Dimensions of the Dental Fear Survey among patients with dental phobia

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The aims of this study were to analyze and assess dimensions of the Dental Fear Survey (DFS), which has been developed to measure dental fears and phobias. The present study of 313 dental-phobic individuals analyzed the DFS in a factor analysis using an exploratory (EFA) and a confirmatory (CFA) factor analysis to show dimensions and latent variables. The EFA showed a five-factor structure, with dimensions including items characterizing 'Avoidance of dental care', 'Physiologic arousal during dental treatment', 'Anticipatory anxiety while waiting for dental treatment', 'Fear of the injection needle', and 'Fear of the drill'. The total explained variance of the EFA was 63%. Although statistically significant, the CFA model showed a factor structure with 6 latent variables including a general dental fear factor loading on all 20 items together with the aforementioned 5 factors. In spite of the limitation in sample size and the significant test statistic for this 6-factor structure, the model was interpretable in its dimensionality. In conclusion, these factor analyses have shown a different factor structure of the DFS in this sample of dental-phobic individuals as compared with the dimensions reported from previous research in samples representing nonclinical populations. □ *Dental anxiety; factor analysis; psychometrics*

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Over the past two decades various forms of self-reported verbal ratings in questionnaires have been used to measure dimensions of dental fear (1). Thus, often one or more questionnaires have been used to investigate both the nature of dental fear and anxiety and outcome measures in clinical trials. Some psychometric tests are simple and easy to use, but they may not incorporate different aspects of the phenomena dental anxiety and fear. The most widely used dental fear tests are the Corah Dental Anxiety Scale (DAS) (2) and the Dental Fear Survey (DFS) (3). The former includes four questions dealing with feelings and physiologic reactions in different dental situations. DAS is easy to use and considered to capture an overall level of dental anxiety, but it performs less well in distinguishing among individuals with high dental anxiety or dental phobia (4, 5). With its few questions DAS does not provide enough information to illuminate narrow and specific areas of fear reactions. The DFS was presented by Kleinknecht et al. (3) in 1973. This specific verbal dental fear measure assesses a broad range of dental fear components. The DFS has been used in epidemiology to ascertain the prevalence of dental fear and in clinical trials to measure effects of dental fear treatment. Furthermore, DFS has shown high reliability and validity in the reported literature (6, 7). Previous exploratory factor analyses have shown three factors or dimensions: avoidance and anticipatory anxiety, physiologic responses, and fear of specific situations during dental treatment (6, 7). The usefulness of different dimensions or factors, as depicted by factor analyses, may be to assess specific treatment outcomes, to predict treatment outcome, or to serve as indicators in tailoring specific therapy for dental-phobic individuals. Reported DFS factor analyses have been conducted on nonclinical populations, such as university students, but have not yet been surveyed on individuals with extreme, phobia-like, dental fear.

The aims of the present study were to analyze and assess dimensions and factors of the DFS by means of exploratory and confirmatory factor analyses in a clinical population of dental-phobic patients.

Materials and methods

The study group consisted of 313 patients self-referred or referred for treatment for extreme dental fear at the specialized Dental Fear Clinic (DFRTC) at the Faculty of Odontology, Göteborg University. All patients reported severe dental fear, avoided dental care, and refused conventional dental treatment. After being admitted to a waiting list before treatment each patient received questionnaires concerning background data, levels of dental fear and general fearfulness, mood, and quality of life as a result of their dental fear. This paper focuses on measures and dimensions of dental fears, and the other aspects were not included in the present analysis.

Patient characteristics (sex, age, and years since last regular dental care) and levels of dental fears are shown in Table 1.

Dental anxiety was assessed with the DFS (3, 8). The DFS concerns three different dimensions—avoidance,

Table 1. Means, standard deviation (s), and median (M) for age, years since last regular dental visit, and dental fear (DFS) (statistically significant differences on the basis of gender are indicated by * for $P < 0.05$, *** for $P < 0.001$)

	Total (n = 313)			Men (n = 91)			Women (n = 222)		
	Mean	s	M	Mean	s	M	Mean	s	M
Age*	34.0	9.0	31.0	36.4	9.6	33.5	32.7	8.6	31.0
Last dental visit	11.8	8.2	12.0	12.6	9.0	12.0	11.4	7.7	11.0
DFS***	79.6	12.5	81.0	75.3	14.7	75.0	81.3	11.0	82.0

physiologic arousal, and fear of specific objects or situations. Twenty items are rated for a high (5) to low (1) intensity of reactions, giving a total score range between 20 and 100. Individuals with severe dental fear have mainly shown sums of scores between 70 and 80 (9–13).

The exploratory factor analyses started with principal component analysis. Inspection of these first analyses with regard to eigen-values and scree plots together with prior theory and knowledge led to a decision on how many factors to retain and then to continue with an orthogonal rotation using the Varimax procedure, among others (14).

In the behavioral and social sciences advanced multivariate statistical methods are used to discover correlations and causality between variables since univariate analysis may lack the power to detect and elucidate possible associations. Such methods may include a confirmatory factor analysis, which can be used to test how observed variables in a measurement model correlate with latent variables and also to specify and test relationships among latent variables. With the CFA method the number of factors and pattern of loadings are specified in advance on the basis of prior knowledge of the factor structure of the variables being measured. This knowledge may come from theory and/ or results from earlier research such as from exploratory factor analyses. In this manner a model is formed and then tested by means of a statistical computer program in a confirmatory analysis, in which estimation is made with maximum likelihood methods, among other estimation techniques. The model-fitting also results in measures of goodness-of-fit indices for the hypothesis testing. In this investigation the CFA models were tested using the computer program EQS, which displays chi-square and normed (NFI), nonnormed (NNFI), and comparative (CFI) fit indices (15). For a model to be acceptable, these fit indices should reach values >0.9, with possible values ranging between 0 and 1, and the chi-square number should reach P values greater than 0.05.

In addition, descriptive statistics, Student's t test, and reliability analysis (alpha) were used in the statistical analyses.

Table 2. Frequency table of each item's distribution in percentage of responses on the scale from 1 to 5

Item	1	2	3	4	5
1. Put off making appointment	3	3	7	18	69
2. Canceled/failed to appear	7	10	14	32	37
3. Muscle tenseness	1	3	6	28	62
4. Increase breathing rate	5	6	27	31	31
5. Perspiration	3	9	21	29	38
6. Nausea	18	21	22	21	18
7. Heart beat faster	4	6	23	35	32
8. Making an appointment	13	16	21	25	25
9. Approaching dental office	4	10	20	33	33
10. Sitting in the waiting room	2	5	17	31	45
11. Sitting in dental chair	2	5	12	29	52
12. Smell of dental office	4	8	20	20	48
13. Seeing the dentist	10	15	25	27	23
14. Seeing anesthetic needle	9	9	15	15	52
15. Feeling anesthetic needle	7	10	13	17	53
16. Seeing drill	3	5	13	22	57
17. Hearing drill	2	5	9	17	67
18. Feeling drill	2	3	10	14	71
19. Having teeth cleaned	9	14	23	27	27
20. Overall fear of dentistry	1	1	4	25	69

Results

The study sample included 91 men and 222 women with a mean age of 34.0 years. Reported last regular dental visit was on average 11.8 years ago. The patients had high levels of dental fear as measured with the DFS (mean, 79.6) with women reporting statistically significant higher scores than men ($t = 4.0$, df 311; $P < 0.001$), and 70% of the individuals had sums of scores of 75 or higher (Table 1). In Table 2 the frequency distribution of all items is shown. As expected, most items showed a skewed distribution, although not violating multivariate normality or linear dependency as measured with the EFA and CFA. The reliability analysis showed an alpha coefficient of 0.89, and the item means was 4.0, with a variance of 0.19 (Table 3).

Table 3 shows the loadings of the Varimax-rotated factor matrix for the total sample. The principal component analysis showed five factors with eigenvalues above 1.0, and the first factor explained 34% of the total variance. The scree plot indicated a break after the third and fifth factors. The Varimax rotation yielded five factors with factor loadings of above 0.40 and a total explained variance of 63%.

Factor 1 included items 1 and 2, which involve avoidance of dental care, whereas factor 2 aggregrated questions 3–7, which deal with patients' reported physiologic responses during dental treatment. The third factor mainly concerned anticipatory anxiety before and during a dental treatment but also an overall estimation of level of dental fear. Items 14 and 15 involve fear of seeing and feeling an injection needle and belonged to factor 4, whereas items 16–18 (fear of the drill) were included in factor 5.

Table 3. Exploratory factor analysis of the Dental Fear Survey. Items' mean, standard deviation (*s*), factor loadings (1–5) and communalities (h^2)

Item	Mean	*s*	1	2	3	4	5	h^2
1. Put off making appointment	4.5	1.0	0.19	0.14	0.15	−0.05	0.80	0.72
2. Canceled/failed to appear	3.8	1.2	0.17	0.14	0.13	0.18	0.79	0.73
3. Muscle tenseness	4.5	0.8	0.18	0.12	0.67	−0.02	0.03	0.50
4. Increase breathing rate	3.8	1.1	0.14	−0.03	0.75	0.05	0.15	0.61
5. Perspiration	3.9	1.1	0.01	0.26	0.59	0.21	0.14	0.48
6. Nausea	3.0	1.4	0.20	0.14	0.42	0.30	0.29	0.41
7. Heart beat faster	3.9	1.0	0.22	0.09	0.65	0.05	0.07	0.49
8. Making an appointment	3.3	1.4	0.77	0.03	−0.02	0.03	0.07	0.60
9. Approaching dental office	3.8	1.1	0.76	0.20	0.15	0.09	0.26	0.72
10. Sitting in the waiting room	4.1	1.0	0.72	0.00	0.23	0.05	0.33	0.68
11. Sitting in dental chair	4.3	0.9	0.55	0.19	0.30	0.07	0.36	0.56
12. Smell of dental office	4.0	1.1	0.43	0.36	0.38	0.11	−0.01	0.47
13. Seeing the dentist	3.4	1.3	0.66	0.21	0.26	0.20	−0.10	0.60
14. Seeing anesthetic needle	3.9	1.4	0.16	0.10	0.10	0.92	0.02	0.89
15. Feeling anesthetic needle	4.0	1.3	0.04	0.07	0.11	0.93	0.09	0.88
16. Seeing drill	4.3	1.0	0.24	0.79	0.10	0.10	0.15	0.73
17. Hearing drill	4.4	0.9	0.18	0.89	0.15	0.07	0.16	0.87
18. Feeling drill	4.5	0.9	0.07	0.85	0.11	0.07	0.09	0.76
19. Having teeth cleaned	3.5	1.3	0.47	0.38	0.19	−0.03	0.06	0.40
20. Overall fear of dentistry	4.6	0.7	0.49	0.19	0.30	0.06	0.34	0.48

The next step in the analysis was to apply the results from the EFA in a confirmatory factor analysis so as to validate the former structure. The result of that analysis with five factors showed a highly significant chi-square (chi-square = 727, df 190, and NFI = 0.74, NNFI = 0.76, CFI = 0.79), thus indicating a bad fit of this model. Since the exploratory factor analysis showed a strong first factor in the principal component analysis, another hypothesized model was based on one general dental fear factor (GDF) including all 20 items and the 5 factors from the exploratory factor analyses. The test statistic for this model was also significant (chi-square = 322, df 152, and NFI = 0.89, NNFI = 0.92, CFI = 0.94) and an obvious improvement compared with the first model. This second model was found acceptable from a theoretical point of view. However, the fit indices indicated a reasonable structure statistically, although this was not supported by the chi-square.

In an attempt to further improve the factor structure, a model with covariances between the factors was tested, since a correlation analysis showed moderate correlation coefficients among the five factors (Table 3). But this CFA did not produce better test statistics than the previous six-factor model. Another model that seemed plausible from a theoretical point of view was a second-order hierarchical structure in which one second-order factor loads on the five first-order factors previously found from the EFA. This second-order factor may also be interpreted as a general fear factor that would account for variances and covariances among the first-order factors and among the dependent observed variables. This model was not acceptable either, showing test statistics parallel to the six-factor model.

The previously reported three-factor model of Kleinknecht et al. (6) and McGlynn et al. (7) was also tested in the EFA and CFA, but such a model yielded a less interpretable model in both analyses, with poor goodness-of-fit indices and chi-square value.

Discussion

Psychometric scales have been developed in the behavioral and social sciences to obtain and analyze individuals' perceptions in various situations. In the field of medicine and health care sciences such instruments have proved to be important as diagnostic tools and as outcome measures assessing patients' self-reported experiences concerning different aspects of received treatments or as predictors of treatment outcomes. These instruments also may help identify patients or subgroups of individuals who are more likely to fail in dental fear therapy (5, 16). Hence, the need for valid and reliable diagnostic and outcome measures is obvious.

Table 4. Correlation coefficients of the five factors extracted from the Dental Fear Survey

	1	2	3	4
1. Avoidance				
2. Arousal	0.40			
3. Anticipatory anxiety	0.47	0.56		
4. Fear of needles	0.19	0.31	0.26	
5. Fear of drilling	0.34	0.38	0.49	0.22

This study factor-analyzed DFS in a sample of individuals with dental phobia. The operational definition for inclusion in the study was refusal of conventional dental treatment and reported extreme dental phobia-like fear. This was, for most patients, linked to a long-standing avoidance of dental care. The level of dental fear was extremely high, since most of the individuals showed a DFS sum of more than 75.

In previous studies of dental-fear patients the DFS has indicated sound psychometric properties—that is, validity and reliability. Johansson & Berggren (10), among others, have shown that DFS distinguishes with regard to high- and low-fear individuals and that it correlates significantly with other measures of dental fear. In addition, Berggren (9) showed a relationship between dental and general fears as measured with the DFS and FSS-II, respectively. This study showed that the internal reliability of the DFS was high, as depicted by Cronbach's alpha coefficient, which is in accordance with the literature, as reported by McGlynn et al. (7) and Stouthard (18), which have shown $\alpha = 0.95$ and $\alpha = 0.93$, respectively.

The role of factor analysis may serve several purposes, such as validating and examining the internal structure of a measurement scale. Pedhazur & Pedhazur Schmelkin (17) state that performing a factor analysis on an already explored scale may still be invaluable when it could be expected that the factor structure may be different from the one previously reported. This could be due to, for example, different respondent populations.

Factor analyses of the DFS have only been exploratory and have captured three dimensions: physiologic arousal, avoidance and anticipatory anxiety, and fear of specific stimuli. As far as we know, DFS has been tested on nonclinical samples, usually students and/or individuals with a relatively low average age (6, 7, 12, 19).

The exploratory factor analysis for this sample showed five factors when using principal component analysis and varimax rotation. These factors have a logical and theoretical structure for this group of dental-phobic patients. The first factor measures situations outside the dental clinic—that is, avoidance. In previous EFA these items (nos. 1 and 2) were included together with items dealing with patients' anticipatory anxiety while being in the dental environment. According to Lang (20), specific phobias may have a framework that consists of a three-system model: autonomic symptoms, feelings of apprehension, and avoidance behavior. With this model in mind, our result with separate factors on avoidance and anticipatory dimensions can be well motivated from a theoretical and logical point of view. Seen in a more general perspective, most individuals in the general population do not avoid dental care but may still report different levels of low to very high anticipatory anxiety and apprehension (21, 22). Factor 2 concerned the physiologic responses patients experience, and the items of this factor were the same as in earlier analyses. Factors 4 and 5 included specific fears of the anesthetic needle and the drill, respectively. However, this result differs from other EFA, in which these items belong to the same factor. In a sample of dental-phobic patients it may well be both logically and theoretically acceptable to find subgroups of individuals that show differences in experiences and feelings in the two major stimuli. Clinical experiences of dental-phobic patients at the DFRTC support this result with solitary phobias such as injection phobia among the patients. Parallel findings have been shown by Öst (23) in individuals with blood and injection phobia. He found that most individuals had both phobias. However, two subgroups were diagnosed with only one of the two different phobias. Factor 3, anticipatory anxiety, was in agreement with previous EFA except for the two items concerning avoidance of dental care.

In the confirmatory factor analysis the factor structure from the EFA was tested. The covariance matrix of the hypothesized model with five latent variables was statistically significantly different from the original covariance matrix, thus indicating a nonacceptable model. Still, after modifications of that model and new analyses, none of the models were statistically sound. However, the best fit was shown by a model with a general dental fear factor loading on all items together with the other five, more narrow factors. The EFA partly supported such a model with a strong first factor in the principal component analysis, and theoretically, a general factor is adequate. A factor score of a GDF would be equivalent to the total sum of scores of the DFS. In the literature the DFS sum is used to evaluate pre- and post-treatment effects and choice of therapy.

These results may indicate the need for different factor structures when using DFS in different populations. One structure may be suitable and appropriate in large epidemiologic surveys with samples representative of the general populations, whereas another factor model may be used in clinical settings among extremely phobic patients for pre- and post-treatment evaluations and therapy strategies.

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