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**ORIGINAL ARTICLE**

# Confirming the factor structure of modified CFSS-DS in Finnish children at different ages

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**Abstract**

***Objective.*** The aims were to determine whether means of different fear-related items were similar in 1998 and 2001 and to find a common factor structure of the modified CFSS-DS for children at different ages. ***Materials and methods:*** Independent random samples of 6-, 9-, 12- and 15-year olds were drawn in two cities in 1998 and 2001 ($n$ = 180 per age group from each city). The study group in 2001 comprised 282, 265, 281 and 234 subjects aged 6, 9, 12 and 15 years, respectively. Each child received a modified CFSS-DS form to be filled out at home. Mean scores of different fear-related items were reported for each age group for both data sets. Confirmatory factor analyses (CFA) were performed to test whether the three factor structures revealed for 6-, 9- and 12–15-year olds in 1998 fitted the 2001 data. Multiple group CFA was used to test for the equivalence of the factorial structure across age groups (configural invariance). ***Results.*** The age-specific patterns of the means for individual fear-related items in 2001 corresponded to the mean values for 1998. When age-specific factor structures were tested separately for each age group, the factor structure for 9-year-olds was, in general, the best-fitting overall structure. The factor structure had a good fit for all age groups, but the loadings differed at different ages. ***Conclusions.*** The modified CFSS-DS provides consistent factor structures for children at different ages and reflects the changes in manifestations of dental fear during growth.

**Key Words:** *child, dental, fear, factor, CFSS-DS*

## Introduction

Efforts have been made to develop a reliable and valid questionnaire for determining children's dental fear. So far, the Child Fear Survey Schedule–Dental Subscale (CFSS-DS) seems to be the most widely used questionnaire that has been found to be reliable in several countries and languages worldwide [1]. Only a few studies have explored the validity in terms of the construct of the CFSS-DS; and, in most cases, three factors have been revealed: highly invasive procedures, less invasive aspects of dental treatment and victimization [2–7]. However, the structures of the explored factors have not been confirmed in independent samples.

There was a need to update the original version of CFSS-DS [8] which is rather long and includes items not specific for dentistry to better reflect the field of dental fear, especially fear of pain [9]. Furthermore, there was a need to develop a more compact questionnaire to suit both scientific and clinical needs in oral healthcare [10–12]. In this process, items on fear of pain, a very important aspect related to dental fear, as well as suction used in the mouth and dental fear in general were included. Seven items related to dental and medical situations were excluded. The reliability of the modified CFSS-DC in terms of internal consistency was high, the age-specific Crohnbach's alphas being over 0.85, for other details see Rantavuori et al. [11].

During development of the modified CFSS-DS, exploratory factor analyses on 1998 data revealed two factors, i.e. fear of attending dentist and fears related to treatment of dental decay among 6-, 9-, 12- and

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15-year-old children [10–12]. Among children of different ages, the percentage of variance explained by the two factors varied. According to the observations, the mean values of the different factors varied at different ages: younger children were more afraid of abstract aspects related to dental situations, such as fear of the dentist or dental instruments, whereas older children's fears were more related to invasive treatment, e.g. applying local anaesthesia and fear of drilling [11]. These findings raised the need to find out whether a common factor structure could be found for all ages in order to enable age-specific comparisons.

The aims of this study were to evaluate whether age-specific patterns in the mean scores could be observed and to determine whether a common factor structure of the Finnish version of modified CFSS-DS could be found for all ages in a similar independent data set in 2001.

## Materials and methods

This study was part of a larger project in which the occurrence and distribution of dental caries were examined [13]. The subjects represented the 6-, 9-, 12- and 15-year-old children in two medium-sized cities in Finland (Jyväskylä and Kuopio) in 1998 and 2001. The independent original random samples based on population register included 180 children from each age group from both cities in both years. The response rates are presented in Tables I and II. Of the study subjects, 51% were girls and 49% were boys in 1998 and 49% were girls and 51% boys in 2001. The subjects received a questionnaire to be filled out at home with the help of their parents, if the child felt she/he needed help or was too young to complete the questionnaire unaided. The questionnaire included 11 fear-related questions. Eight of them were taken from the Finnish version of the CFSS-DS [2]. In addition, items concerning fear of pain, fear of suction used in the mouth and dental fear in general were included. The fear-related questions had 5-point Likert-scale reply alternatives from 1 = not afraid to 5 = very afraid and an alternative 6 = no experience of this particular matter. The children who had no experience on a particular item in the questionnaire were recoded as 1 in the corresponding question. Similar recoding was done in 1998 [11] and hence used also in 2001. In 1998 the recoding of individual missing items and markings 6 were few.

The design of this study was identical to that conducted in 1998 for sampling method and questionnaire administration [10–12]. The questions used in the modified CFSS-DS are presented in Table I.

The age-specific mean values of individual fear-related items were calculated on 1998 and 2001 data and the overall patterns of the values were compared and statistical significances of the differences between the years were evaluated using Mann-Whitney U-tests.

Confirmatory factor analyses (CFA) were performed to test whether the three factor structures revealed for 6-, 9- and 12–15-year olds in 1998 fitted the 2001 data. CFA provides information on how items measure hypothesized underlying latent constructs (factors) beforehand that are not directly measurable. In the analysis, items were not allowed to load on more than one factor, nor were their error terms allowed to correlate.

Multiple group CFA (MGCFA) was used to test for the equivalence of the factorial structure across age groups (configural invariance). To assess invariance with respect to factor loadings (metric invariance), a nested model with parameters constrained to be identical between age groups was compared to a model where parameters were allowed to vary between age groups.

The fit indexes used were normed chi-square ($\chi^2$/df), comparative fit index (CFI), root mean square error of approximation (RMSEA) and Akaike information criterion (AIC), with values $\chi^2$/df <5, CFI >0.90 and RMSEA <0.08, indicating reasonably good fit, and the best model having the smallest AIC [14].

Summary mean values for the best fitting factor structure (9-year olds in 1998) for the pooled 2001 data were calculated. Mean scores of the values for items loading high on factors TDD and AD of the final factorial structure were calculated in the same way as in 1998. For both data sets, mean scores of GF, PV, TDD and AD were reported for each age group. Statistical analyses were conducted using SPSS 16.0 and AMOS 16.0 softwares.

The study was approved by the Ethics committee of the University of Kuopio.

## Results

Mean values for the fear-related items of modified CFSS-DS, number of participants and response rates among each age group in 1988 and 2001 are presented in Table I. The individual fear-related items found in 2001 corresponded to the mean values in 1998 except for one item 'Drilling', for which the mean value was higher in 1998 than in 2001 among 12-year-old children.

In 1998 [11], four different measures of dental fear from the 11 fear-related questions were reported. 'Dental treatment in general' (GF) was drawn from a single question: 'Are you afraid of dental treatment in general?', which was also used by Milgrom et al. [15]. 'Peak value for dental fear' (PV) described the highest value a child had on the 11 fear-related questions and this was used as a clinically relevant indicator that the child was afraid of something in dental treatment and might thus show fear-related behavior. The latter two, 'Treatment of dental decay' (TDD)

Table I. Mean values (range 1–5) for fear-related items of the modified CFSS-DS, number of participants and response rates for each age group in 1998 [11] and in 2001.

| | | Mean (SD) | | | | ANOVA | |
|---|---|---|---|---|---|---|---|
| Fear of: | | 6-years | 9-years | 12-years | 15-years | *F* | *p* |
| Dental treatment in general | 1998 | 1.93 (1.09) | 1.67 (0.87) | 1.53 (0.80) | 1.59 (0.89) | 11.30 | < 0.001 |
| | 2001 | 1.81 (0.99) | 1.63 (0.82) | 1.59 (0.82) | 1.58 (0.88) | 4.08 | 0.007 |
| | Difference | −0.12 | −0.04 | 0.06 | −0.01 | | |
| Keeping the mouth open | 1998 | 1.59[a] (1.06) | 1.25[a] (0.64) | 1.15[a] (0.43) | 1.19[a] (0.56) | 24.55 | < 0.001 |
| | 2001 | 1.48 (0.84) | 1.19 (0.48) | 1.22 (0.63) | 1.20 (0.62) | 12.23 | < 0.001 |
| | Difference | −0.11 | −0.06 | 0.07 | 0.01 | | |
| Dentist | 1998 | 1.58[a] (0.93) | 1.33[a] (0.76) | 1.25[a] (0.64) | 1.27[a] (0.69) | 11.92 | < 0.001 |
| | 2001 | 1.53 (0.91) | 1.31 (0.72) | 1.28 (0.68) | 1.25 (0.67) | 7.91 | < 0.001 |
| | Difference | −0.05 | −0.02 | 0.03 | −0.02 | | |
| Teeth being cleaned by dentist or nurse | 1998 | 1.63[a] (1.01) | 1.41[a] (0.73) | 1.26[a] (0.62) | 1.26[a] (0.75) | 14.51 | < 0.001 |
| | 2001 | 1.61 (0.94) | 1.32 (0.60) | 1.31 (0.72) | 1.32 (0.73) | 10.00 | < 0.001 |
| | Difference | −0.02 | −0.09 | 0.05 | 0.06 | | |
| Drilling | 1998 | 1.73[b] (1.29) | 1.88[b] (1.14) | 2.10[b] (1.24) | 2.18[b] (1.31) | 8.33 | < 0.001 |
| | 2001 | 1.77 (1.28) | 1.83 (1.21) | 1.83 (1.08) | 2.09 (1.25) | 3.25 | 0.021 |
| | Difference | 0.04 | −0.05 | −0.27** | −0.09 | | |
| Local anesthesia | 1998 | 1.44[b] (1.02) | 1.63[b] (1.14) | 1.80[b] (1.14) | 1.91[b] (1.24) | 10.03 | < 0.001 |
| | 2001 | 1.57 (1.15) | 1.76 (1.23) | 1.82 (1.13) | 2.00 (1.23) | 6.00 | < 0.001 |
| | Difference | 0.13 | 0.13 | 0.02 | 0.09 | | |
| Hearing the sound of drilling | 1998 | 1.52[b] (1.08) | 1.50[b] (0.94) | 1.66[b] (1.05) | 1.75[b] (1.13) | 3.83 | 0.010 |
| | 2001 | 1.66 (1.17) | 1.46 (0.91) | 1.53 (0.96) | 1.80 (1.15) | 5.33 | 0.001 |
| | Difference | 0.14 | −0.04 | −0.13 | 0.05 | | |
| Being unable to breathe | 1998 | 1.87[c] (1.30) | 1.92[b] (1.24) | 1.87[b] (1.09) | 1.92[b] (1.23) | 0.17 | 0.918 |
| | 2001 | 1.76 (1.20) | 1.78 (1.12) | 1.88 (1.13) | 2.07 (1.24) | 3.54 | 0.014 |
| | Difference | −0.11 | −0.14 | 0.01 | 0.15 | | |
| Instruments put in the mouth | 1998 | 1.98[a] (1.26) | 1.67[a] (1.01) | 1.53[b] (0.91) | 1.56[b] (0.95) | 12.25 | < 0.001 |
| | 2001 | 1.80 (1.16) | 1.65 (1.01) | 1.59 (0.93) | 1.61 (0.95) | 2.50 | 0.06 |
| | Difference | −0.18 | −0.02 | 0.06 | 0.05 | | |
| Suction used in the mouth | 1998 | 1.56[b] (1.09) | 1.29[a] (0.74) | 1.15[a] (0.46) | 1.20[a] (0.62) | 17.68 | < 0.001 |
| | 2001 | 1.61 (1.10) | 1.28 (0.69) | 1.21 (0.59) | 1.19 (0.59) | 17.73 | < 0.001 |
| | Difference | 0.05 | −0.01 | 0.06 | −0.01 | | |
| Dental treatment causing pain | 1998 | 1.96[b] (1.39) | 2.18[b] (1.27) | 2.25[b] (1.22) | 2.50[b] (1.33) | 8.92 | < 0.001 |
| | 2001 | 2.01 (1.39) | 2.06 (1.25) | 2.22 (1.21) | 2.35 (1.27) | 3.71 | 0.011 |
| | Difference | 0.05 | −0.12 | −0.03 | −0.15 | | |
| *n* (response rate %) Jyväskylä | 1998 | 148 (82) | 142 (79) | 148 (82) | 142 (79) | | |
| | 2001 | 143 (79) | 142 (79) | 140 (78) | 118 (66) | | |
| *n* (response rate %) Kuopio | 1998 | 152 (84) | 154 (86) | 152 (84) | 147 (82) | | |
| | 2001 | 138 (77) | 121 (67) | 139 (77) | 108 (60) | | |

**$p < 0.01$ for Mann-Whitney U-test; [a]item loaded high on factor AD (attending dentist); [b]item loaded high on factor TDD (attending dentist); [c]item did not load high on either factor.

and 'Attending dentist' (AD), were revealed by factor analyses and consisted of the items that loaded high on these factors. TDD included items related to invasive treatment of decay, for example drilling, hearing the sound of drilling, local anesthesia and pain. AD included less invasive items related to dental visits in general, for example fear of the dentist, keeping the mouth open, teeth being cleaned by a dentist or nurse and suction used in the mouth. The factor analyses revealed a different structure for 6- and

Table II. Fit indices for the age-specific 1998 factor structures on age-specific 2001 data.

| 2001 age group | 1998 factor structure | $\chi^2$/df | CFI | RMSEA | AIC |
|---|---|---|---|---|---|
| 6 | 6 | 6.531 | 0.888 | 0.141 | 207.805 |
| | 9 | 5.073 | 0.903 | 0.121 | 214.482 |
| | 12/15 | 6.223 | 0.875 | 0.137 | 253.566 |
| 9 | 6 | 6.040 | 0.849 | 0.138 | 195.035 |
| | 9 | 4.463 | 0.884 | 0.115 | 193.752 |
| | 12/15 | 5.197 | 0.860 | 0.126 | 218.682 |
| 12 | 6 | 7.778 | 0.874 | 0.157 | 240.229 |
| | 9 | 5.225 | 0.911 | 0.124 | 219.640 |
| | 12/15 | 4.679 | 0.922 | 0.116 | 201.079 |
| 15 | 6 | 5.778 | 0.881 | 0.145 | 188.221 |
| | 9 | 4.581 | 0.900 | 0.126 | 197.741 |
| | 12/15 | 5.659 | 0.870 | 0.144 | 234.409 |

9-year olds, whilst the 12-year-olds and 15-year-olds shared the same model (Table I).

The results of the CFA for the age-specific 2001 data based on age-specific 1998 factor structures are presented in Table II. When age-specific factor structures were tested separately for each age group, the factor structure for 9-year-olds was the best-fitting overall structure. Only among 12-year-olds in 2001, the factor structure for 12-year-olds (1998) had the best fit. However, the factor structure for 9-year-olds had almost as good fit for the 12-year-olds in 2001. Therefore, the factor structure for 9-year-olds was chosen for the MGCFA, which is presented in Table III. The results revealed good fit for the unconstrained model indicating configural invariance, i.e. the same factor structure across age groups. The difference between the unconstrained model and the nested model (constrained factor loadings) was statistically significant, indicating lack of invariance between age groups with respect to factor loadings (metric invariance). In general, the factor structure was the same; but factor loadings differed in different age groups.

The results of the mean scores for GF, PV and the summary means of the items loading high on confirmed factor structures TDD and AD are presented in Table IV. GF and AD mean values were higher among younger children than among older children. TDD mean values were higher among older than among younger children. However, there was no statistically significant difference in PV mean values between different age groups. The patterns of TDD, AD, GF and PV were similar in the 1998 and 2001 data.

## Discussion

In 2001 the age-specific mean item and factor sum scored showed a similar pattern in comparison to 1998. In addition, the study revealed a common factor structure of the Finnish version of modified CFSS-DS for all ages: the factor structure of the modified CFSS-DS for 9-year-olds was a good fit for the pooled data. This study further supports the validity of the modified CFSS-DS in the Finnish child and adolescent population.

The study is the first to confirm the factor structures of a dental fear questionnaire among children over different ages. As no previous studies suggested a rationale for preferring certain structure we decided to test all different structures and found the structure for 9-year-olds the most suitable for all age groups. This decision was further supported with the results of the MGCFA. The population from both cities was large enough to perform the statistical analyses and the study represented the children of these age groups in the cities. The designs of the studies were identical for independent random sampling and for questionnaires and their administration which made the data sets comparable. Similarly to ten Berge et al. [16], replacing the missing and 'no experience' values with

Table III. Fit indices for the 9-year-olds' 1998 factor structures on age specific 2001 data).

| Model | $\chi^2$ | df | $\chi^2$/df | CFI | RMSEA | AIC | *p* |
|---|---|---|---|---|---|---|---|
| Unconstrained | 657.623 | 136 | 4.835 | 0.901 | 0.061 | 825.623 | |
| Constrained factor loadings | 783.620 | 160 | 4.898 | 0.882 | 0.061 | 903.620 | |
| Difference | 125.997 | 24 | | | | | < 0.001 |

Table IV. Mean values for 'Peak value for dental fear' and 'Fear of dental treatment in general' and factor means for 'Treatment of dental decay' and 'Attending dentist' (9-year-old factor structure) and their standard deviations among each age group in 1998 [11] and 2001.

| | | Mean (SD) | | | | ANOVA | |
|---|---|---|---|---|---|---|---|
| | Data | 6-years | 9-years | 12-years | 15-years | *F* | *p* |
| Dental treatment in general | 1998 | 1.93 (1.09) | 1.67 (0.87) | 1.53 (0.80) | 1.59 (0.89) | 11.30 | 0.000 |
| | 2001 | 1.81 (0.99) | 1.63 (0.82) | 1.59 (0.82) | 1.58 (0.88) | 4.08 | 0.007 |
| Peak value for dental fear | 1998 | 3.02 (1.38) | 2.78 (1.29) | 2.77 (1.27) | 2.87 (1.34) | 2.26 | 0.080 |
| | 2001 | 2.82 (1.43) | 2.69 (1.34) | 2.63 (1.23) | 2.82 (1.32) | 1.41 | 0.232 |
| Treatment of dental decay | 1998 | 1.70 (0.92) | 1.82 (0.88) | 1.94 (0.90) | 2.05 (1.01) | 7.89 | 0.000 |
| | 2001 | 1.75 (0.98) | 1.78 (0.88) | 1.86 (0.91) | 2.06 (1.00) | 5.43 | 0.001 |
| Attending dentist | 1998 | 1.67 (0.81) | 1.39 (0.60) | 1.27 (0.46) | 1.29 (0.55) | 26.47 | 0.000 |
| | 2001 | 1.61 (0.789 | 1.35 (0.52) | 1.32 (0.58) | 1.31 (0.56) | 13.98 | 0.000 |

value 1 (no dental fear) when calculating the mean values did not change the results in 1998 [11] and, thus, justified the use of the same method in 2001, especially to make the data sets comparable.

The children filled out the questionnaire themselves; parent's help was to be used only if needed. This could be a limitation as parents' help or their own dental fear may have an effect on the responses of younger age groups. However, the questionnaire has stable factor structures and important extra questions that are not included in the original version of CFSS-DS: fear of pain was the most prevalent fear in 1998 and 2001. All the questions focus on dental treatment-related situations, therefore it lacks information on personality characteristics or other possible psychical and psychosocial determinants on child dental fear. It may not reveal whether the dental fear itself is of internal or external origin. However, the questionnaire can reveal how dental fear changes in different age groups. It replicated our earlier findings of dental fear: younger children were more likely to fear general aspects related to dental treatment and older children were more likely to fear treatment-related aspects of dental treatment, which is likely to reflect the increasing experiences of invasive dental treatment with age.

In conclusion, the modified CFSS-DS provides consistent factor structures over time for children at different ages and reflects changes in the manifestations of dental fear during growth. Thus, it is a compact questionnaire for both clinical and scientific purposes to study child dental fear.

***Declaration of interest:*** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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