]. The number of remaining teeth, restorations, crowns, pontics, and endodontically treated teeth were assessed [114, 115]. The dental part of the survey in 1992-93 included an oral examination and a structured interview. The dental examination was performed by three dentists, who had been calibrated with regard to the clinical examination before the start of the study. In the 28-year follow-up in 1996 a mail questionnaire concerning dental anxiety was sent to the women.

The psychiatric examinations included several instruments/questionnaires as well as an extensive interview [111]. In the 1968-69, 1974-75 and 1992-93 psychiatric examinations, general phobias were assessed by means of a phobia self-report questionnaire, including questions on dental phobia and anxiety [46].

Survey methods /Instruments (I-V)

Background data

- *Marital status* (II) (single, divorced/separated, widowed, married) was obtained from the national register.
- *Education* (II-IV) was chosen from one of eight different alternatives (ranged from 6 years of school to academic studies) in a questionnaire.
- Satisfaction with *economic situation at present* (II) was used as a measure of economic status. It was assessed on a scale from 1 to 7 where 1 corresponded to 'very good, couldn't be better' and 7 meant 'very poor'.

Oral health descriptors

- *Dental utilisation* (I-IV) was scored from answers to the questions 1. "How often do you visit a dentist?" and 2. "When was your last dental visit?" The alternatives to the first question were 'twice a year', 'once a year', 'at least every second year', 'occasionally', 'for emergencies' and 'never', and to the second question: <1, 1-2, 3-5 and > 5 years ago. In paper I irregularity in dental visits (question 1) was referred to as: at least every second year, occasionally, for emergencies and never. In all other studies irregularity meant: occasionally, for emergencies and never.
- Variables related to *oral status* (I-III) were assessed from the panoramic radiograph and included dental status; dentate vs. edentulous and if dentate; number of teeth (1-32), restored teeth, decayed teeth and root-filled teeth.
- Perceived *chewing ability* (I,II) was assessed by the question "How would you describe your ability to chew?" on a scale from 1 ('very poor') to 5 ('very good') in the dental questionnaire.
- *Esthetics* (I,II) was assessed in a similar way by the question "Are you satisfied with the appearance of your teeth?". Answers were on a scale from 1 ('very unsatisfied') to 5 ('very satisfied').

In the PWGS in 1992-93, participants were interviewed regarding pain and discomfort in the oral and facial regions during the previous four-week period (I). They were asked if they had experienced toothache and about dental pain when eating warm or cold food or when chewing. They were also asked about pain from the jaw when chewing, or from the jaw-

joint, or when opening the mouth wide, and about headaches, xerostomia, burning mouth, mucosal lesions or irritations.

Dental fear assessments

Level of *dental anxiety* in this thesis was determined by using the Dental Anxiety Scale (DAS) (I-III,V), the Dental Anxiety Question (DQ) (III, IV), Visual Analogue Scales (VAS) (I, III) and the Dental Fear Survey (DFS) (V).

- *The Dental Anxiety Scale (DAS)* [47, 48] (I-III,V) translated into Swedish [116] consists of four items concerning reactions to imagined dental situations scored on a 1 to 5 point scale from calm to terrified. The score for all four items thus adds up to a total score of between 4 and 20. Population normative mean scores have been reported to be between 8 and 9 [47, 48, 116-118]. A DAS score of 15 or higher is judged to indicate severe dental fear [48, 116]. The reliability and validity of the DAS has been demonstrated in several previous studies [16, 47, 116-118].

In the present study DAS-values were used to form different analysis groups:
In paper I, mean value on the DAS (7.2) was used as a cut-off point. Those with scores of 8 and above were classified as experiencing high dental anxiety, while those scoring 7 or lower formed a low anxiety group. In paper II, those with DAS scores of 12 and above were classified as experiencing high dental anxiety, while those scoring 11 or lower formed a low anxiety group. Other epidemiological studies have used this cut-off point for dichotomous analyses [10, 16, 58]. Paper III analyses used a DAS cut-off score of 13 or higher for high dental fear and 12 and lower for low dental fear. This was until recently the most commonly used cut-off point [44, 48]. In paper V the DAS was used as a continuous variable.

- *The dental anxiety question* (III,IV) from the phobia self-report questionnaire is referred to as *"DQ"* [111]. This question scored from 1 to 4 and read:

"Many people find it more or less unpleasant going to the dentist.
Check the statement that you feel is in most agreement with your opinion:
1. Visiting the dentist doesn't bother me at all.
2. I don't like it or I think it's quite unpleasant.
3. I'm very afraid or I think it's very unpleasant.
4. I'm terrified."

The low and high dental fear groups were obtained by merging alternatives 1 and 2 into one group, and 3 and 4 into another, for 'going to the dentist' in the phobia questionnaire. However, in paper III, the DQ was mostly used without dichotomization.

The DQ has not been validated previous to the validation process in paper III. No reliability analysis has been performed.

- A 100 mm *Visual Analogue Scale (VAS)* was used in paper I and III to assess responses to the single item question "Generally, how fearful are you of dentistry?". The line was anchored by 'not at all afraid' (0) and 'terrified' (100). An additional VAS concerning level of unpleasantness when visiting the dentist was administrated where 0 corresponded to 'not at all unpleasant' and 100 to 'extremely unpleasant' (III). This VAS assessment was included after pilot investigations indicating that elderly women do not necessarily use the words "fear or anxiety" to express negative feelings towards dentistry, but rather described it as feelings of unpleasantness or discomfort. Thus we wanted to compare the VAS/fear rating and the VAS/unpleasantness rating and to correlate these scales to the DAS.

- *The Dental Fear Survey (DFS)* was used in paper V to assess dental fear in addition to the DAS. The DFS is a 20 item test of different aspects of dental anxiety with a scale from 1 (no fear) to 5 (extreme fear) and sum of scores between 20 and 100. Those with scores greater than 75 were considered highly dentally anxious. The different dimensions of dental anxiety as measured by the DFS have been shown to be fear of specific situations, physiologic arousal, anticipatory anxiety, fear of needles and fear of drilling [22, 119-121]. In the analysis of paper V, three dimensions, fear of specific situations (DFSSITU), physiologic arousal (DFSPHYS) and anticipatory anxiety (DFSACIP) were used to capture dental fear among all 20 items.

- *The Dental Beliefs Survey (DBS)* (V) has 15 questions concerning patients' attitudes and beliefs about the interaction between patients and dentists [8]. The items range from 1 to 5 and sum up from 15 (highly positive beliefs) to 75 (highly negative beliefs).

Psychiatric/psycho-social evaluations

General anxiety and fearfulness were measured by the State - Trait Anxiety Inventory (STAI-S and STAI-T, respectively) (V), the Geer Fear Scale (GFS) (V), a phobia self-report questionnaire (IV) and a single item question concerning anxiety level (IV).

- *STAI-S* (V) assesses situational and short-term anxiety, while *STAI-T* captures trait anxiety levels, which are more stable over time [122]. These scales each have 15 items with choices from 1 (no anxiety) to 5 (high anxiety) with sums of scores between 15 and 75.

- *GFS* (V) is a 22-item modified version of the original Fear Survey Schedule–II that measures number and levels of specific fears or phobias [123]. The items have a scale from 1 (no fear) to 7 (terrified) with sum of scores between 22 and 154.

- *The phobia self-report questionnaire* (IV) includes 60 objects or situations known to provoke fear [111]. The scaling of the items was 1 (no fear) to 4 (terrified). Alternative 4 was used in the analyses to describe extreme fear or phobia.

- The single item question assessed *anxiety level* (IV) by the question: "Are you ever worried or anxious without knowing why?" The four alternative answers were never, seldom, sometimes, often.

- Mood was measured by a *Mood Adjective Checklist (MACL)* [124] (V). MACL has proved to be a valid instrument and indicator of emotional reactions to a dental appointment [125]. The original version has 6 dimensions, however in this study we used only two dimensions to describe patients' mood namely hedonic tone (MOOD(h)) and relaxation (MOOD(r)), which measure degree of pleasantness/unpleasantness and relaxation/tension, respectively. Mood is measured from 1 (low/negative) to 4 (high/positive) in the different dimensions.

- *Psychiatric impairment* (III,IV) (= "psychiatric insufficiency" in paper III) was assessed by a psychiatrist at the end of the psychiatric interview. This global assessment measured the degree of disability, according to a five-point scale (0-4), in which 0 was complete or almost complete freedom from psychiatric symptoms, 1= mild symptoms and very little or no functional impairment, 2= moderate symptoms and clear functional impairment, 3= pronounced symptoms and work capacity greatly reduced, 4= severe symptoms and complete incapacity for work [111].

- Evaluation of current *social disability* (III,IV) due to phobic disorder (=social function impairment in paper III) was diagnosed by a psychiatrist on a global four point scale (0=no disability, 1=mild, 2=moderate, 3=severe impairment).

- *Major depression* (IV) during the last month was diagnosed according to the DSM-III [126, 127] and the DSM-III-R [128] criteria.

- *The Eysenck Personality Inventory (EPI-Form B)* (IV) measured the personality dimensions intro/extraversion and neuroticism [111, 129, 130]. The two dimensions are assessed by 24 questions each, all answered by 'yes' or 'no'. High scores on the two dimensions indicated high extraversion or high neuroticism.

- *Health related quality of life* (II) was assessed using the SF-36 (Short–Form-36 items) Health Survey [131]. This widely used generic measure, has been translated into Swedish and validated in Sweden [132-135]. It covers both functioning and well-being and has been shown to be useful in both populations and clinical samples. The SF-36 assesses health from the patient's point of view and uses scores from eight multi-item scales: physical functioning, limitations due to physical health problems (role-physical), bodily pain, general health, vitality, social functioning, limitations due to emotional health problems (role-emotional) and mental health. Higher SF-36 scores indicate better health. Thus, a higher physical functioning score indicates better functioning and higher bodily pain score indicates less pain.

Statistical methods

The data was analysed using the computerised SYSTAT (I) and SPSS (II-V) statistical packages. Distributions of variables are given as frequencies, percentages, means, standard deviations (I-V) and ranges (IV).

Parametric as well as non-parametric methods were applied in the statistical inference testing. Thus, for comparison between two groups the Student t-test (I, II,V) and the Mann-Whitney U-test (III, IV) and between three groups or more the Kruskal –Wallis One-Way Anova (IV). For comparison of proportions between groups the Chi-square-test (I-III) and the Fisher exact test (2*2 table) (IV) were used. Changes over time were analysed within groups with the Wilcoxon Signed Rank Test (for continuous variables) (III,IV) and the McNemar Test (for dichotomised variables) (IV) and the Friedmans Two-Way Anova (III). The z-test was used to test if mean values were within the normal distribution (III). The Spearman's rank order correlation test (I,III,IV) was used for correlation analysis. Agreement between pairs of measures was assessed using the Kappa statistics (III).

To analyse the effects of more than one factor the Two-Way Analysis of Variance (ANOVA) was used (I). A stepwise multiple logistic regression (II,IV) was applied for prediction. In order to adjust for confounding variables such as age, logistic regressions (II-IV) were used. The structural equation modeling analysis (SEM) models were tested using the computer program LISREL 8.3 [136](V).

The pre-chosen level of significance was $p<0.05$ in all analyses.

RESULTS

Paper I

This study was cross-sectional and conducted on the material from 1992-93 in the Population Study of Women in Göteborg, Sweden (PWGS).

A basic description of the dental anxiety data was achieved. The average DAS score obtained among 1016 women who had completed the DAS questionnaire, was 7.2. Data was analysed after separating the study sample into low and high dental anxiety groups according to the DAS mean value (<8 and ≥8, respectively). The highly anxious women constituted 40% of the total sample. Severe dental anxiety (DAS≥15) was experienced by 3.9% of the participants. Older women were found to be significantly less anxious than younger ones with an average DAS-score of 6.1 for the 84-year olds up to 8.8 for the 38-year olds (paper I: table 1). Dental anxiety assessed with the VAS (0-100) showed a total average score of 10.8 (SD=22.2). The means in the low and high anxiety groups were 1.5 (SD=5.8) and 25.2 (SD=29.4). The correlation between the DAS and VAS measures was 0.71. High levels of dental anxiety were associated with longer intervals between dental visits, poorer chewing ability and dissatisfaction with dental esthetics (I: table 2).

The radiographical examination revealed a generally poorer oral status among highly anxious women (I: table 3). These women were found to have fewer teeth, fewer root-filled and restored teeth, but a higher number of decayed teeth. However, no significant differences were found between women high and low in dental fear with regard to the proportions who were edentulous or who had a complete dentition. With regard to proportions of the total sample a difference (non-significant) between edentulous/non-edentulous high and low anxiety women was discussed in Paper I. However, given the distribution of women with high and low anxiety, this discussion is redundant and should be disregarded.

Of the participating women, 16% reported dental pain and 7.3% reported TMJ pain during the previous four-week period. Significant differences with regard to dental anxiety and dental pain or TMJ pain were found only for pain related to chewing (I: table 4). Among other oral symptoms (I: table 5) the prevalence of mucosal lesions, burning mouth complaints and irritations from restorations were all lower than 10%, while dry mouth symptoms were the single most

prevalent symptom reported (34%). The latter were more common with increasing age. However, no significant differences with regard to level of dental fear were found. The total prevalence of headaches was high (23%) and significantly more frequent among the highly dentally anxious women (I: table 4). An age-effect was revealed; headaches were more common in younger age-groups.

Paper II

In paper II the dental anxiety data analysed in paper I were further explored, using a different method. In addition to dental anxiety the focus of the study was dental attendance. Due to major differences in dental visiting patterns found between dentate and edentulous women, these groups were analysed separately. Thus, the groups consisted of 881 dentate (87%) and 127 edentulous (13%) women.

There were no significant differences found between edentulous and dentate women with regard to dental fear (average DAS 6.9 and 7.2, respectively). According to the DAS cut-off score selected for this study (high dental fear: DAS≥12) the proportion of highly anxious women was 11.9%. The average DAS score was 6.2 in the low dental fear group and 13.9 in the high fear group. Older dentate women were found to be significantly less anxious than younger ones. No such difference was found for the edentulous group (II: table 1). Irregular dental attendance was reported by 16.2% of all the participants and was significantly more common in the older age groups (χ^2=70.6, p<0.001). A separate analysis of dental attendance according to age among dentate subjects revealed smaller and statistically non-significant results (II: table 1). Edentulous women had more irregular dental visiting patterns than dentate women, 89% compared to 6%. Thus, in paper II we stated that the significant age differences found for regularity in dental attendance in the group as a whole were mainly explained by the edentulous group which on average was older than the dentate group and where the majority reported irregular dental attendance (II: table 1).

A significantly higher proportion of dentate subjects with high dental fear reported irregular dental attendance (19.4%) than did dentate subjects with low dental fear (4.0%) (II: table 2). However, more than 80% of the highly dentally anxious women had regular dental care.

Analyses of the edentulous group showed no significant differences according to anxiety level or regularity in dental attendance. Only simple statistical inference testings of the edentulous group were performed. Multiple logistic regressions were excluded due to the limited number of respondents and the high number of variables. Women with high dental fear reported poorer chewing ability, which was the only significant difference found between the high and low fear edentulous groups. The only difference found for the variable regularity in dental attendance was that women with irregular dental care reported more dissatisfaction with the esthetics of their dentures.

Among dentate women significant correlations between socio-economic factors and dental fear were only found for marital status (high dental fear was more common among single or divorced/separated women) (II: table 3), and for self-reported economic situation (more positive among low fear than high fear women, and among women with regular compared to irregular dental attendance). The analyses of oral status/conditions all showed significant differences according to level of dental fear and regularity of dental visits (II: table 4). When controlled for number of teeth, the association between dental fear and number of restored teeth was found to be indirect and confounded by number of teeth. Thus fearful women had fewer restored teeth because they had fewer teeth. However, high fear individuals still had a significantly higher number of decayed teeth than women with low fear.

As regards the SF-36 health survey scales mean values for all age groups were mostly within the Swedish norm or somewhat higher. Z-test analyses of the women of the present study and the Swedish normative female population revealed differences in a minority of cases. Significantly higher values on the vitality and general health scales were found for the 78 and 84 year-olds and for the 38 and 70 year-olds on the general health and social functioning scales. The SF-36 logistic regression analyses, which controlled for age, showed that there were significant differences on all but one SF-36 scale according to level of dental fear (II: table 5), indicating that women with low dental fear generally reported better health status. The regularity of dental attendance was only significantly influenced by two SF-36 scales: social functioning and mental health, which were assessed as lower among women with irregular attendance (II: table 5).

Multiple logistic regression analyses showed that the following factors were associated with high dental fear among dentate women: irregular dental care, age (younger), fewer teeth, dissatisfaction with dental esthetics and lower scores on the SF-36 mental health scale (II: table 6).

In the multiple regression for dental utilisation, irregular dental care was shown to be associated with high dental anxiety, fewer teeth, more decayed and restored teeth, poorer chewing ability, dissatisfaction with dental esthetics and lower scores on the SF-36 physical functioning and general health scales (II: table 6).

Of special interest for this study was the investigations of potential differences between high fear individuals with regular and irregular dental attendance. High fear individuals with regular as opposed to irregular dental care were more satisfied with their dental esthetics. They had significantly more teeth which were less often decayed and more often restored. In spite of having fewer teeth the group with high dental fear and irregular attendance had a level of decay which was seven times as high as regular attenders with high dental fear.

Paper III

The design of paper III was a longitudinal follow-up, based on 778 women participating in the psychiatric subsample investigation of the PWGS in 1968-69, 1974-75 and 1992-93, and at the follow-up mail survey in 1996. The primary aim of the study was to investigate how dental anxiety changes with aging. Furthermore, the objective was to analyse drop-out effects, and to compare and validate the results from the Dental Anxiety Question (DQ) with three other scales of dental anxiety.

Dental anxiety

In 1968-69, 48 (12.8%) out of the 375 women who participated during the full 28-year period assessed themselves as 'very afraid' or 'terrified' when visiting the dentist, while in 1996 the frequency was 21 (5.6%) among the same women. At baseline, 180 women (48%) reported no dental anxiety visiting the dentist and 28 years later the frequency was 230 (61%).

Among the 663 women participating in the six-year follow-up between 1968-69 and 1974-75 the scores on the Dental Anxiety Question (DQ) decreased significantly in all age-groups. Among the 375 women participating over the 28-year period the DQ scores decreased significantly in all age-groups except for women born in 1914 (III: table 3). However, only 24 individuals from this age-group participated in the 28-year follow-up, and one should therefore be careful when interpreting the results from this group.

A raw change score was obtained by subtracting the score from 1968-69 from the follow-up score in 1996 (III: table 4). Most women (63%) had the same score on both occasions. Here it should be taken into consideration that 65% scored on the lowest level of the DQ already in the initial study and hence could not report lower scores. However, almost 9% rated themselves higher and 28% lower on the DQ over the 28-year follow-up. Table 3 shows changes in reported levels of dental fear during the 6- and 28-year period.

Table 3. Cross-tabulation according to level of dental fear for respondents in 1968-69 and in the 6-year follow-up in 1974-75 and in the 28-year follow-up in 1996.

		Dental fear in 1974-75				
	DQ[1]	1	2	3	4	
Dental fear in 1968-69	1	243	52	6	1	*302*
	2	114	129	17	3	*263*
	3	12	27	17	9	*65*
	4	5	10	8	11	*34*
		374	*218*	*48*	*24*	*664*

	Dental fear in 1996				
DQ[1]	1	2	3	4	
1	154	25	1		*180*
2	65	75	7		*147*
3	8	16	6		*30*
4	3	8	5	2	*18*
	230	*124*	*19*	*2*	*375*

[1] Dental Anxiety Question; 1= no fear, 2= low fear, 3= very afraid, 4= terrified

Concordance among dental fear measurements

The Dental Anxiety Question (DQ) has previously been used in dental anxiety research by Hällström and Halling [46]. In the present study the DQ correlated well with the other scales used (the DAS and VAS) both in 1992-93 and especially in 1996. Table 5 (III) shows the distribution of mean scores on the DAS, the VAS for fear and the VAS for unpleasantness according to score levels on the Dental Anxiety Question.

Using a DAS-score of 13 or higher as cut-off level revealed a prevalence of high dental anxiety in 21 (5.6%) individuals in 1996. This was paralleled by the results of the DQ showing 21 (5.6%) women who considered themselves to be 'very afraid' or 'terrified' of visiting the dentist. However, only 12 women assessed themselves as highly anxious on both scales. When the DQ and the DAS cut-off points were used to dichotomise these measures for a cross-tabulation, the percent agreement between pairs of measures was high (92.2%). However, the Kappa statistic value was 0.55, suggesting that agreement corrected for chance was moderate.

Paper IV

The design of paper IV was longitudinal, based on the psychiatric subsample investigation of the PWGS in 1968-69 and at the 24-year follow-up in 1992-93. The primary aim of the study was to investigate the longitudinal course of dental anxiety in relation to specific fears/phobias, depression, neuroticism, extraversion/introversion and psychiatric impairment. In addition, cross-sectional analyses regarding these factors were performed on the base-line data from 1968-69. The 24-year drop-out was also analysed.

Longitudinal analyses

The analyses were based on 310 women born in 1922, 1918 and 1914. Dental anxiety decreased significantly during the 24-year period (IV: table 4), which paralleled the results of paper III. The longitudinal analyses of mental health and personality factors were performed on the sample separated into four groups based on level of dental fear (low: DQ 1-2, high: DQ 3-4) and changes over time from baseline to follow-up. Among 36 women who reported high dental fear in 1968-69, 23 (64%) remitted *(Remitted* group*)* and 13 (36%) remained fearful *(Chronic* group*)*. Among 274 women who reported low dental fear in 1968-69, 13 (5%) reported high dental fear in 1992-93 *(Incident* group*)* (IV: table 5). Consequently 261 women reported low dental fear both in 1968-69 and 1992-93 *(Never group)*.

Table 5 (IV) shows changes in mental health and personality factors at baseline and follow-up among women in the four dental fear groups described above. At baseline in 1968-69 the two high fear groups (*Chronic and Remitted*) had a higher number of extreme fears/phobias than the two low fear groups (*Incident* and *Never*). In the 24-year follow-up the two high fear groups (*Chronic* and *Incident*) had significantly more fears/phobias, while the *Remitted* group had not only remitted from dental fear but also from other fears/phobias. Contrary to this the *Incident* group in addition to dental anxiety showed an increased number of fears/phobias. A chronic course of dental fear was predicted by psychiatric impairment and the personality factor neuroticism at baseline, while remission from dental fear was predicted by extraversion (IV; table 5).

In general, prevalence rates and mean values for mental health and personality factors were stable in the *Chronic* and *Never* groups, decreased for the *Remitted* group and increased in the *Incident* group. Extraversion showed a different pattern, being stable over the period for the *Remitted* and *Incident* groups and increasing for the *Chronic* and *Never* groups. However, the changes over the 24-year period were only statistically significant for the *Remitted* and *Incident* groups regarding extreme fears/phobias and for the *Never* group regarding extraversion.

A stepwise multiple logistic regression showed that dental fear at follow-up in 1992-93 was associated with a higher level of dental fear in 1968-69 and a greater number of phobias in 1992-93 (IV: table 6).

Cross-sectional analyses in 1968-69

High dental fear (DQ 3-4) was reported by 131 (16.8%) out of 778 women born in 1930, 1922, 1918 and 1914 who responded to the self-report phobia questionnaire in 1968-69. High dental fear at baseline was associated with a significantly higher number of phobias, a higher level of neuroticism, greater psychiatric impairment, greater social disability due to phobic disorder and a higher anxiety level (IV: table 3). However, a stepwise multiple logistic regression including these statistically significant factors as independent variables, showed that high dental fear was predicted only by the presence of other phobias.

Paper V

Paper V was, in contrast to paper I-IV, performed on data from a clinical study. This data was collected from 220 phobic patients (59 men and 161 women) with an average age of 32.5 (SD=9.0) years. The patients had avoided dental care for an average of 11.8 (SD=8.6) years. No significant differences were found with respect to sex and age or last dental visit (V: table 1). However, women reported higher levels for all variables concerning dental anxiety, general anxiety and mood, although not at a statistically significant level for DFSSITU , MOOD(h) and STAI-T (V: table 2). All abbreviations in this study are explained in the Methods section and in paper V.

The aim of this study was to explore the structural relationships between dental anxiety, mood and general anxiety by using a Structural Equation Modeling (SEM) approach in the LISREL program.

The initial inspection of the variables under study showed skewed distributions for some variables. Multivariate normality was achieved by transforming the data into normal scores for the analyses. Then different models were tested in the LISREL program, (V, table 3). Model A included the hypothesised latent variable dental anxiety (observed variables: DAS, DFSACIP, DFSPHYS, DFSSITU, DBS) which was tested in a confirmatory factor analysis (CFA). This model showed acceptable properties from a statistical point of view, although one of the fit indices (RMSEA) was not acceptable. A CFA was performed on Model B, a measurement model with STAI-S, STAI-T, GFS and MOOD but was found to have less statistical fit, however reasonable from a theoretical point of view. These two models were then merged in a SEM analysis according to Model C. This model fit had an acceptable solution for one of the fit indices (GFI), while the other test-statistics showed close to acceptable statistical values except the highly significant chi-square probability level. The modification indices revealed a substantial improvement in model fit if a subsequent respecification of the model included covariance terms between the error variance of STAIT and GFS, and STAI-T and MOOD(h), respectively. Thus, Model C^1, which constituted the final model, was tested and a clear improvement in the test-statistics was shown (V: table 3 and figure 1).

DISCUSSION

Epidemiological studies (I-IV)

Cross-sectional studies (I,II)

In the 1992-93 cross-sectional studies, dental anxiety in middle-aged and elderly women was assessed, and associations to oral health (I,II), dental attendance (I, II), and general health (SF-36) and concomitant socio-economic factors (II) were investigated.

Summary

These studies (I, II) showed that although the prevalence rates of dental anxiety were lower in higher age-groups, there was still a considerable proportion of elderly women who experienced negative feelings, ranging from slight discomfort to terror. Higher levels of dental anxiety predicted irregular dental visits, while both dental anxiety and dental attendance had only limited associations to dental and general health status and to socio-economic factors. Among subjects high in dental fear a significantly poorer oral status was found for irregular dental attenders compared to regular attenders. This finding may explain why the strong association to deterioration of the oral status found in clinical studies of dental phobic patients has seldom been established in population studies of dentally anxious individuals. Irregular dental visiting patterns were more common among the elderly, but this was shown to be primarily an effect of being edentulous. In addition, paper I and II showed the importance of using multivariate statistical methods. This became especially evident with regard to the oral health and general health (SF-36) analyses.

Dental anxiety

In paper I those with DAS-scores ≥8 were classified as experiencing high dental anxiety, while in paper II those scoring ≥12 formed the high dental anxiety group. In paper I, where the sample mean was used as a cut-off score, the proportion of women counted as experiencing high dental fear (40%) probably included subjects experiencing anything from some discomfort to extreme fear. Given differences in sample and methodology this was largely in

agreement with the results of a previous Swedish population study [15], which showed that about 40% of the participants reported 'some' or 'high' dental anxiety. With the higher cut-off point used in paper II the high dental fear group consisted of women who experienced a more significant distress in relation to dental care. The prevalence rate of 12% for high dental fear was similar to other studies using the same DAS cut-off score [10, 16, 137]. However, it is important to remember that these frequencies do not relate to a phobic level of dental fear. Such 'clinically important' dental anxiety has usually been identified at DAS-levels of 15 or higher [48, 116]. The frequency of women with this extreme level of fear was close to 4%, which corresponded to analyses by Hällström and Halling from the same group of women in 1968-69 [46]. Thus, our studies substantiated findings by others that no major changes in dental anxiety seem to have occurred during the last decades [12, 15, 38, 44, 46, 50, 56].

A significant reduction in level of dental fear was shown according to age – elderly women were generally less fearful. This drop in dental fear prevalence was most evident between the ages of 38 and 62 (I and II, tables 1). This indicated that dental fear among women, as with many other specific fears and phobias, peaks in middle-age and falls off over the age of 65 [63].

Oral health and dental attendance

In agreement with some previous studies [49, 138] paper I and II showed no significant difference in level of dental fear between dentate and edentulous subjects. However, there are also investigations that have shown that edentulous subjects are more dentally anxious than dentate subjects [44, 69]. In the present multiple logistic regression the variable 'presence of teeth' was included in the final model of dental anxiety; being dentate was predictive of high dental fear but the odds ratio was close to one. Our findings contradict the clinical contention "no teeth - no dental fear".

In both paper I and II the associations between dental anxiety and oral status/health seemed clear when using group comparisons. These comparisons parallel other studies using similar methods and samples [23, 24, 68]. It was found that loss of teeth was associated with dental anxiety. However, the differences in number of teeth between the low and high anxiety groups might have been expected to be larger. A similar small difference was also found by Locker and Liddell [23] in a population aged 50 years and older. They hypothesised that if dental anxiety, like many other fears, declines with increasing age, this would explain the reduced

difference in number of teeth between individuals with high and low dental anxiety. Consequently the relationship between dental anxiety and oral health may change with aging. However, these differences may also be due to cohort effects and only longitudinal studies would cast light on the influence of aging. Such analyses of aging and dental fear were performed in this thesis and will be discussed below.

Caries was found to be significantly related to dental anxiety (I,II). Thus, while this was very clear for decayed teeth, the relationship between dental fear and number of restored teeth was confounded by number of teeth. Fearful women had fewer restorations because they had fewer teeth, but they still had a significantly higher number of decayed teeth than women with low fear. This was in particular evident among irregular attenders; women with high dental fear, in spite of having fewer teeth, had a level of decay which was seven times as high as among fearful individuals with regular dental care. This supports the idea that the relationships between dental fear and oral health found in paper I and II as well as other studies may be due to a strong association of these factors among dentally anxious individuals who avoid dental treatment rather than signifying a relationship that concerns the whole dental anxiety population.

The frequent, significant correlations between oral status variables and dental anxiety revealed a clear (although not necessarily strong) relationship between dental anxiety and oral health. However, it is noteworthy that subjective assessments such as self-perceived chewing ability and esthetics were also influenced by level of dental anxiety. Thus, it is plausible to state that the psychosocial effects of dental anxiety, which have been clearly established among dental phobic patients [29] are also visible to some degree in this population sample.

In agreement with other Swedish studies, frequencies of regular dental attendance in dentate subjects were high in this study [38, 39, 56]. It has been shown that the frequency of visits to physicians increase, while visits to dentists decrease with increasing age [139]. However, the present study paralleled results in previous reports showing that differences in dental attendance were not mainly related to age, but more clearly to presence or absence of natural teeth [38, 39, 139, 140]. Thus, edentulousness was found to be the foremost strongest predictor of irregularity in dental care in the multivariate logistic regression analysis of the total group. However, dental anxiety was found to be the strongest predictor of irregular dental attendance when analysing dentate subjects separately. Again, this showed that edentulousness 'over-

shadowed' dental fear as a risk-factor for irregular dental care among these elderly women, while dental fear was still a significant risk-factor for those who were dentate.

General health and socio-economic factors

Socio-economic factors were not included in the final multiple logistic regression models of dental anxiety. However, in the group comparisons there were significantly more single and divorced/separated women reporting high dental fear. In addition, dentally anxious women were also significantly less satisfied with their economic situation. However, in agreement with several other studies [15, 26], no significant differences were found between education level and dental fear. These findings point to a very limited impact from socio-economic factors on dental fear. Similar results were found for general health (SF-36). Women with low dental fear had significantly better health on all scales, except for 'social functioning', than highly fearful individuals. However, only 'the mental health' scale was included in the final model of the multiple logistic regression but the odds ratios were close to one, suggesting minor influence. On the other hand, the mental health dimension predicting dental fear was not unexpected, since other studies have shown that dental anxiety appears to be related to a number of personality disorders and psychological dimensions [74, 75, 78].

Thus, the association between dental anxiety, socio-economic factors and general health factors (SF-36) seemed relatively clear when using simple group comparison. However, the multivariate logistic regression analyses indicated that oral status, socio-economic and health (SF-36) factors were of minor importance.

Longitudinal studies (III,IV)

Summary

In the longitudinal part of this study dental fear was found to decline with increasing age. In addition, associations between dental anxiety and high general anxiety level, number of other phobias and neuroticism were found. A high level of dental fear in 1968-69 and a greater number of fears/phobias in 1992-93 predicted high dental fear in 1992-93. Over the study period, dental anxiety increased or decreased with number of other fears. A chronic course of dental fear was related to psychiatric impairment and neuroticism at baseline, while remission was related to the personality factor extraversion. These findings demonstrate that longitudinal

studies are important in order to detect variations in the course of dental fear, and suggest that distinct dental fear subgroups may be identified based on their longitudinal course.

Natural history of dental anxiety

In spite of three or four decades of research, a number of epidemiological questions concerning dental anxiety have not been answered. Little is known about its incidence at different points in the life span and about the course of dental anxiety over time. Also issues related to an onset in adulthood have been neglected. The reason is the almost complete lack of longitudinal data concerning dental anxiety. The majority of previous epidemiological studies have assessed dental anxiety prevalence retrospectively. Prevalence figures have thus been derived from reconstructed 'life-histories' provided by cross-sectional interviews and not from longitudinal observations. Kent [41] stated that even if longitudinal studies are more demanding in terms of time and effort, they are necessary to investigate why and how dental anxiety is maintained, and also why anxiety declines without formal intervention in some individuals. He meant that such studies would provide information, which can influence the choice and design of therapeutic interventions.

Cross-sectional studies have shown that older individuals are significantly less dentally anxious than younger ones [5, 15, 17, 18, 46, 53, 54]. However, research has not been able to show why. Thus, one of the most important findings of this thesis was that dental fear like many general and specific fears/phobias in a population declines over time. The drop-out showed no significant influence on this result; dental fear decreased significantly in the first 6-year follow-up (1968/69 - 1974/75) of the PWGS, and no differences between participants and drop-outs were found for dental fear or for any of the other variables in the drop-out analysis. Nor were there any significant differences in dental fear between those who participated and those who dropped out and were still alive in the 28-year follow-up. However, for some other factors differences were revealed in the 28-year drop-out analysis.

Thus, in the present study, we found that the lower prevalence rates of dental fear in older age-groups were due to aging, which is also the case for general and specific fears and phobias. However, the contention that many fears decline with age [1, 41, 141, 142] is not fully understood, and the causal history of such changes is still under debate.

A number of possible explanations for the lower prevalence rates of anxiety disorders among the elderly have been discussed in two recent papers by Kogan et al [143] and by Krasucki et al [63]. Factors discussed were older people's reluctance to report psychological symptoms, anxious individuals disinclination to participate in studies, and the fact that the currently available anxiety self-report measures are designed for younger populations. Another possible explanation was the aging of the sympathetic nervous system, as SNS is responsible for controlling responses to stressful stimuli. However, the three explanatory factors that were considered to be of the greatest clinical importance were a possible cohort effect, the relationship between anxiety and cognitive impairment, and 'anxiety-related mortality' [63]. The possibility of a cohort effect increasing the rates of anxiety disorders in younger cohorts could not be ruled out. The possibility of anxiety being reclassified as a cognitive impairment or dementia with increasing age has found some support [63]. However, other studies of individuals with cognitive impairment suggest that some anxiety symptoms may in fact persist or increase as dementia supervenes [63]. 'Anxiety-related mortality' means that excess mortality both from suicide and from physical illness could result in a lower prevalence for phobic anxiety and panic disorders in older age-groups. In our study we found that the mortality over the 28-year period among women with high dental fear was significantly higher than in the low fear group (52% and 23%, respectively). However, since our study was longitudinal most of these proposed explanations could be ruled out as reason for the decrease in dental fear over the time periods of the present studies.

However, there are other possible explanations for the decline in dental fear with age, which may not be applicable for other fears/phobias. It has been debated that a reason for the decrease in dental anxiety could be the technological and professional advances in modern dentistry, which have occurred during this 28-year period. This is, however, contradicted by cross-sectional studies showing that the prevalence of dental anxiety in all age-groups has been relatively stable during the past four decades in Sweden as well as in other countries and cultures [12, 15, 38, 44, 46, 50, 56]. Yet another reason for the decrease of dental anxiety could be that some of the participants became edentulous during the period which reduced their dental fear. However, in an additional analysis it was found that levels of dental anxiety decreased in both the dentate and edentulous groups, but only at a statistically significant level in the dentate group.

This suggested that the reduction in dental anxiety with age was not due to women becoming edentulous.

Locker and Liddell [26] meant that an age-dependent decline in dental anxiety might be due to the general decline in anxiety with aging and to a greater exposure to other diseases and their treatment. They have further reported [10] that old individuals (70 years or over) are less likely to have simple conditioned phobias and more often suffer from generalised anxiety than younger individuals. They hypothesised that individuals with multiple phobias and generalised anxiety would be more likely to carry dental anxiety into old age, while those with a simple conditioned phobia recover over time. However, cohort effects could explain the distributions in their analyses and they stated that this issue could only be resolved by longitudinal studies of dental anxiety. Thus, in paper IV the association to number of extreme fears/phobias was investigated among those who remitted from dental fear, those who maintained their dental fear and those who became dentally anxious during the study period. In addition, other relationships in terms of mental health and personality factors were investigated for these groups. In agreement with other studies [2, 26, 37] dentally anxious individuals reported a larger number of fears/phobias. However, multiple fears at baseline did not predict chronicity in those with dental fear at baseline. Nor did it predict onset of dental fear during follow-up. Our findings challenge the Locker et al theory [10], since the number of fears/phobias at baseline did not predict outcome (chronic vs remission) at follow-up. Moreover, the Remitted group had fewer, and the Incident group more, extreme fears/phobias at the 24-year follow-up compared to baseline, while the Chronic group continued to have a high number of other phobias. Thus, dental anxiety seemed to increase or decrease with number of other fears.

Dental anxiety and mental health/personality factors

Paper IV showed a clear relationship between dental anxiety and most of the studied mental health and personality factors such as psychiatric impairment, neuroticism, intro-/extraversion and general anxiety. However, it is a minority of extreme cases, which influence these results. The majority of women with high dental fear were not affected by any of these factors, when fears/phobias were not taken into account.

Women with high dental fear had significantly higher values for neuroticism than low fear women, which has also been found in other studies [69, 75-77, 144]. Furthermore,

neuroticism was found to be related to a chronic course of dental anxiety. Gershuny and Sher [145] reported in a 3-year prospective study that personality, in particular the combination of high neuroticism and low extraversion, may play an important predisposing, etiological role for anxiety, since an interaction between neuroticism and extraversion predicted global anxiety. They speculated that an introvert neurotic person is prone to experience greater anxiety due to not having the coping strategy of seeking social support. Low extraversion and high neuroticism might be related to lower susceptibility to reward, and greater to punishment, and higher vulnerability to arousal and anxiety. Even if an individual was highly neurotic, this same individual with high extraversion would more likely also be sensitive to signals of reward, which might offset or mask feelings of extreme anxiety. This may explain why those with high dental fear and high extraversion scores at baseline in our study more often remitted from their dental fear.

As with neuroticism, psychiatric impairment was related to a chronic course of dental fear. In general, for all factors but extraversion, prevalence rates and mean values for mental health and personality factors were stable in the *Chronic* and *Never* groups, decreased for the *Remitted* group and increased in the *Incident* group. The increase and decrease over time were only statistically significant for number of fears/phobias. Nevertheless, for the majority of the middle-aged women, the situation was stable into older age concerning the mental health and personality factors investigated. However, due to the small number of women in three out of the four dental fear sub-groups, the results of this study should be interpreted with caution.

Sample and methodological considerations

Sample

In epidemiology, representativity of the study population is essential. A first requirement is random sampling. The sampling methods used in the PWGS are both stratified (women and certain age-groups) and simple random since all women born on certain dates of every month were sampled. This sampling procedure and the high participation rate ensured a representative sample from the population selected at baseline in 1968-69 [32]. However, non-participation and drop-outs may affect representativity. Differences between participants and non-participants vary in different populations and non-participation should always be investigated. In a study by Locker [146] it was stated that if non-participation is investigated,

even low response rates can be accepted and do not compromise the results of an epidemiological study. However a problem encountered in all longitudinal studies is that even low drop-out rates accumulate to give less and less representativeness. In paper IV, but not paper III, dental fear was found to be related to drop-out, which might have led to underestimation of the frequency of dental fear at follow-up. However, given the length of the follow-up and the age of the women, the participation rate was considered satisfactory. After every new stage of the PWGS a non-participation/drop-out analysis has been performed to investigate representativeness [32, 107-109]. After 24 years the initial sample was still found to be mainly representative of women in these age-groups in the general population [109]. In addition, drop-out analyses were performed in paper III and IV with regard to the factors investigated.

All women in the longitudinal part of paper III and the majority of women in paper IV were 70 years or older. More than half of the drop-outs in 1996 were deceased or had moved from the city. Among individuals eligible in 1996, the main reason for not participating in the investigation was 'poor health'. Payne et al [147] found when studying drop-out in a longitudinal study of older adults' oral health that those retained in the study were healthier, were less often edentulous and had more often regular dental care. This was in consistency with our findings. Thus, keeping drop-out to a minimum can be regarded as the best method for eliminating a major source of bias in longitudinal studies, but it is not always possible in older populations due to high rates of mortality and morbidity. Consequently, one has to take into account that in longitudinal studies like the present, it is the younger and healthier subjects who remain in the last phases. This is probably also relevant for cross-sectional studies of the elderly (non-participation). This was indicated in the SF-36 health survey in paper II, since in some of the scales the participants were in better health than the normative population.

According to Chapman [41] the ideal epidemiological study should target either samples representative of the population as a whole, or populations that are known to have predictable profiles relative to the larger population, to allow generalisation. In the PWGS the sample was stratified to include women only. Men and women have been seen to differ in terms of health and health-related behaviour. [5, 15, 16, 31, 32, 36]. If men had been included in the present epidemiological study of dental anxiety, it would have called for the study population to be much larger. Alternatively, if half of the population of women had been substituted for men,

various aspects of dental anxiety would probably not have been elucidated. Thus, it seemed justified to treat women separately.

However, the present study was limited to a city population of middle-aged and elderly women on the west coast of Sweden. The results cannot immediately be generalised to any other population, but may still be of general interest. There are indeed few reasons to believe that dental anxiety among middle-aged and elderly women in Göteborg differs greatly from that in similar populations in other industrialised countries.

Methodological considerations

Paper I and II showed the importance of going further in analyses using multivariate methods. This is now common practice in most epidemiological studies. However, many associations found with dental anxiety in earlier studies have not taken the covariation of other factors (e.g. age) into account.

Cross-sectional studies, like studies I and II here, cannot be used for studies of causality or risk factors, but may be useful for describing risk indicators (Genco 1996). When multiple logistic regression analyses are used (II and IV), there is in principle a predictive assumption connected with the model specification. No single study can reach definite conclusions about causality, but it can contribute to meta-analytic studies that can attain such conclusions. As an example, in the present paper IV, there might be a causal relation between extraversion (EPI) and remission from dental fear among women 50-years and older. However, the group that remitted from dental fear was too small to draw any conclusions. Other longitudinal studies would have to be performed to establish if such assumptions about causality can be made. However, such a finding, albeit of only minor importance for the present study, may add to the results of other studies and help to establish causality.

In the papers of the present thesis several psychometric scales were included. Most of them have been thoroughly validated and tested for reliability (see Method section). However, the two main instruments used to measure dental fear in study in this thesis, the DAS and the DQ, may require further discussion. The reliability and validity of the DAS has been demonstrated in several previous studies [9, 47, 48, 116-118]. However, except for the cut-off-score of 15 and above which is commonly used to measure extreme dental fear, no strict cut-off score for measuring other levels of dental fear has been defined. In the present studies different DAS cut-

off scores were used to form analysis groups. In paper I, the mean value on the DAS was used as a cut-off point (high dental anxiety: DAS≥8). In paper III the DAS was used only for validation of the DQ. DAS cut-off score of 13 or higher formed the high dental fear group. This has been the most commonly used cut-off score in epidemiological studies. However in paper II, we settled for the cut-off score of 12 and above, as it had been used in the most recently published epidemiological studies [10, 16, 58, 137]. However, in the future an essential issue in epidemiological studies of dental fear must be to decide upon a concordant cut-off score.

The DQ was one of 60 questions in a phobia self-report questionnaire. This questionnaire has not been validated and no reliability analysis has been performed. However, in paper III the result from DQ was compared with the results from three other scales of dental anxiety, the DAS, VAS/fear and VAS/unpleasantness.

The correlations between the DQ and the other measurement scales of dental anxiety were high, and 12 women out of 21 were classified as highly anxious on both the DQ and the DAS. Moore et al [16] and Locker et al [148] reported similar results when studying three well-established measures of dental anxiety. In the latter study as well as in our study, agreement between measures was only moderate, in spite of broadly similar prevalence rates. Locker et al [148] concluded that dentally anxious subjects identified by each instrument differed according to certain behavioural and other characteristics. However, the moderate intercorrelation between the fear scales in our studies may be accounted for also by variation in distribution. In 1996 the three dental anxiety measures plus the VAS/unpleasantness were included in a questionnaire, which was sent home to the respondents. This resulted in a higher intercorrelation (III).

Moore et al found, when comparing the DFS final item [22], the Seattle single item [5] and the DAS [47] that individuals with extreme dental anxiety were a homogeneous group since good concordance between measures for this group was found. However, for those who were 'somewhat afraid' on the DFS and the Seattle single item or who had DAS scores of 12-14, considerable discrepancy was found. Thus, the discrepancy between the DQ and the DAS found in paper III may also be due to the fact that the description of moderate fear is more difficult than that of extreme fear.

Structural Equation Modeling (V)

Dental anxiety is a complex bio-psycho-social condition and requires that investigations not only assess and analyse individuals' level of dental anxiety, but include measurements of emotional, social, and somatic expressions of the condition. As previously shown in this thesis and other studies, dental anxiety has been found to correlate to general psychosocial dimensions and concomitants such general anxiety, specific phobias, mood and distress traits, pain, avoidance behaviour and socio-economic factors [6, 7, 15, 23, 25, 26, 45, 46, 125, 149]. The pattern of a chronic course of dental anxiety may be very complex and therefore difficult to analyse with only the traditional quantitative analysis tools used in most studies. However, there are theoretical models taking into account different factors that interact in the initiating and maintenance of e.g. anxiety or pain. In the behavioural and social sciences advanced multivariate statistical methods are used to discover correlations and structures between variables since uni-, bivariate or multivariable analysis of variance or regression may lack the power to detect and elucidate possible associations and hierarchical relationships [150]. Such a powerful method is a structural equation modeling analysis (SEM) [136, 150].

In the present study three dimensions, dental anxiety, general anxiety and mood, were hypothesised and measured indirectly by different psychometric scales. By using the SEM approach each characteristic or latent variable may be estimated from a broad range of test instruments which hopefully will improve the area under study as compared to a single measurement. Another advantage of the SEM method is the approximation and magnitude of measurement error for each observed variable and dependent latent variable. Such estimates may implicate validity and reliability issues of the different psychometric and measurement instruments used to reveal structural relationships among the variables. The present study was the first stage in a series of structural equation modeling analyses of dental anxiety and concomitant factors. Thus, this analysis method is new to odontological research and aimed at future use in epidemiology. In our study we used a step-by-step analysis to reveal the relationships between these anxiety and emotional states. The final model showed that mood and general anxiety had positive factor loadings on dental anxiety. However, the impact of the general anxiety latent variable was not significant as compared to the mood factor. Another finding was that the

residual variance for the latent variable dental anxiety was high (0.68). This clearly indicated that a major portion of the variance of dental anxiety is, indeed, unexplained, and that other important parameters should be included in the structural model. One shortcoming of the present study was the small sample size, which calls for caution when interpreting the results. However, since this study is a controlled clinical study, larger sample sizes than the present may be difficult to achieve from a practical point of view.

In conclusion, this explorative study revealed a structural relationship between dental anxiety, general anxiety and mood in a clinical sample of dental phobic patients. Furthermore, the state of mood associated with dental care showed a clear impact on level of dental anxiety. The study also revealed the advantages of using a structural equation modeling method in detecting and estimating the variance – covariance structures among multiple measurement variables.

Implications for dentistry

The high frequencies of regular dental attendance regardless of dental fear level among dentate subjects in the older age-groups found in paper II is noteworthy. Here it is perhaps relevant that the participants in this study were urban women, two categories that report higher regularity in dental visits than male rural inhabitants [35, 137, 139, 140]. The increasing prevalence of dentate subjects with heavily restored teeth, especially when increasing life expectancy and other demographic changes are taken into account, means that the need for extensive dental care, the number of visits and the cost of care will increase for older adults. Österberg et al estimated in 1995 that each of 8000 Swedish dentists would have about 150 more dentate patients at the turn of the century than 25 years earlier [39]. Furthermore, the age-groups investigated in the present study have lived through a tremendous expansion of the welfare system in Sweden, with accompanying high expectations of public assistance for their health care needs. The results of the present paper I and II as well as other studies [5, 15, 17, 18, 46, 53, 54] show that the prevalence of dental fear was lower in older age-groups but there was still a high proportion who felt discomfort or fear about dental care. Suggested explanations of these lower prevalence rates among the elderly have been age-effect, cohort-effects, technological advances

in dentistry or simply that when individuals loose their teeth they also loose their dental fear. However, paper III indicated that the lower prevalence rates of dental anxiety were mainly due to an age-effect. If it had been a result of cohort effects the high prevalence of fear reported in the younger age groups would not have decreased over time, but remained stable and lead to large cohorts of old women with high dental fear instead of the lower rates indicated by this study. However, with the increasing proportion of elderly with preserved teeth, in future it will - even with these lower prevalence rates - be increasingly important to take dental anxiety into account when providing dental care for older adults.

The possibility of exploring and revealing relationships between dental fear and concomitant factors by means of structural modeling, will have important implications for dental anxiety research. This methodology has features that may elucidate and validate theoretical models and show new pathways for development. The application of this method may thus, in the future, validate the model of a vicious cycle of dental anxiety in a time perspective.

MAIN OBSERVATIONS AND CONCLUSIONS

- The frequency of women with an extreme level of dental anxiety (DAS≥15) was estimated as close to 4%. Moreover a considerable proportion of women experienced moderate negative feelings, ranging from slight discomfort to fear. The prevalence rates were lower in higher age-groups.

- The lower prevalence rate of dental anxiety in older age-groups was found to be an age-effect and not a cohort-effect. Thus, this study supported the contention that dental fear, like many other fears/phobias, declines with age.

- Irregular dental visiting patterns were more common among the elderly women, but this was shown to be primarily an effect of being edentulous. Thus, edentulousness was found to be the strongest predictor of irregular dental care. However, dental anxiety was found to be the strongest predictor of irregular dental attendance when analysing dentate subjects separately.

- Among subjects high in dental fear a significantly poorer oral status was found for irregular dental attenders compared to regular attenders. This supported the idea that the frequently reported relationship between dental fear and negative oral health effects in clinical studies is a consequence of phobic avoidance effects, and does not hold for the whole dental anxiety population.

- The association between dental anxiety, general health and socio-economic factors seemed relatively clear when using simple group comparisons. However, these associations were less evident when multivariate logistic regressions were applied. This underlined the significance of using multivariate statistical methods to control for covariation between associated factors.

- In a longitudinal perspective, dental anxiety increased or decreased in concert with number of other fears. In addition, it was revealed that a chronic course of dental fear was related to psychiatric impairment and neuroticism at baseline, while remission was related to the personality factor extraversion.

- The clinical explorative study revealed a structural relationship between dental anxiety, general anxiety and mood in a clinical sample of dental phobic patients. Furthermore, the mood associated with dental care showed a clear impact on level of dental anxiety.

- The advantages of using a Structural Equation Modeling (SEM) method in detecting and estimating the variance/covariance structures among multiple measurement models were also revealed.

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