Prevalence of Dental Anxiety among 5- to 8-Year-Old Taiwanese Children

Chen-Yi Lee, MS; Yong-Yuan Chang, ScD; Shun-Te Huang, DDS

Abstract

Objectives: *Many people experience discomfort to a greater or lesser degree about the prospect of dental treatment. Dental treatment can be a terrible experience, especially for children with dental anxiety. This study estimated the prevalence of dental anxiety among 5- to 8-year-old children in Kaohsiung City, Taiwan.* ***Methods:*** *The Children's Fear Survey Schedule-Dental Subscale (CFSS-DS) was translated into Chinese, and a receiver operating characteristic (ROC) curve was made based on criteria determined from pretest clinical observations of a sample population to set a cutoff score. Then, the parental CFSS-DS was used as a screening tool to survey the dental anxiety levels of 5- to 8-year-old children at kindergartens and elementary schools in Kaohsiung City, Taiwan. Participants were selected by stratified random sampling. The stratification was done by geographic district, age group, and sex. A total of 3,597 valid questionnaires were collected.* ***Results:*** *The Chinese version of the CFSS-DS had an optimal cutoff score of 38/39 (sensitivity was 0.857, specificity was 0.882) with an area under the ROC curve of 0.912. The estimated prevalence of dental anxiety among 5- to 8-year-old children in Kaohsiung City was 20.6 percent. The dental anxiety score was found to decrease as age increased; primary school boys had significantly lower scores.* ***Conclusions:*** *The prevalence of dental anxiety was found to be high for 5- to 8-year-old Taiwanese children. The study's findings point to the urgent need for preventive health education and intervention programs in Taiwan to promote children's oral health and reduce dental anxiety.*

Key Words: dental anxiety, prevalence, ROC curve, children

Introduction

Children commonly experience anxiety when receiving professional dental treatment. Dental anxiety is characterized by a general apprehension toward stimulation in dental situations. A child's feelings of anxiety during dental treatment can lead to uncooperative behavior that may obstruct and delay treatment. Dentists in England (1) and America (2) have singled out dental anxiety as one of the most troublesome problems facing dentistry today. Children with dental anxiety may change their dental visit behavior; indeed some parents have reported that their children's "fear" is a barrier to taking their children to visit a dentist (3–6). Thus, children's oral health protection is often compromised because of dental anxiety. Rachman (7) has proposed three pathways to fear: directly through conditioning, indirectly via vicarious learning, or by modeling. The high prevalence of caries in Taiwanese children (8–10) suggested that dental anxiety in Taiwan could be high as a result of negative conditioning. Although the topic clearly deserves close attention as a crucial dental public health issue, little is known about dental anxiety among children in Taiwan.

The estimated prevalence rates of dental anxiety varies considerably by country, from about 3 to 20 percent (11–14), possibly because of differences in population, instrument, research method, or culture. The dental subscale of the Children's Fear Survey Schedule (CFSS-DS) was developed by Cuthbert and Melamed in 1982 (15). The CFSS-DS has been applied in several ways. For younger children without the ability to read or write, the CFSS-DS can be filled out by their parents, who generally know their children's concerns very well (12, 16–19). For older children who have learned to read, researchers may ask them to fill out the questionnaires by themselves (20–22). The CFSS-DS has been used commonly as a screening tool in a number of population-based studies around the world (12, 15–20). Some of those studies have found higher dental anxiety scores in Asian and American populations (15, 20), decreasing scores as age increased (12, 15–17), or higher CFSS-DS scores among girls (12, 15) or boys (16).

One problem common to all of these studies is that they used less-than-ideal methods for setting the cutoff score, such as one standard deviation (SD) above the mean (12, 18, 20), or other methods that did not provide any information about sen-

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sitivity and specificity (15–17, 19, 23). Mean 1 SD is often used to determine cutoff values when using psychometric measures. However, studies using the CFSS-DS have often reported significantly positively skewed distributions. In such cases, different cutoff score standards may result in different prevalence rates, which would increase the difficulty of comparing the findings across studies. We believe that receiver operating characteristic (ROC) curves will provide a more consistent standard for setting cutoff scores.

In this study, we investigated the prevalence of dental anxiety among young girls and boys in Taiwan by using an ROC curve to establish the cutoff score.

Methods

Pretest Sample. A pretest to establish an external standard of evaluation by which to generate an ROC curve for the Chinese version of the CFSS-DS was carried out at a dental clinic in Kaohsiung Medical University's Chung-Ho Memorial Hospital in October 2002. Parents/guardians (we will refer to them all as "parents" because the majority were parents) of consecutively scheduled child patients between the ages of 5 and 8 were recruited for the pretest when they visited the clinic. Children with abnormal psychological development, such as mental retardation, developmental retardation, pervasive developmental disorder, tic disorder, severe sensorimotor impairment (paralysis, deafness, blindness), or psychotic disorder were excluded from participating in the study. Ninety-six parents of 52 boys and 44 girls participated in the pretest. No parent or child refused to assist in the pretest. The parents were asked to complete the CFSS-DS on behalf of their children during their visit. The purpose of the study was explained to the parents, informed consent was obtained from at least one parent in writing, and then at least one parent filled out the questionnaire. In some cases, both parents filled it out together or the child also participated through verbal feedback to parent. The parents who completed the questionnaire were assumed to be knowledgeable about the concerns of the child.

As a parent(s) was filling out the questionnaire, the child was observed by three graduate students of the Institute of Behavioral Sciences. The three observers were familiar with child developmental psychology and child behavior observation, and senior pediatric dentists at the clinic imparted clinical knowledge and experience, all of which qualified the three assistants to make informed observations about the children's level of anxiety. To estimate the consistency between the three observers, these first 20 participants were rated by all three of them. The Kappa statistic among the three observers was 0.8 to 1.0. After establishing the consistency of the three observers' estimate of dental anxiety levels, the remaining 76 participants were randomly assigned to and rated by one of the three observers. To assure observational objectivity, the observers received no information about the parents' answers to the questionnaire.

Because of the high rate of caries and the lack of regular dental visits by Taiwanese parents and children (8–10, 24, 25), most of the participants in the pretest were visiting a dental clinic because of caries or pain; therefore, treatment mostly involved fillings and root canals (95.8 percent). The average time of each session of treatment was about 30 minutes. If the child received an injection during that treatment session, the observational record was excluded from the analysis. (A dentist with a metal syringe is a scary sight even for an adult. A child without dental anxiety may express fear and resistance when a metal syringe is approaching, leading the observer to overestimate the child's anxiety level.) Dental anxiety should be a general anxiety toward dental situations, not just injection. Finally, only four records (4 percent) were excluded.

Dental anxiety levels were rated from 0 (not at all) to 5 (extremely frightened), and levels of uncooperativeness were rated from 0 (fully cooperative) to 5 (completely uncooperative). A high level of dental anxiety was defined as either a level of anxiety or level of uncooperativeness of four points or more. The pretest clinical observations were used as diagnostic criteria for constructing an ROC curve of the Chinese version of the CFSS-DS. In the pretest sample, the correlation between "anxiety" and "uncooperativeness" was 0.90, suggesting that the results would be similar no matter if the definition of dental anxiety was anxiety ≥4 or uncooperativeness ≥4.

ROC Curve. In epidemiology, criterion validity is often presented in terms of the specificity and sensitivity of the test (26). The sensitivity of the test is defined as the proportion of positive cases correctly identified. The specificity of the test is the proportion of negative cases identified. The sensitivity and specificity change as one moves the cutoff score and can be used to determine the most efficient cutoff score. The true positive rate (sensitivity) can be plotted against the false positive rate (100 percent – specificity) to produce a graph, known as the ROC curve (27, 28). This visual display makes it very easy to see the impact of selecting different cutoff scores and aids in the selection of the most appropriate test. In tests without perfect sensitivity and specificity, generally the best cutoff score is the one which lies nearest to the upper left corner (23), and the area under the ROC curve is a reasonable summary of the overall diagnostic accuracy of the test (29). In this study, the observers' estimates of dental anxiety levels were used as external criteria to set an ROC curve-based cutoff score for the Chinese version of the CFSS-DS.

Screening. Our Chinese parental version of the CFSS-DS was used as a screening tool to survey 5- to 8-year-old children from 11 kindergartens and six elementary schools located in Kaohsiung City, Taiwan.

The Kaohsiung City Bureau of Education gave us a list of all kindergartens and elementary schools and information about the distribution of kindergarten and elementary school children by age and geographic district within the city. Approval for the study was obtained from the local government.

The study population was recruited by stratified randomization, proportional to size. The stratification was done on age group, sex, and geographic district. Four districts (Sanmin, Yancheng, Lingya, and Qianjin) were randomly selected from 11 districts in Kaohsiung City, and then 11 kindergartens and six elementary schools were randomly selected from those districts. Finally, four age groups (5, 6, 7, and 8 years old) were randomly selected from those schools. The number of subjects required in each age group was in proportion to the number of the whole population in each selected schools. We estimated that 3,500 respondents would be a large enough representative sample.

It was estimated that the response rate would be about 90 percent from the four districts, and the proportion of valid questionnaires would be about 95 percent. Based on these estimates, 4,300 questionnaires were prepared to send out to the schools. The teachers gave the questionnaires to their students and asked them to take it home and fill it out with their parents' help and then return it to the teachers. An informed consent form was included with each questionnaire for the parents to sign. A research assistant then retrieved the questionnaires from the teachers. Using these sampling methods, 3,789 valid questionnaires and the informed consent forms signed by the parents were collected; the return rate was 88 percent. Finally, 192 questionnaires were missing CFSS-DS items and were thus excluded from the analysis. A total of 3,597 valid questionnaires were collected.

The research protocol for this study was approved by the Human Experiment and Ethics Committee of the Chung-Ho Memorial Hospital, Kaohsiung Medical University.

Survey Instrument. The CFSS-DS consists of 15 items, including "the dentist drilling" and "injections." Each item covers a different aspect of dental and medical situations and all are used to measure the level of dental anxiety. The possible response to each item is a score between 1 (not afraid) and 5 (very afraid). The total scores range from 15 to 75, with a high score indicating a high level of dental anxiety. The test–retest reliability, reported by Cuthbert and Melamed (15), was 0.86.

The Chinese version of the CFSS-DS translated from English by Milgrom et al. for use in mainland China (23) was not used in this study because some of the diction common to mainland China differs from that of Taiwan. The English version of the CFSS-DS was thus newly translated into Chinese by the authors, and then back-translated for quality control. To fit the conditions of dental procedures in Taiwan, the item "Having the nurse clean your teeth" was changed to "Having the dentist clean your teeth."

Data Analysis. The Cronbach's α and ROC curve were calculated to obtain the validity and cutoff score for our Chinese-version of the CFSS-DS. Descriptive statistics were used to describe the positively skewed distribution of CFSS-DS scores. Mean scores of the CFSS-DS and prevalence were calculated for each gender at each age level. A three-way analysis of variance (ANOVA) was performed to test the differences in mean scores between each age level, gender, and type of school (public or private). Data were analyzed using SPSS release 11.5 (SPSS, Inc., Chicago, IL).

Results

Reliability. We analyzed the pretest sample and the normative sample as one sample. The Cronbach's α in this study was 0.90 for the whole sample (pretest sample plus normative sample).

Cutoff Score. As shown in Table 1, the Chinese version of the CFSS-DS had an optimal cutoff score of 39. The optimal sensitivity was 0.86 and the specificity was 0.88. The ROC curve we generated from the pretest sample data illustrates that the point lying nearest the upper left corner was 39, and the area under the ROC curve was 0.91, meaning that the overall predictive accuracy of this screening tool was up to 91 percent.

Prevalence of Dental Anxiety. The prevalence of dental anxiety in 5-year-olds was 24.8 percent, 21.1 percent in 6-year-olds, 19.2 percent in 7-year-olds, and 19.3 percent in 8-year-olds. The overall estimated prevalence of dental anxiety was 20.6 percent.

ANOVA. The overall median CFSS-DS score was 27 (range 15 to 75, 1st quartile 21; 3rd quartile 36), and the overall mean CFSS-DS score was 29.68 (SD = 10.91). For all four age groups (5- to 8-year-olds), the mean scores for girls were 30.94, 31.26, 29.93, and 30.66, and the mean scores for boys were 31.99, 28.69, 28.03, and 27.53, respectively. The test results of the three-way ANOVA show a significant main effect for gender and a significant interaction effect between age level and gender (Table 2). The mean scores for the boys were found to be significantly lower than those for the girls. In addition, scores decreased as age increased.

CFSS-DS Items Rankings. The most fearful situation for the participating Taiwanese children among the 15 items of the CFSS-DS was "injections," with 54.7 percent of the children answering "a fair amount (of fear)" (score 3), "pretty much afraid" (score 4), or "very afraid" (score 5). The item scoring next highest was "Being touched by a stranger," with 47.4 percent of the children answering score 3 or above. This was followed by "The dentist's drilling" (45.8 percent) and "Having somebody put instruments in your mouth" (37.7 percent).

Discussion

The internal consistency of the Chinese-version CFSS-DS we modified and used in Taiwan proved to

Table 1
The Different Sensitivity and Specificity for Different Cutoff Scores of CFSS-DS

	Clinical observation			2 × 2 tables resulting from shifting cutoff scores					
		Yes	No	45/46		38/39		32/33	
DS score	>46	13	4	13	4				
	39 to 45	11	4	15	64	24	8		
	33 to 38	2	8			4	60	26	16
	15 to 32	2	52					2	52
Sensitivity				13/28		24/28		26/28	
				46%		86%		93%	
Specificity				64/68		60/68		52/68	
				94%		88%		76%	

CFSS-DS, Children's Fear Survey Schedule-Dental Subscale; DS, CFSS-DS.

Table 2
Comparison of the Means of CFSS-DS Scores by Age Level, Gender, and School Using Three-Way ANOVA

Source	Sum of square	*df*	Mean square	*F*	*P*
Intercept	96,289.112	1	96,289.112	830.488	0.000
Gender	1,928.536	1	1,928.536	16.634	0.000
Age level	630.217	3	210.072	1.812	0.143
School	30.646	1	30.646	0.264	0.607
Gender × Age level	1,153.702	3	384.567	3.317	0.019
Age level × School	840.184	3	280.061	2.416	0.065
Gender × School	1.235	1	1.235	0.011	0.918
Error	409,741.918	3,534	115.943		

CFSS-DS, Children's Fear Survey Schedule-Dental Subscale; ANOVA, analysis of variance.

be reliable. The positively skewed distribution of the CFSS-DS scores in this study was similar to the normative data of previous studies in Singapore (20), the United States (12, 15), and Japan (22), and the mean score was relatively higher than the findings in Finland (21), Sweden (16), the Netherlands (19), and Denmark (17, 18).

The cutoff score found in this research was 39, which satisfied sensitivity and specificity, and moreover, proved that using an ROC curve to set the cutoff score is practical. Using the standards for cutoff scores set in other studies, in this research if the cutoff score were mean + 1 SD, then it would have been 41, or slightly higher than the cutoff score set by the ROC curve and close to the cutoff scores of the Singapore study (20) and urban American study (12). Then the prevalence of dental anxiety would be 17 percent. Compared with calculating the prevalence using the ROC curve, using mean + 1 SD would result in a slight underestimate. If we were to choose to adopt 38 as the cutoff, as set by Klinberg et al. (16) in the Swedish study's sample, to estimate the prevalence of child dental anxiety in Taiwan, then it would be 22.7 percent. It seems that only minor differences exist, but it is because of the nonserious skewedness of the Taiwan sample. If we were to choose the seriously skewed sample of, for example, the Danish, in which 38 was the cutoff score, the prevalence of child dental anxiety would be 5 percent (17); when the cutoff score were set at mean + 1 SD, the prevalence in that study would change to 15.8 percent (18). This is a large difference. Moreover, if the research conducted by ten Berge et al. (19) were to use mean + 1 SD, then the cutoff score would be 32, which is far different from the score (≧39) set according to the dentist's clinical fear rating. In other words, if score distributions are skewed and differ from population to population, adopting a mean + 1 SD to set the cutoff score creates analytical limitations.

Furthermore, it is possible to compare this study's finding with those of previous studies using external criteria to set the cutoff scores. Klinberg et al. (16) and ten Berge et al. (19) both adopt clinical observation-based criteria, and obtained cutoff scores similar to that of this study. But the clinical rating instruments they used were different from those of this study, and the methods they used did not provide information about the predictive accuracy of the cutoff score. Thus, it is hard to ascertain if the similarity in the cutoff scores was induced by the TRUE of the diagnostic criteria or if it was just a coincidence. In contrast, Alvesalo et al. (21) used parental reports as their criteria and got a cutoff score far lower than the one in this study. More importantly, what criteria have the prior studies used to define "high dental anxiety"? What level of anxiety should be defined as "high" dental anxiety? It is a question currently with no conclusive standard. Therefore, clinical criteria run the risk of being subjectively defined, which causes difficulties when trying to compare the results of different studies.

The different mean scores and distributional patterns between populations in the previous studies indicate that some culture-related factors or country-specific factors exist. In Taiwan, the higher mean score may be in part because of insufficient oral health education. Several studies revealed that young children have a high prevalence of dental caries (8–10). The prevalence was about 75 percent among preschool children (8, 9), and 26.4 percent among first-year elementary students (10). The high prevalence of caries may increase the chances of experiencing pain and of a negative experience

during dental procedures. According to Rachman's three pathways theory (7), previous negative dental experience may be an important risk factor. In our findings, the type of school (private or public) did not show significant influence on the dental anxiety scores. But the results may also be explained by the absence of oral health education at all of the schools.

In our study, we found that there was no significant main effect between age levels, but a significant main effect between genders, and a significant interaction effect between age levels and gender. These findings are in agreement with the findings of studies in Finland (21), the Netherlands (19), and Japan (22). But those studies did not find the interaction effect that we found.

The influence of age could be partially explained by the cognitive and emotional development of children, but the possible cultural influences should not be overlooked (30). In addition, in contrast to the finding of Klingberg et al. (16) reporting that boys had higher anxiety levels in Sweden, higher dental anxiety scores were found in girls in Singapore (20), the United States (12, 15), and the Netherlands (19), as in the present study. Wogelius et al. (18), however, found no gender difference in the dental anxiety scores of a Danish population. The discrepancy might not be solely explained by gender role orientation; a cross-cultural study may be needed for a further comparison of those findings (30).

In this study, we found that age and gender could only explain 2.1 percent of the total variance in dental anxiety, indicating that some other factors not included in this study might play a major role in dental anxiety. Further investigation that includes other possible factors such as socioeconomic status, previous dental experiences, hygiene knowledge, personality traits, temperament, general fear of objects, and so on, is warranted.

Comparing this study's findings to previous findings, the top-ranked CFSS-DS items in this study were similar to the findings from a small Canadian Chinese sample (n = 70) reported by Milgrom et al. (23), a sample in Japan (22), and a low-income American sample (12), but were somewhat dissimilar to the findings from another small (n = 99) and younger (mean = 3.7 years) Yunnan (PRC) sample reported by Milgrom et al. (23), an older (aged 10 to 14) sample in Singapore (20), a Danish sample (17), a Netherlands sample (19), and a Finnish sample (21). Sample size, age range, cultural differences, or national conditions may have induced these inconsistencies. The consistency among these findings was that "injection" and "drilling" played an important role in the participating children's dental anxiety across all the countries, indicating that dental materials, tools, and techniques must be improved to decrease the anxiety of dental patients.

Although the children who received an injection were excluded from the pretest in this study, the proportion was small and may have had little influence on the estimation of the prevalence of child dental anxiety. The estimated prevalence of young children's dental anxiety in Taiwan seems relatively higher than that in the other countries where similar studies have been done. If the high prevalence of caries leads to an increase in negative attitudes toward dental treatment among young children, it once again suggests that the promotion of oral health education in Taiwan should be a top priority of dental health professionals. With the improvement of oral health behavior, we could reduce the vicious cycle between caries, negative dental experience, and dental anxiety. The high prevalence of dental anxiety in Taiwanese children suggests the urgent need for preventive health education and intervention programs aimed at promoting children's oral health and reducing dental anxiety level.

Finally, to our knowledge, this is the first study using an ROC curve to set the cutoff score. The Chinese parental version of the CFSS-DS modified by the authors for used in Taiwan proved to have optimal reliability and criterion validity.

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