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Prevalence and risk factors of children's dental anxiety in China: A longitudinal study

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ABSTRACT

Objectives Dental anxiety remains widespread among children, may continue into adulthood and affect their oral health-related quality of life and clinical management. The aim of the study was to explore the trend of children's dental anxiety over time and potential risk factors.

Design Longitudinal study

Methods Children aged between 5 and 12 years were investigated with the Chinese version of face version of Children's Fear Survey Schedule-Dental Subscale (CFSS-DS) and Frankl Behavior Rating scale from 2008 to 2017, and influential factors were explored.

Results Clinical data were available from 1061 children. Scores of CFSS-DS were negatively

correlated with the clinical behavior level of Frankl. The prevalence of dental anxiety is 11.59%. No significant differences in total CFSS-DS scores between females and males were found. 11-12-year-old children had significantly decreased scores compared to other age groups, and there was a decline in the scores of 8-10-year-old group over time. The factor analysis divided 15 items of CFSS-DS into four factors, and the total scores of 'less invasive oral procedures' items belonging to factor III decreased significantly over time in the 8-10-year-old group. This study is one of the few large longitudinal studies to report the change for children's dental anxiety in a new era of information.

Conclusions The results suggest that age is a significant determinant for children's dental anxiety, and dental anxiety outcomes have improved for Chinese children aged 8-10 years.

Strengths and limitations of this study

►We anticipate our study to be the first systematic longitudinal survey with representative data obtained for comparison of time trends of children dental anxiety in multiple age groups.

►The findings of this study have the potential to influence the direction and specific content of oral health promotion.

►The Chinese version CFSS-DS with facial image scale showed good applicability in clinical practice.

►Tri blindness paradigm was employed to avoid bias as much as possible.

►The sample size of this survey, the region and age range of the research objects are limited.

INTRODUCTON

Dental fear and anxiety refers to a feeling of dread and anticipation that something will happen, combined with a sense of losing control in relation to dentistry. Dental phobia is defined as a more severe form that leads to an out of proportion reaction and interferes with daily life [1]. A significant problem in patient management as such patients are more likely to avoid or delay dental treatment is related to dental anxiety, further leading to a vicious circle where the levels of dental anxiety are reinforced as a result of greater disease severity and greater dental treatment needs [2, 3]. Childhood dental anxiety has been shown to be widespread, and research has suggested the adults often acquire such fears in childhood [4], and the early-life social and biological factors have long-lasting effects on health later in life [5]. For many years, dental anxiety in children has been recognized as a source of problems in patient management [6]. Identifying anxiety in children at the earliest possible age is essential and helpful to select methods of behavior management.

The Dental Sub-scale of Children's Fear Survey Schedule (CFSS-DS) is a frequently used measure of children's dental anxiety [7]. Then the facial version CFSS-DS was first proposed by Arapostathis in 2007 [8]. In several countries, the scale has demonstrated good reliability and acceptable validity and has been used to estimate the prevalence of dental anxiety, and evaluate the behavior-management procedures used for child patients. The Chinese version CFSS-DS was established the cross-cultural adaptation and showed good psychometric properties [9]. The prevalence of dental anxiety according to CFSS-DS varies considerably in the international literature ranging from 2.4% to 28.3% in different populations and cultural backgrounds [10-13]. The etiology of dental anxiety is complex and multifactorial. To date, relatively few published

study evaluated the dental anxiety of children and behavioral influence factors in dental settings in china. Moreover, the trends of children's dental anxiety over time are poorly characterized. Developing dental anxiety questionnaires will thoroughly assist dentists and researchers to study the effectiveness of fear-reduction techniques. The objective of this research is to provide normative data on dental anxiety of Chinese children, and describe and compare the influence of relevant factors on dental anxiety in a decade.

METHODS

Ethical Approval-Permissions

The Ethics Committee of the Institute of Stomatological Research, Sun Yat-sen University, China, gave approval for the study. Parents were distributed informative leaflets about the procedure and were asked to provide written consent.

Chinese version CFSS-DS with FIS

The Chinese version CFSS-DS was adopted, which consists of 15 items and a five-point pictorial scale, that is, the Facial Image Scale (FIS). The FIS consists of five drawings of a face, displaying affective features ranging from extremely negative (score 5) through neutral to extremely positive (score 1). The total score ranges from 15 to 75. Children are presented with the five images and are asked to select which one best corresponds to how they are feeling. The FIS is a reliable and valid method for children's self-report of dental anxiety in subjects as young as three years old [14,

15]. In this study, the pilot test of Chinese version CFSS-DS with FIS was carried on 32 children and their parents, which revealed that young children were able to answer the CFSS-DS items with reference to the facial images.

Measures

Children's dental anxiety over the ten-year period was investigated, which was a randomized triple-blinded longitudinal study. The patients were selected randomly to participate in the study who were treated in the department of Pediatric Stomatology, affiliated Stomatology Hospital of Sun Yat-sen University. Inclusion criteria were children aged 5 to 12 years old; no mental retardation or developmental disorders; no cognitive impairment or psychiatric history; no serious congenital and acquired oral and maxillofacial deformities. Before entering the study, each parent and child were well informed about the purpose of the study and affirmed that participation was voluntary.

Upon entering the waiting room, the children were invited to complete the Chinese version CFSS-DS with FIS. Any child experiencing difficulty in reading the questions was assisted by the receptionist. At the same time, the parents (in almost all cases, the mother) provided a dental health questionnaire related to demographic information and previous dental experiences. The gender, age, and source of referral of the participants were recorded. After the completion of the CFSS-DS, the children were invited into the operatory for regular dental examination. The dentist and dental nurse were unaware of the children's responses to the questionnaire. During examinations, the behavior and facial expressions of the children were recorded by video cameras,

which were later rated according to the Frankl scale [16]. To ensure sample "blindness", the rater did not have access to the CFSS-DS scores of the children. We assigned the children with behaviors classified as "definitely positive" (the dentist and child share good rapport, the child is laughing) and "positive" (willingness to comply, cautiousness) to the cooperative group, whereas those with behaviors classified as "definitely negative" (fearful behavior, forceful crying) and "negative" (reluctance and/or uncooperativeness, but not as severe as in the previous category) were assigned to the uncooperative group.

Data Processing and Statistical Analysis

The data from all the children who had completed the Chinese version CFSS-DS and finished the dental examination on one occasion were used to provide normative data. If there is one item in one scale that is not answered, it will be treated as missing item, and the data of missing entries is replaced by the mean of the remaining samples with complete data; if there are two or more items that are not answered, it will be eliminated to the invalid scale.

Data management and analysis were conducted using SPSS version 16.0. The associations between CFSS-DS scores and demographic variables were analysed using the t-tests and one-way analysis of variances (ANOVA). When significant effects were found, Tukey post-hoc test was used to determine significant intergroup mean differences. Factor analysis (principal components, varimax rotation) was employed to assess the factor structure [17, 18], and factor scores above 0.5 indicate strong loading on a particular subset of items. Kruskal Wallis rank sum test was used to evaluate the differences of gender groups and age groups among three time periods. $P<0.05$ is

statistically significant.

RESULTS

Characterization of the sample

For the analysis of dental anxiety in children, the representative sample selected randomly who were treated in Department of Pediatric Stomatology, and 1061 copies of the effective scale were received from August 2008 to October 2017. Of those eligible, there were 533 (48.9%) male participants and 528 (49.8%) female participants. There was no significant difference in the ratio of patient's gender, or their evaluation of economic level by treatment status. 411 children aged 5-7 years accounted for 38.7%, 399 children aged 8-10 years accounted for 37.6% and 251 aged 11-12 years accounted for 23.7%. The mean age of the children was 7.8 years (SD 1.7). Gender and age distributions remained stable over time, with increasing proportions of respondents in higher family income categories.

From the 1061 children assessed, 238 were allocated to the uncooperative group and of the remaining 833 children were allocated to the cooperative group according to the Frankl scale. The distribution patterns of CFSS-DS scores were very different between the two groups (Table 1). The results showed that the CFSS-DS scores were correlated negatively with the Frankl behavior level. That is, there is a certain consistency between the CFSS-DS score and the clinical performance.

Table 1 CFSS-DS scores and the children behavior in the Frankl scale

Scores	Behavior classification N (%)	
	Cooperative group	Uncooperative group
≦32’	603 (72.4%)	28 (11.8%)
32’-38’	196 (23.5%)	137 (57.6%)
≧38’	34 (4.1%)	73 (30.7%)
Total	833	238

Dental anxiety of children and time factor

Table 2 shows the 1061 participants’ scores in the CFSS-DS to dental practice events. Items that over 25% children felt “very afraid” or “quite afraid” were “Dentist drilling” (46.84%), “Injection” (29.5%) and “Choking” (26.2%). Range of total CFSS-DS score was 16~66. The mean total CFSS-DS score for all children was 24.8±10.3. We assigned those children with CFSS-DS total score below 33 to ‘non-fearful range’, scores between 33 and 37 to ‘borderline range’, and scores of 38 and higher as ‘fearful range’. From the children assessed, 823 (77.57%) were rated as the non-fearful range, with the mean CFSS-DS total score of 21.6, 115 (10.84%) were rated as the borderline range with the mean CFSS-DS total score 32.6 and 123 (11.59%) were rated as fearful range, with mean CFSS-DS total score 38.7. Therefore, the prevalence of dental anxiety in this sample is 11.59%, and 88.41% of the children did not suffer from it.

Table 2 Children’s dental anxiety in the Chinese version CFSS-DS

Items		Total (N=1061)				
		Not afraid	A little afraid	Fairly afraid	Quite afraid	Very afraid
1	Dentists	461（43.44%）	324（30.54%）	131（12.35%）	65（6.13%）	80（7.54%）
2	Doctors	528（49.76%）	290（27.33%）	94（8.86%）	65（6.13%）	84（7.92%）
3	Injections	268（25.26%）	281（26.48%）	199（18.76%）	144（13.57%）	169（15.93%）
4	Having someone examine your mouth	519（48.92%）	334（31.48%）	163（15.36%）	27（2.54%）	18（1.70%）
5	Having to open your mouth	741（69.84%）	192（18.10%）	97（9.14%）	15（1.41%）	16（1.51%）
6	Having a stranger touch you	262（24.69%）	299（28.18%）	243（22.90%）	136（12.82%）	121（11.40%）

7	Having somebody look at you	504（47.50%）	293（27.62%）	187（17.62%）	62（5.84%）	15（1.41%）
8	Dentist drilling	109（10.27%）	203（19.13%）	252（23.75%）	241（22.71%）	256（24.13%）
9	Sight of the dentist drilling	431（40.62%）	237（22.33%）	183（17.25%）	134（12.63%）	76（7.16%）
10	Noise of the dentist drilling	369（34.78%）	303（28.56%）	154（14.51%）	90（8.48%）	145（13.67%）
11	Having somebody put instruments in your mouth	416（39.21%）	237（22.34%）	175（16.49%）	113（10.65%）	120（11.31%）
12	Choking	351（33.08%）	313（29.50%）	119（11.22%）	156（14.70%）	122（11.50%）
13	Having to go to the hospital	454（42.79%）	308（29.03%）	204（19.23%）	29（2.73%）	66（6.22%）
14	People in white uniforms	649（61.17%）	157（14.80%）	147（13.85%）	76（7.16%）	32（3.02%）
15	Having the nurse clean your teeth	582（54.86%）	149（14.04%）	175（16.49%）	69（6.50%）	86（8.11%）

N total number of children

The results in Table 3 show that the CFSS-DS scores of gender groups and age groups between 2008 and 2017. There was no statistical difference in CFSS-DS scores between males and females, and within the two groups among the three time periods during ten years, indicating that there was no significant correlation between gender and dental anxiety (Fig. 1a). On the other hand, age was statistically significantly related to CFSS-DS score. The overall data indicated that 11-12-year-old children had significantly decreased scores compared to other age groups. Over time, there was a decline of the CFSS-DS scores in 8-10-year-old group. The children of this group in 2015-2017 were found with significantly lower CFSS-DS score compared with peers in 2008-2011 (Fig. 1b, p =0.019). The other two age groups did not show significant trends over time.

Table 3 Mean CFSS-DS scores by gender and age

	2008-2011		**2012-2014**		**2015-2017**	
	N=299		N=367		N=395	
Variables	N (%)	CFSS-DS score Mean (SD)	N (%)	CFSS-DS score Mean (SD)	N (%)	CFSS-DS score Mean (SD)
Gender						
Male	152 (50.8%)	25.3 (10.2)	172 (46.9%)	26.0 (10.1)	209 (52.9%)	23.6 (10.3)
Female	147 (49.2%)	23.4 (9.9)	195 (53.1%)	25.4 (9.9)	186 (47.1%)	24.9 (10.5)

Age (years)						
5-7	113 (37.8%)	28.1 (9.7)	148 (40.3%)	29.6 (10.2)	180 (45.6%)	29.3 (10.3)
8-10	110 (36.8%)	24.6 (10.4)	143 (39.0%)	23.9 (9.8)	146 (37.0%)	**20.2** (10.6)*
11-12	76 (25.4%)	18.6 (10.4)	76 (20.7%)	21.5 (10.1)	69 (20.1%)	19.4 (10.3)
Mean		24.4 (10.0)		25.7 (10.2)		24.2 (10.4)

N total number of children; SD Standard Deviation

Fig. 1. CFSS-DS scores by gender and age. *Statistically significant ($p < 0.05$)

Factor analysis

This study conducted factor analysis of the Chinese version CFSS-DS (maximum variation method). The 15 items were divided into four factors, which accounted for 58.7% of the total scale variance. Factor I, accounting for 22.6% of the variance, consists of items pertaining to highly invasive dental procedures, such as “Dentists” and “Drilling”. Factor II consists of items related to general medical aspects of treatment, such as “Doctors”. Factor III consists of items pertaining to less invasive procedures and potential ‘victimization’, such as “Having someone examine your mouth”. Factor IV consists of items related to the distrust of strangers or unfamiliar objects, which were unrelated to general medical aspects of treatment, such as “Having a stranger touch you”. Corrected item-domain correlation ranged from 0.58 to 0.90. A certain logical relationship among the items in the same factors was observed. When stratified analysis was carried out for children in the 8-10-year-old group, the anxiety level of ‘less invasive oral procedures’ items belonging to the factor III tend to decrease over time and children in 2015-2017 reported significantly lower CFSS-DS scores as compared with those in 2008-2011 (Table 4, p =0.041).

Table 4 Factor analysis and scores of items with respect to the factors in 8-10y age group

Rotated CFSS–DS factor matrix		**Factors** (% total scale variance)				**Mean CFSS-DS score** of 8-10-year-old children		
	Items in CFSS-DS	**I** (22.6)	**II** (17.3)	**III** (12.1)	**IV** (7.9)	2008-2011	2012-2014	2015-2017
I	**Highly invasive dental procedures**							
1	Dentists	**0.492**	0.451	0.285	0.031			
8	Dentist drilling	**0.816**	0.187	0.123	0.074			
9	Sight of the dentist drilling	**0.792**	0.113	0.084	0.165			
10	Noise of the dentist drilling	**0.608**	0.242	0.136	0.045	12.63	12.06	11.08
11	Having somebody put instruments in your mouth	**0.714**	0.138	0.202	0.087			
12	Choking	**0.513**	0.311	-0.146	0.378			
15	Having the nurse clean your teeth	**0.442**	0.191	0.285	0.011			
II	**General medical aspects of treatment**							
2	Doctors	0.341	**0.568**	0.099	0.151			
3	Injections	0.124	**0.633**	0.021	0.012	5.31	6.21	5.23
13	Having to go to the hospital	0.169	**0.696**	0.118	0.156			
14	People in white uniforms	0.086	**0.618**	0.304	0.077			
III	**Less invasive procedures and potential 'victimization'**							
4	Having someone examine your mouth	0.256	0.303	**0.764**	0.099	4.15	3.01	**2.03***
5	Having to open your mouth	0.233	0.034	**0.657**	0.113			
IV	**Distrust of strangers or unfamiliar objects**							
6	Having a stranger touch you	0.201	0.189	-0.037	**0.821**	2.59	2.72	2.56
7	Having somebody look at you	0.021	0.016	0.270	**0.807**			

*Statistically significant ($p < 0.05$)

DISCUSSION

Children commonly experience anxiety when receiving professional dental treatment. Effectively recognizing an anxious patient, while being based on the validity of clinical observations is a recognized problem for both dentists and researchers. CFSS-DS is an international survey tool for children's dental anxiety that covers basically all aspects of dental events and can be used for epidemiological investigations, controlled trials, and longitudinal prospective studies. This study adopted the Chinese version CFSS-DS that has undergone cross-cultural adaptation, and the results showed that the high rate of the scale recovery and the low rate of missing items indicating

good feasibility. Children may be well able to assess their fear using the faces version CFSS-DS, however, their incomprehension of the content of individual items is the main reason for the lack of data, which focused on item 12 “Chocking”. In addition, It was found that in the preliminary test children aged 4 and below can not accurately grasp the meaning of most items. This study believes that as a self-assessment scale, CFSS-DS must be understood by the surveyed population. In view of this, this study selected 5 to 12 years old children as the survey objects.

In this study, there is a negative correlation between the anxiety level of children obtained by the CFSS-DS and the clinical behavior classification, indicating that children with high anxiety levels have poor clinical cooperation. Our finding suggested that, the distribution patterns of the total CFSS-DS scores were clearly different between the clinical behavior groups according to Frankl scale. In the cooperative group, although the younger child patients exhibited high scores of dental anxiety, they had the potential to overcome their resistance behaviors of dental treatment, indicating that cooperative patients can have hidden dental anxiety. Therefore, even in the face of cooperative children during dental treatment, it should be taken into account that clinicians may be required to implement appropriate behavioral induction measures to reduce dental anxiety. It has been suggested that dental anxiety decreases with repeated exposure to dental procedures [19]. However, in the uncooperative group older children seemed not to be able to overcome their dental anxiety, which caused behavior management problems. At this time more risk factors should be considered, such as previous medical experience, family structure, etc.

Demographically this study found no difference in dental anxiety between females and males, that is supported by previous studies [10, 20-21]. This is however contrary to other studies which have reported more girls than boys in the anxious group [8, 22, 23]. Contradictory research

findings may be explained by different study designs and methods of data collection, moreover, gender influences should be regarded in combination with other factors such as local culture and socioeconomic status of the family.

Bad dental experience is considered as one of life-long stress situations for children [24]. As cultural and social behavioral norms can affect the development and expression of children's dental anxiety, and as dental care systems can vary considerably across cultures, normative data in each culture are needed. The main strength of this study was the continuous assessment over a 10-year period, which provides information on the development and progression of dental anxiety during the important life course, when children transition from the primary to the permanent dentition and mental state grows enormously. To our knowledge, this is the first study to use representative data from China for comparison of time trends of children dental anxiety in multiple age groups. The study showed that dental anxiety seems to decrease with increasing age and this is in agreement with previous studies [22]. The results showed that 8-10-year-old children recent years exhibited less fear and anxiety in dental procedures compared with children of the same age in the initial period of this study, indicating that the change in social environment experienced in these years influences the incidence and progression of dental anxiety and its outcomes have improved for children in Guangdong Province. The researchers conclude that the possible reasons for these findings would be the oral health education in the mass media, especially the Internet, which has enhanced the cognition and acceptance of oral treatment for the older children. But the effect was not obvious to preschool children because of their limited cognitive ability. However, children dental anxiety were influenced by a multiplicity of interacting environmental factors including words and deeds of people around; any single influence is

dubious to clarify much divergence. So the positive trend of parents towards dental procedures may be passed on to children indirectly, which may also be due to the growing public awareness.

Factor analyses, which are conventionally used to evaluate the construct validity of scales, have been previously reported in CFSS-DS studies of different populations. In Netherlands and Finland, investigators divided the scale items into three factors, and the connotation of them were as follows: 1) fear of highly invasive procedures, 2) fear of potential 'victimization' and 3) fear of less invasive procedures [17]. In the present research, factor analysis resulted in four factors. There were 1) fear of highly invasive dental procedures, 2) fear of general medical aspects of treatment, 3) fear of less invasive procedures and potential 'victimization', and 4) fear of strangers or unfamiliar objects. Despite minor differences in populations and methods, similar results were found in the aforementioned studies in other cultures [4, 25], indicating that the setting of psychological and behavioral scale conforms to the theoretical conception of the design in this study. The results of factor analysis also provided some support for the conclusion above: the less invasive oral operation items (Factor III) showed the trend of decreasing dental anxiety scores, while the changes of other factors were not significant. It can be explained that the image output in oral health publicity is indeed considered to make patients have a certain degree of familiarity with the treatment situation before coming to the hospital, so as to reduce the anxiety tendency to a certain extent. This also suggests that future public oral health publicity should be introduced to the scene of positive emotional feedback from the characters about the sight and noise of the "drilling", in order to further reduce the public's fear of specific dental operations.

The limitation to our study design should be pointed out. The sample was taken from a single medical institution, which the group of children represented by are more inclined to show the

behavior of visiting a dentist, probably because of lower levels of dental anxiety [26]. Hence, a school sample is generally considered more representative. Future studies are required to further relate CFSS-DS scores to broader risk factors and/or physiological observations of children during dental treatment, then the tool will help clinicians recognize children in need of extra attention and subsequently select the most appropriate treatment approach and evaluate the outcome of interventions.

CONCLUSIONS

The assessment in this study provides an overall picture of dental anxiety in Chinese-speaking populations, age is significant determinant for children's dental anxiety. Furthermore, in recent years, parts of children's dental anxiety tends to decrease with time.

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Contributors SG contributed to the data analysis and manuscript preparation. JL and PL contributed to the material preparation and data collection. WZ and DY supervised the data collection, data analysis and critical revisions. All authors contributed to the study conception and design and approved the final manuscript.

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Competing interests None declared.

Ethical approval and consent to participate All procedures performed involving human participants were in

accordance with the ethical standards of the institutional research committee. Informed written consent was taken from parents of each participating child.

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Data availability statement The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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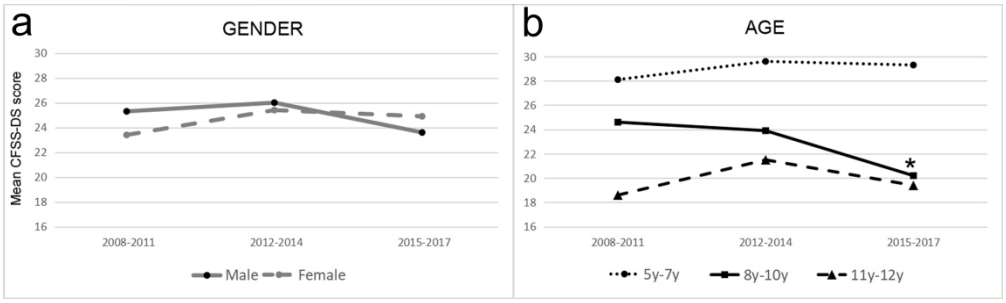

Fig. 1. CFSS-DS scores by gender and age. *Statistically significant ($p < 0.05$)

173x51mm (600 x 600 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	5-6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	5-6
Study size	10	Explain how the study size was arrived at	5-6

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-7
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	5-6
		(*e*) Describe any sensitivity analyses	6

Continued on next page

Results			
Participants	13 *	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	6-7
		(c) Consider use of a flow diagram	
Descriptive data	14 *	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	7-8
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	7
Outcome data	15 *	*Cohort study*—Report numbers of outcome events or summary measures over time	*7-10*
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-10
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Prevalence and risk factors of children's dental anxiety in China: A longitudinal study

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Prevalence and risk factors of children's dental anxiety in China: A longitudinal study

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ABSTRACT

Objectives Dental anxiety remains widespread among children, may continue into adulthood and affect their oral health-related quality of life and clinical management. The aim of the study was to explore the trend of children's dental anxiety over time and potential risk factors.

Design Longitudinal study

Methods Children aged between 5 and 12 years were investigated with the Chinese version of face version of Children's Fear Survey Schedule-Dental Subscale (CFSS-DS) and Frankl Behavior Rating scale from 2008 to 2017, and influential factors were explored.

Results Clinical data were available from 1061 children, including 533 (50.2%) male participants and 528 (49.8%) female participants. The total CFSS-DS scores ranged from 16 to 66, with a mean of 24.8±10.3. The prevalence of dental anxiety is 11.59%. No significant differences in total CFSS-DS scores between females and males were found. According to the Frankl scale, 238 children were allocated to the uncooperative group and the remaining 823 children were allocated to the cooperative group. Scores of CFSS-DS were negatively correlated with the clinical behavior level of Frankl. 11-12-year-old children had significantly decreased scores compared to other age groups, and there was a decline in the scores of 8-10-year-old group over time. The factor analysis divided 15 items of CFSS-DS into four factors, and the total scores of 'less invasive oral procedures' items belonging to factor III decreased significantly over time in the 8-10-year-old group.

Conclusions Age is a significant determinant for children's dental anxiety, and dental anxiety outcomes have improved for Chinese children aged 8-10 years. This study is one of the few reports on changes of children dental anxiety in a new era of information, but the results may be extrapolated to other populations with caution.

Strengths and limitations of this study

►This study is a systematic longitudinal survey with representative data obtained for comparison of time trends of children dental anxiety in multiple age groups.

►The duration of this observational study spanned a decade.

►The Chinese version CFSS-DS with facial image scale showed good applicability in clinical practice.

►Tri blindness paradigm was employed to avoid bias as much as possible.

►The sample size of this survey, the region and age range of the research objects are limited.

INTRODUCTON

Dental fear and anxiety refers to a feeling of dread and anticipation that something will happen, combined with a sense of losing control in relation to dentistry. Dental phobia is defined as a more severe form that leads to an out of proportion reaction and interferes with daily life [1]. A significant problem in patient management as such patients are more likely to avoid or delay dental treatment is related to dental anxiety, further leading to a vicious circle where the levels of dental anxiety are reinforced as a result of greater disease severity and greater dental treatment needs [2, 3].

Childhood dental anxiety has been shown to be widespread, and research has suggested the adults often acquire such fears in childhood [4], and the early-life social and biological factors have long-lasting effects on health later in life [5]. Child's dental anxiety predicts more dental disease and poorer oral health in measures, such as decay experience, the presence of untreated dental infection and treatment that carries more risk, that results in a detrimental effect on the quality of the life of the individual and family and engagement in oral health-related behaviours [6, 7]. For many years, dental anxiety in children has been recognized as a source of problems in

patient management [8]. Identifying anxiety in children at the earliest possible age is essential and helpful to select methods of behavior management. In the literature of recent years, there is considerable variation in the designs of study and target populations, particularly in the scales used for measurement and the age of the children, so that the reported prevalence of dental fear and anxiety in children varies widely, ranging from 7.4% [9] to 93.8% [10]. It can be said that there is currently no fully ideal dental anxiety scale for children in use. Efforts should therefore continue to be directed towards the development and validation of suitable instruments for the detection of dental anxiety in children.

The Dental Sub-scale of Children's Fear Survey Schedule (CFSS-DS) is a frequently used measure of children's dental anxiety [11]. Then the facial version CFSS-DS was first proposed by Arapostathis in 2007 [12]. In several countries, the scale has demonstrated good reliability and acceptable validity and has been used to estimate the prevalence of dental anxiety, and evaluate the behavior-management procedures used for child patients. The Chinese version CFSS-DS was established the cross-cultural adaptation and showed good psychometric properties [13]. The prevalence of dental anxiety according to CFSS-DS varies considerably in the international literature ranging from 2.4% to 28.3% in different populations and cultural backgrounds [9, 14-16].

The etiology of dental anxiety is complex and multifactorial. Numerous factors were discussed as influences of children dental anxiety, with socioeconomic factors, general health, dental history and caregiver status being frequently included aspects [17]. Poor oral health and hygiene behavior, unstable general health and parents' high dental anxiety were found to be associated with elevated levels of children dental anxiety. Children with toothache or caries have

higher chance of dental anxiety [18]. Patterns of dental visits and previous experiences have also important impact in dental fear occurrence [19]. Studies demonstrated that subjects with higher social and financial resources show lower prevalence of dental anxiety [20]. The potential risk factors of dental anxiety are likely to be different from each person. Thus, further investigation into intrinsic and environmental factors associated with dental anxiety is needed. To date, relatively few published study evaluated the dental anxiety of children and behavioral influence factors in dental settings in China. Moreover, the trends of children's dental anxiety over time are poorly characterized. The objective of this research is to provide normative data on dental anxiety of Chinese children, and describe and compare the influence of relevant factors on dental anxiety in a decade.

METHODS

Participants and procedures

The study was conducted at the department of Pediatric Stomatology, affiliated Stomatology Hospital of Sun Yat-sen University, during 10 years (August 2008 - October 2017). The children patients aged 5 to 12 years old were selected randomly to participate in the study. Inclusion criteria were children with no mental retardation or developmental disorders; no cognitive impairment or psychiatric history; no serious congenital and acquired oral and maxillofacial deformities. The Ethics Committee of the Institute of Stomatological Research, Sun Yat-sen University, China, gave approval for the study. Before entering the study, each parent and child were well informed about the purpose of the study and affirmed that participation was voluntary.

Parents were distributed informative leaflets about the procedure and were asked to provide written consent.

Chinese version CFSS-DS with FIS

The Chinese version CFSS-DS was adopted, which consists of 15 items and a five-point pictorial scale, that is, the Facial Image Scale (FIS). The FIS consists of five drawings of a face, displaying affective features ranging from extremely negative (score 5) through neutral to extremely positive (score 1). The total score ranges from 15 to 75. Children are presented with the five images and are asked to select which one best corresponds to how they are feeling. The FIS is a reliable and valid method for children's self-report of dental anxiety in subjects as young as three years old [21, 22]. In this study, the pilot test of Chinese version CFSS-DS with FIS was carried on 32 children and their parents, in order to clarify whether young children could answer the CFSS-DS items with reference to the facial images (results not shown).

Measures

Children's dental anxiety over the ten-year period was investigated, which was a randomized triple-blinded longitudinal study. Data collection included children's completion of the Chinese version CFSS-DS with FIS and evaluation of behavior during dental visit. Upon entering the waiting room, the children were invited to fill in the Chinese version CFSS-DS with FIS. Any child experiencing difficulty in reading the questions was assisted by the receptionist. At the same time, the parents (in almost all cases, the mother) provided a dental health questionnaire related to

demographic information and previous dental experiences. The gender, age, and source of referral of the participants were recorded. After the completion of the CFSS-DS, the children were invited into the operatory for regular dental examination. The dentist and dental nurse were unaware of the children's responses to the questionnaire. During examinations, the behavior and facial expressions of the children were recorded by video cameras, which were later rated according to the Frankl scale [23]. To ensure sample "blindness", the rater did not have access to the CFSS-DS scores of the children and assigned the children with behaviors classified as "definitely positive" (the dentist and child share good rapport, the child is laughing) and "positive" (willingness to comply, cautiousness) to the cooperative group, whereas those with behaviors classified as "definitely negative" (fearful behavior, forceful crying) and "negative" (reluctance and/or uncooperativeness, but not as severe as in the previous category) were assigned to the uncooperative group.

Data Processing and Statistical Analysis

The data from all the children who had completed the Chinese version CFSS-DS and finished the dental examination on one occasion were used to provide normative data. If there is one item in one scale that is not answered, it will be treated as missing item, and the data of missing entries is replaced by the mean of the remaining samples with complete data; if there are two or more items that are not answered, it will be eliminated to the invalid scale.

Data management and analysis were conducted using SPSS version 16.0. The associations between CFSS-DS scores and demographic variables were analysed using the t-tests and one-way

analysis of variances (ANOVA). When significant effects were found, Tukey post-hoc test was used to determine significant intergroup mean differences. Factor analysis (principal components, varimax rotation) was employed to assess the factor structure [24, 25], and factor scores above 0.5 indicate strong loading on a particular subset of items. Kruskal Wallis rank sum test was used to evaluate the differences of gender groups and age groups among three time periods. $p<0.05$ is statistically significant.

Patient and public involvement

Participation in this survey is voluntary for each child and his/her parents. The receptionists or assistants helped understand the items and complete the scale. The children and their parents were not involved in the design, recruitment or conduct of the study.

RESULTS

Characterization of the sample

For the analysis of dental anxiety in children, the representative sample selected randomly who were treated in Department of Pediatric Stomatology, and 1061 copies of the effective scale were received from August 2008 to October 2017. Of those eligible, there were 533 (50.2%) male participants and 528 (49.8%) female participants. There was no significant difference in the ratio of patient's gender, or their evaluation of economic level by treatment status. 411 children aged 5-7 years accounted for 38.7%, 399 children aged 8-10 years accounted for 37.6% and 251 aged

11-12 years accounted for 23.7% (Table 1). The mean age of the children was 7.8 years (SD 1.7). Gender and age distributions remained stable over time, with increasing proportions of respondents in higher family income categories.

Table 1 Gender and age distribution of the survey sample

Sample characteristics		N	%
Age(y)	5-7	411	38.7
	8-10	399	37.6
	11-12	251	23.7
Gender	Female	528	49.8
	Male	533	50.2

N total number of children

Dental anxiety of children and Behavior classification

Table 2 shows the 1061 participants' scores in the CFSS-DS to dental practice events. Items that over 25% children felt "very afraid" or "quite afraid" were "Dentist drilling" (46.84%), "Injection" (29.50%) and "Choking" (26.20%). Range of total CFSS-DS scores was 16~66. The mean total CFSS-DS scores for all children was 24.8±10.3. We assigned those children with CFSS-DS total scores equal to and below 32 to 'non-fearful range', scores between 32 and 38 to 'borderline range', and scores of 38 and higher as 'fearful range' [14, 26-32]. From the children assessed, 605 children (57.02%) were rated as the non-fearful range, 333 (31.39%) were rated as the borderline range and 123 (11.59%) were rated as fearful range. Therefore, the prevalence of

dental anxiety in this sample is 11.59%, and 88.41% of the children did not suffer from it. According to the Frankl scale, 238 children assessed were allocated to the uncooperative group and the remaining 823 children were allocated to the cooperative group. The distribution patterns of CFSS-DS scores were very different between the two groups. Children of the uncooperative group tended to report dental anxiety, as compared with cooperative children (30.67% vs. 6.08%) (Table 3). The results showed that the CFSS-DS scores were correlated negatively with the Frankl behavior level. That is, there is a certain consistency between the CFSS-DS score and the clinical performance.

Table 2 Children's dental anxiety in the Chinese version CFSS-DS

		Total (N=1061)				
Items		Not afraid	A little afraid	Fairly afraid	Quite afraid	Very afraid
1	Dentists	461（43.44%）	324（30.54%）	131（12.35%）	65（6.13%）	80（7.54%）
2	Doctors	528（49.76%）	290（27.33%）	94（8.86%）	65（6.13%）	84（7.92%）
3	Injections	268（25.26%）	281（26.48%）	199（18.76%）	144（13.57%）	169（15.93%）
4	Having someone examine your mouth	519（48.92%）	334（31.48%）	163（15.36%）	27（2.54%）	18（1.70%）
5	Having to open your mouth	741（69.84%）	192（18.10%）	97（9.14%）	15（1.41%）	16（1.51%）
6	Having a stranger touch you	262（24.69%）	299（28.18%）	243（22.90%）	136（12.82%）	121（11.40%）
7	Having somebody look at you	504（47.50%）	293（27.62%）	187（17.62%）	62（5.84%）	15（1.41%）
8	Dentist drilling	109（10.27%）	203（19.13%）	252（23.75%）	241（22.71%）	256（24.13%）
9	Sight of the dentist drilling	431（40.62%）	237（22.33%）	183（17.25%）	134（12.63%）	76（7.16%）
10	Noise of the dentist drilling	369（34.78%）	303（28.56%）	154（14.51%）	90（8.48%）	145（13.67%）
11	Having somebody put instruments in your mouth	416（39.21%）	237（22.34%）	175（16.49%）	113（10.65%）	120（11.31%）
12	Choking	351（33.08%）	313（29.50%）	119（11.22%）	156（14.70%）	122（11.50%）
13	Having to go to the hospital	454（42.79%）	308（29.03%）	204（19.23%）	29（2.73%）	66（6.22%）

14	People in white uniforms	649（61.17%）	157（14.80%）	147（13.85%）	76（7.16%）	32（3.02%）
15	Having the nurse clean your teeth	582（54.86%）	149（14.04%）	175（16.49%）	69（6.50%）	86（8.11%）

N total number of children

Table 3 CFSS-DS scores and the children behavior in the Frankl scale

CFSS-DS Scores	Behavior classification		Total
	Cooperative group	Uncooperative group	
≦32’	577 (70.11%)	28 (11.76%)	605 (57.02%)
32’-38’	196 (23.82%)	137 (57.56%)	333 (31.39%)
≧38’	50 (6.08%)	73 (30.67%)	123 (11.59%)
Total	823	238	1061

N total number of children

Dental anxiety of children and gender, age and time factors

The results in Table 4 show that the CFSS-DS scores of gender groups and age groups between 2008 and 2017. There was no statistical difference in CFSS-DS scores between males and females, and within the two groups among the three time periods during ten years, indicating that there was no significant correlation between gender and dental anxiety (Fig. 1a). On the other hand, age was statistically significantly related to CFSS-DS score. The overall data indicated that 11-12-year-old children had significantly decreased scores compared to other age groups. Over time, there was a decline of the CFSS-DS scores in 8-10-year-old group. The children of this group in 2015-2017 were found with significantly lower CFSS-DS score compared with peers in 2008-2011 (Fig. 1b, p =0.019). The other two age groups did not show significant trends over time.

Table 4 Mean CFSS-DS scores by gender and age

	2008-2011		2012-2014		2015-2017	
	N=299		N=367		N=395	
Variables	N (%)	CFSS-DS score Mean (SD)	N (%)	CFSS-DS score Mean (SD)	N (%)	CFSS-DS score Mean (SD)
Gender						
Male	152 (50.8%)	25.3 (10.2)	172 (46.9%)	26.0 (10.1)	209 (52.9%)	23.6 (10.3)
Female	147 (49.2%)	23.4 (9.9)	195 (53.1%)	25.4 (9.9)	186 (47.1%)	24.9 (10.5)
Age (years)						
5-7	113 (37.8%)	28.1 (9.7)	148 (40.3%)	29.6 (10.2)	180 (45.6%)	29.3 (10.3)
8-10	110 (36.8%)	24.6 (10.4)	143 (39.0%)	23.9 (9.8)	146 (37.0%)	**20.2** (10.6)*
11-12	76 (25.4%)	18.6 (10.4)	76 (20.7%)	21.5 (10.1)	69 (17.4%)	19.4 (10.3)
Mean		24.4 (10.0)		25.7 (10.2)		24.2 (10.4)

N total number of children; SD Standard Deviation

Fig. 1. CFSS-DS scores by gender and age. *Statistically significant ($p < 0.05$)

Factor analysis

This study conducted factor analysis of the Chinese version CFSS-DS (maximum variation method). The 15 items were divided into four factors, which accounted for 58.7% of the total scale variance. Factor I, accounting for 22.6% of the variance, consists of items pertaining to highly invasive dental procedures, such as “Dentists” and “Drilling”. Factor II consists of items related to general medical aspects of treatment, such as “Doctors”. Factor III consists of items pertaining to less invasive procedures and potential ‘victimization’, such as “Having someone examine your mouth”. Factor IV consists of items related to the distrust of strangers or unfamiliar objects, which were unrelated to general medical aspects of treatment, such as “Having a stranger touch you”. Corrected item-domain correlation ranged from 0.58 to 0.90. A certain logical relationship among

the items in the same factors was observed. When stratified analysis was carried out for children in the 8-10-year-old group, the anxiety level of 'less invasive oral procedures' items belonging to the factor III tend to decrease over time and children in 2015-2017 reported significantly lower CFSS-DS scores as compared with those in 2008-2011 (Table 5, p =0.041).

Table 5 Factor analysis and scores of items with respect to the factors in 8-10y age group

Rotated CFSS–DS factor matrix		**Factors** (% total scale variance)				**Mean CFSS-DS score** of 8-10-year-old children		
	Items in CFSS-DS	**I** (22.6)	**II** (17.3)	**III** (12.1)	**IV** (7.9)	2008-2011	2012-2014	2015-2017
I	**Highly invasive dental procedures**							
1	Dentists	**0.492**	0.451	0.285	0.031			
8	Dentist drilling	**0.816**	0.187	0.123	0.074			
9	Sight of the dentist drilling	**0.792**	0.113	0.084	0.165	12.63	12.06	11.08
10	Noise of the dentist drilling	**0.608**	0.242	0.136	0.045			
11	Having somebody put instruments in your mouth	**0.714**	0.138	0.202	0.087			
12	Choking	**0.513**	0.311	-0.146	0.378			
15	Having the nurse clean your teeth	**0.442**	0.191	0.285	0.011			
II	**General medical aspects of treatment**							
2	Doctors	0.341	**0.568**	0.099	0.151	5.31	6.21	5.23
3	Injections	0.124	**0.633**	0.021	0.012			
13	Having to go to the hospital	0.169	**0.696**	0.118	0.156			
14	People in white uniforms	0.086	**0.618**	0.304	0.077			
III	**Less invasive procedures and potential 'victimization'**							
4	Having someone examine your mouth	0.256	0.303	**0.764**	0.099	4.15	3.01	**2.03***
5	Having to open your mouth	0.233	0.034	**0.657**	0.113			
IV	**Distrust of strangers or unfamiliar objects**							
6	Having a stranger touch you	0.201	0.189	-0.037	**0.821**	2.59	2.72	2.56
7	Having somebody look at you	0.021	0.016	0.270	**0.807**			

*Statistically significant ($p < 0.05$)

DISCUSSION

Children commonly experience anxiety when receiving professional dental treatment. Effectively recognizing an anxious patient, while being based on the validity of clinical observations is a recognized problem for both dentists and researchers. CFSS-DS is an international survey tool for children's dental anxiety that covers basically all aspects of dental events and can be used for epidemiological investigations, controlled trials, and longitudinal prospective studies. This study adopted the Chinese version CFSS-DS that has undergone cross-cultural adaptation, and the results showed that the high rate of the scale recovery and the low rate of missing items indicating good feasibility. Children may be well able to assess their fear using the faces version CFSS-DS, however, their incomprehension of the content of individual items is the main reason for the lack of data, which focused on item 12 "Chocking". In addition, It was found that in the preliminary test children aged 4 and below can not accurately grasp the meaning of most items. This study believes that as a self-assessment scale, CFSS-DS must be understood by the surveyed population. In view of this, this study selected 5 to 12 years old children as the survey objects.

In this study, there is a negative correlation between the anxiety level of children obtained by the CFSS-DS and the clinical behavior classification, indicating that children with high anxiety levels have poor clinical cooperation. Our finding suggested that, the distribution patterns of the total CFSS-DS scores were clearly different between the clinical behavior groups according to Frankl scale. In the cooperative group, although the younger child patients exhibited high scores of dental anxiety, they had the potential to overcome their resistance behaviors of dental treatment, indicating that cooperative patients can have hidden dental anxiety. Therefore, even in the face of cooperative children during dental treatment, it should be taken into account that clinicians may be

required to implement appropriate behavioral induction measures to reduce dental anxiety. It has been suggested that dental anxiety decreases with repeated exposure to dental procedures [33]. However, in the uncooperative group older children seemed not to be able to overcome their dental anxiety, which caused behavior management problems. At this time more risk factors should be considered, such as previous medical experience, family structure, etc.

The CFSS-DS scores in the international literature in recent years varies with different populations and dental situations. The mean score in the present study was 24.8±10.3, which was comparatively lower than scores from studies in Brazil (29.3±10.5) [34], Hong Kong (29.1±11.0) [16], Greece (27.1±10.8) [14], Egypt (26.09±10.70) [26] and Jeddah, Saudi Arabia (25.99 ± 9.3) [17]. CFSS-DS scores in the current study did not differ greatly from data from these previous studies, that may be due to the similar age range of the subjects and different cultural parameters.

It is necessary to determine the cut-off point for distinguishing between children who are more prone to dental anxiety that is helpful for clinicians to choose appropriate behavior management measures. Generally, dental anxiety is measured according to clear cut-off points on continuous measure that acts as a categorical boundary. In view of the balance of the sensitivity and specificity in the measurement of scale, different prevalence estimates depend on the different cut-off values used to define "dental anxiety". Children dental anxiety cut-off points on CFSS-DS are already defined in several researches, but the conclusions are not all the same. In the present study, the participated children with CFSS-DS scores of 38 and higher [26-32] were considered as dentally anxious. There is still a need for further research to find more desirable instrument for understanding the dental anxiety of children and adolescents.

Demographically this study found no difference in dental anxiety between females and males, that is supported by previous studies [14, 20, 34-39]. This is however contrary to other studies which have reported more girls than boys in the anxious group [12, 17, 26]. Contradictory research findings may be explained by different study designs and methods of data collection, moreover, gender influences should be regarded in combination with other factors such as local culture and socioeconomic status of the family.

Bad dental experience is considered as one of life-long stress situations for children [40]. As cultural and social behavioral norms can affect the development and expression of children's dental anxiety, and as dental care systems can vary considerably across cultures, normative data in each culture are needed. The main strength of this study was the continuous assessment over a 10-year period, which provides information on the development and progression of dental anxiety during the important life course, when children transition from the primary to the permanent dentition and mental state grows enormously. To our knowledge, this is the first study to use representative data from China for comparison of time trends of children dental anxiety in multiple age groups. The study showed that dental anxiety seems to decrease with increasing age and this is in agreement with previous studies [17]. The results showed that 8-10-year-old children recent years exhibited less fear and anxiety in dental procedures compared with children of the same age in the initial period of this study, indicating that the change in social environment experienced in these years influences the incidence and progression of dental anxiety and its outcomes have improved for children in Guangdong Province. The researchers conclude that the possible reasons for these findings would be the oral health education in the mass media, especially the Internet, which has enhanced the cognition and acceptance of oral treatment for the

older children. But the effect was not obvious to preschool children because of their limited cognitive ability. However, children dental anxiety were influenced by a multiplicity of interacting environmental factors including words and deeds of people around; any single influence is dubious to clarify much divergence. So the positive trend of parents towards dental procedures may be passed on to children indirectly, which may also be due to the growing public awareness.

Factor analyses, which are conventionally used to evaluate the construct validity of scales, have been previously reported in CFSS-DS studies of different populations. In Netherlands and Finland, investigators divided the scale items into three factors, and the connotation of them were as follows: 1) fear of highly invasive procedures, 2) fear of potential 'victimization' and 3) fear of less invasive procedures [24]. In the present research, factor analysis resulted in four factors. There were 1) fear of highly invasive dental procedures, 2) fear of general medical aspects of treatment, 3) fear of less invasive procedures and potential 'victimization', and 4) fear of strangers or unfamiliar objects. Despite minor differences in populations and methods, similar results were found in the aforementioned studies in other cultures [4, 41], indicating that the setting of psychological and behavioral scale conforms to the theoretical conception of the design in this study. The results of factor analysis also provided some support for the conclusion above: the less invasive oral operation items (Factor III) showed the trend of decreasing dental anxiety scores, while the changes of other factors were not significant. It can be explained that the image output in oral health publicity is indeed considered to make patients have a certain degree of familiarity with the treatment situation before coming to the hospital, so as to reduce the anxiety tendency to a certain extent. This also suggests that future public oral health publicity should be introduced to the scene of positive emotional feedback from the characters about the sight and noise of the

"drilling", in order to further reduce the public's fear of specific dental operations.

The limitation to our study design should be pointed out. The sample was taken from a single medical institution, which the group of children represented by are more inclined to show the behavior of visiting a dentist, probably because of lower levels of dental anxiety [42]. The generalizability of our results cannot be directly extrapolated to broader urban populations. Hence, a school sample is generally considered more representative. However, the school sample may have introduced recall bias, and children without dental experience are likely to have difficulty answering items such as "drilling" that they had never experienced previously [12, 43, 44]. There may be a need for a comparative study between the clinic and school samples. Another limitation of the present study is that the presence of parents when children respond to the scale reduces privacy, which may lead to the children's answering in line with parents' expectations and social expectations. Perhaps this problem could be mitigated by having the items interpreted by the investigators rather than the parents. Future studies are required to further relate CFSS-DS scores to broader risk factors and/or physiological observations of children during dental treatment, then the tool will help clinicians recognize children in need of extra attention and subsequently select the most appropriate treatment approach and evaluate the outcome of interventions.

CONCLUSIONS

The assessment in this study provides an overall picture of dental anxiety in Chinese-speaking populations, age is significant determinant for children's dental anxiety. Furthermore, in recent years, parts of children's dental anxiety tends to decrease with time.

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Contributors SG contributed to the data analysis and manuscript preparation. JL and PL contributed to the material preparation and data collection. WZ and DY supervised the data collection, data analysis and critical revisions. All authors contributed to the study conception and design and approved the final manuscript.

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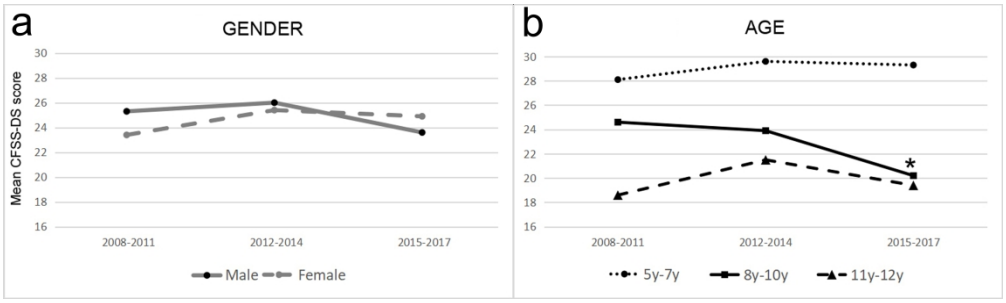

Fig. 1. CFSS-DS scores by gender and age. *Statistically significant ($p < 0.05$)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5-6
Methods			
Study design	4	Present key elements of study design early in the paper	6-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6-7
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-9
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	6-8

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	8-9
		(*c*) Explain how missing data were addressed	8-9
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	6-7
		(*e*) Describe any sensitivity analyses	8-9

Continued on next page

Results			
Participants	13 *	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9-10
		(b) Give reasons for non-participation at each stage	9-10
		(c) Consider use of a flow diagram	
Descriptive data	14 *	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-10
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	9, 12-13
Outcome data	15 *	*Cohort study*—Report numbers of outcome events or summary measures over time	10-14
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-14
		(*b*) Report category boundaries when continuous variables were categorized	10-13
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	11-14
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	15-18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Prevalence and risk factors of children's dental anxiety in China: A longitudinal study

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Prevalence and risk factors of children's dental anxiety in China: A longitudinal study

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ABSTRACT

Objectives Dental anxiety remains widespread among children, may continue into adulthood and affect their oral health-related quality of life and clinical management. The aim of the study was to explore the trend of children's dental anxiety over time and potential risk factors.

Design Longitudinal study

Methods Children aged between 5 and 12 years were investigated with the Chinese version of face version of Children's Fear Survey Schedule-Dental Subscale (CFSS-DS) and Frankl Behavior Rating scale from 2008 to 2017, and influential factors were explored.

Results Clinical data were available from 1061 children, including 533 (50.2%) male participants and 528 (49.8%) female participants. The total CFSS-DS scores ranged from 16 to 66, with a mean of 24.8±10.3. The prevalence of dental anxiety is 11.59%. No significant differences in total CFSS-DS scores between females and males were found. According to the Frankl scale, 238 children were allocated to the uncooperative group and the remaining 823 children were allocated to the cooperative group. Scores of CFSS-DS were negatively correlated with the clinical behavior level of Frankl. 11-12-year-old children had significantly decreased scores compared to other age groups, and there was a decline in the scores of 8-10-year-old group over time. The factor analysis divided 15 items of CFSS-DS into four factors, and the total scores of 'less invasive oral procedures' items belonging to factor III decreased significantly over time in the 8-10-year-old group.

Conclusions Age is a significant determinant for children's dental anxiety, and dental anxiety outcomes have improved for Chinese children aged 8-10 years. This study is one of the few reports on changes of children dental anxiety in a new era of information, but the results may be extrapolated to other populations with caution.

Strengths and limitations of this study

►This study is a systematic longitudinal survey with representative data obtained for comparison of time trends of children dental anxiety in multiple age groups.

►The duration of this observational study spanned a decade.

►The Chinese version CFSS-DS with facial image scale showed good applicability in clinical practice.

►Tri blindness paradigm was employed to avoid bias as much as possible.

►The sample size of this survey, the region and age range of the research objects are limited.

INTRODUCTON

Dental fear and anxiety refers to a feeling of dread and anticipation that something will happen, combined with a sense of losing control in relation to dentistry. Dental phobia is defined as a more severe form that leads to an out of proportion reaction and interferes with daily life [1]. A significant problem in patient management as such patients are more likely to avoid or delay dental treatment is related to dental anxiety, further leading to a vicious circle where the levels of dental anxiety are reinforced as a result of greater disease severity and greater dental treatment needs [2, 3].

Childhood dental anxiety has been shown to be widespread, and research has suggested the adults often acquire such fears in childhood [4], and the early-life social and biological factors have long-lasting effects on health later in life [5]. Child's dental anxiety predicts more dental disease and poorer oral health in measures, such as decay experience, the presence of untreated dental infection and treatment that carries more risk, that results in a detrimental effect on the quality of the life of the individual and family and engagement in oral health-related behaviours [6, 7]. For many years, dental anxiety in children has been recognized as a source of problems in

patient management [8]. Identifying anxiety in children at the earliest possible age is essential and helpful to select methods of behavior management. In the literature of recent years, there is considerable variation in the designs of study and target populations, particularly in the scales used for measurement and the age of the children, so that the reported prevalence of dental fear and anxiety in children varies widely, ranging from 7.4% [9] to 93.8% [10]. It can be said that there is currently no fully ideal dental anxiety scale for children in use. Efforts should therefore continue to be directed towards the development and validation of suitable instruments for the detection of dental anxiety in children.

The Dental Sub-scale of Children's Fear Survey Schedule (CFSS-DS) is a frequently used measure of children's dental anxiety [11]. Then the facial version CFSS-DS was first proposed by Arapostathis in 2007 [12]. In several countries, the scale has demonstrated good reliability and acceptable validity and has been used to estimate the prevalence of dental anxiety, and evaluate the behavior-management procedures used for child patients. The Chinese version CFSS-DS was established the cross-cultural adaptation and showed good psychometric properties [13]. The prevalence of dental anxiety according to CFSS-DS varies considerably in the international literature ranging from 2.4% to 28.3% in different populations and cultural backgrounds [9, 14-16].

The etiology of dental anxiety is complex and multifactorial. Numerous factors were discussed as influences of children dental anxiety, with socioeconomic factors, general health, dental history and caregiver status being frequently included aspects [17]. Poor oral health and hygiene behavior, unstable general health and parents' high dental anxiety were found to be associated with elevated levels of children dental anxiety. Children with toothache or caries have

higher chance of dental anxiety [18]. Patterns of dental visits and previous experiences have also important impact in dental fear occurrence [19]. Studies demonstrated that subjects with higher social and financial resources show lower prevalence of dental anxiety [20]. The potential risk factors of dental anxiety are likely to be different from each person. Thus, further investigation into intrinsic and environmental factors associated with dental anxiety is needed. To date, relatively few published study evaluated the dental anxiety of children and behavioral influence factors in dental settings in China. Moreover, the trends of children's dental anxiety over time are poorly characterized. The objective of this research is to provide normative data on dental anxiety of Chinese children, and describe and compare the influence of relevant factors on dental anxiety in a decade.

METHODS

Participants and procedures

The study was conducted at the department of Pediatric Stomatology, affiliated Stomatology Hospital of Sun Yat-sen University, during 10 years (August 2008 - October 2017). The children patients aged 5 to 12 years old were selected randomly to participate in the study. Inclusion criteria were children with no mental retardation or developmental disorders; no cognitive impairment or psychiatric history; no serious congenital and acquired oral and maxillofacial deformities. The Ethics Committee of the Institute of Stomatological Research, Sun Yat-sen University, China, gave approval for the study. Before entering the study, each parent and child were well informed about the purpose of the study and affirmed that participation was voluntary.

Parents were distributed informative leaflets about the procedure and were asked to provide written consent.

Chinese version CFSS-DS with FIS

The Chinese version CFSS-DS was adopted, which consists of 15 items and a five-point pictorial scale, that is, the Facial Image Scale (FIS). The FIS consists of five drawings of a face, displaying affective features ranging from extremely negative (score 5) through neutral to extremely positive (score 1). The total score ranges from 15 to 75. Children are presented with the five images and are asked to select which one best corresponds to how they are feeling. The FIS is a reliable and valid method for children's self-report of dental anxiety in subjects as young as three years old [21, 22]. In this study, the pilot test of Chinese version CFSS-DS with FIS was carried on 32 children and their parents, in order to clarify whether young children could answer the CFSS-DS items with reference to the facial images (results not shown).

Measures

Children's dental anxiety over the ten-year period was investigated, which was a randomized triple-blinded longitudinal study. Data collection included children's completion of the Chinese version CFSS-DS with FIS and evaluation of behavior during dental visit. Upon entering the waiting room, the children were invited to fill in the Chinese version CFSS-DS with FIS. Any child experiencing difficulty in reading the questions was assisted by the receptionist. At the same time, the parents (in almost all cases, the mother) provided a dental health questionnaire related to

demographic information and previous dental experiences. The gender, age, and source of referral of the participants were recorded. After the completion of the CFSS-DS, the children were invited into the operatory for regular dental examination. The dentist and dental nurse were unaware of the children's responses to the questionnaire. During examinations, the behavior and facial expressions of the children were recorded by video cameras, which were later rated according to the Frankl scale [23]. To ensure sample "blindness", the rater did not have access to the CFSS-DS scores of the children and assigned the children with behaviors classified as "definitely positive" (the dentist and child share good rapport, the child is laughing) and "positive" (willingness to comply, cautiousness) to the cooperative group, whereas those with behaviors classified as "definitely negative" (fearful behavior, forceful crying) and "negative" (reluctance and/or uncooperativeness, but not as severe as in the previous category) were assigned to the uncooperative group.

Data Processing and Statistical Analysis

The data from all the children who had completed the Chinese version CFSS-DS and finished the dental examination on one occasion were used to provide normative data. If there is one item in one scale that is not answered, it will be treated as missing item, and the data of missing entries is replaced by the mean of the remaining samples with complete data; if there are two or more items that are not answered, it will be eliminated to the invalid scale.

Data management and analysis were conducted using SPSS version 16.0. The associations between CFSS-DS scores and demographic variables were analysed using the t-tests and one-way

analysis of variances (ANOVA). When significant effects were found, Tukey post-hoc test was used to determine significant intergroup mean differences. Factor analysis (principal components, varimax rotation) was employed to assess the factor structure [24, 25], and factor scores above 0.5 indicate strong loading on a particular subset of items. Kruskal Wallis rank sum test was used to evaluate the differences of gender groups and age groups among three time periods. $p<0.05$ is statistically significant.

Patient and public involvement

Participation in this survey is voluntary for each child and his/her parents. The receptionists or assistants helped understand the items and complete the scale. The children and their parents were not involved in the design, recruitment or conduct of the study.

RESULTS

Characterization of the sample

For the analysis of dental anxiety in children, the representative sample selected randomly who were treated in Department of Pediatric Stomatology, and 1061 copies of the effective scale were received from August 2008 to October 2017. Of those eligible, there were 533 (50.2%) male participants and 528 (49.8%) female participants. There was no significant difference in the ratio of patient's gender, or their evaluation of economic level by treatment status. 411 children aged 5-7 years accounted for 38.7%, 399 children aged 8-10 years accounted for 37.6% and 251 aged

11-12 years accounted for 23.7% (Table 1). The mean age of the children was 7.8 years (SD 1.7). Gender and age distributions remained stable over time, with increasing proportions of respondents in higher family income categories.

Table 1 Gender and age distribution of the survey sample

Sample characteristics		N	%
Age(y)	5-7	411	38.7
	8-10	399	37.6
	11-12	251	23.7
Gender	Female	528	49.8
	Male	533	50.2

N total number of children

Dental anxiety of children and Behavior classification

Table 2 shows the 1061 participants' scores in the CFSS-DS to dental practice events. Items that over 25% children felt "very afraid" or "quite afraid" were "Dentist drilling" (46.84%), "Injection" (29.50%) and "Choking" (26.20%). Range of total CFSS-DS scores was 16~66. The mean total CFSS-DS scores for all children was 24.8±10.3. We assigned those children with CFSS-DS total scores equal to and below 32 to 'non-fearful range', scores between 32 and 38 to 'borderline range', and scores of 38 and higher as 'fearful range' [14, 26-32]. From the children assessed, 605 children (57.02%) were rated as the non-fearful range, 333 (31.39%) were rated as the borderline range and 123 (11.59%) were rated as fearful range. Therefore, the prevalence of

dental anxiety in this sample is 11.59%, and 88.41% of the children did not suffer from it. According to the Frankl scale, 238 children assessed were allocated to the uncooperative group and the remaining 823 children were allocated to the cooperative group. The distribution patterns of CFSS-DS scores were very different between the two groups. Children of the uncooperative group tended to report dental anxiety, as compared with cooperative children (30.67% vs. 6.08%) (Table 3). The results showed that the CFSS-DS scores were correlated negatively with the Frankl behavior level. That is, there is a certain consistency between the CFSS-DS score and the clinical performance.

Table 2 Children's dental anxiety in the Chinese version CFSS-DS

		Total (N=1061)				
Items		Not afraid	A little afraid	Fairly afraid	Quite afraid	Very afraid
1	Dentists	461（43.44%）	324（30.54%）	131（12.35%）	65（6.13%）	80（7.54%）
2	Doctors	528（49.76%）	290（27.33%）	94（8.86%）	65（6.13%）	84（7.92%）
3	Injections	268（25.26%）	281（26.48%）	199（18.76%）	144（13.57%）	169（15.93%）
4	Having someone examine your mouth	519（48.92%）	334（31.48%）	163（15.36%）	27（2.54%）	18（1.70%）
5	Having to open your mouth	741（69.84%）	192（18.10%）	97（9.14%）	15（1.41%）	16（1.51%）
6	Having a stranger touch you	262（24.69%）	299（28.18%）	243（22.90%）	136（12.82%）	121（11.40%）
7	Having somebody look at you	504（47.50%）	293（27.62%）	187（17.62%）	62（5.84%）	15（1.41%）
8	Dentist drilling	109（10.27%）	203（19.13%）	252（23.75%）	241（22.71%）	256（24.13%）
9	Sight of the dentist drilling	431（40.62%）	237（22.33%）	183（17.25%）	134（12.63%）	76（7.16%）
10	Noise of the dentist drilling	369（34.78%）	303（28.56%）	154（14.51%）	90（8.48%）	145（13.67%）
11	Having somebody put instruments in your mouth	416（39.21%）	237（22.34%）	175（16.49%）	113（10.65%）	120（11.31%）
12	Choking	351（33.08%）	313（29.50%）	119（11.22%）	156（14.70%）	122（11.50%）
13	Having to go to the hospital	454（42.79%）	308（29.03%）	204（19.23%）	29（2.73%）	66（6.22%）

14	People in white uniforms	649（61.17%）	157（14.80%）	147（13.85%）	76（7.16%）	32（3.02%）
15	Having the nurse clean your teeth	582（54.86%）	149（14.04%）	175（16.49%）	69（6.50%）	86（8.11%）

N total number of children

Table 3 CFSS-DS scores and the children behavior in the Frankl scale

CFSS-DS Scores	Behavior classification		Total
	Cooperative group	Uncooperative group	
≦32’	577 (70.11%)	28 (11.76%)	605 (57.02%)
32’-38’	196 (23.82%)	137 (57.56%)	333 (31.39%)
≧38’	50 (6.08%)	73 (30.67%)	123 (11.59%)
Total	823	238	1061

N total number of children

Dental anxiety of children and gender, age and time factors

The results in Table 4 show that the CFSS-DS scores of gender groups and age groups between 2008 and 2017. There was no statistical difference in CFSS-DS scores between males and females, and within the two groups among the three time periods during ten years, indicating that there was no significant correlation between gender and dental anxiety (Fig. 1a). On the other hand, age was statistically significantly related to CFSS-DS score. The overall data indicated that 11-12-year-old children had significantly decreased scores compared to other age groups. Over time, there was a decline of the CFSS-DS scores in 8-10-year-old group. The children of this group in 2015-2017 were found with significantly lower CFSS-DS score compared with peers in 2008-2011 (Fig. 1b, p =0.019). The other two age groups did not show significant trends over time.

Table 4 Mean CFSS-DS scores by gender and age

	2008-2011		2012-2014		2015-2017	
	N=299		N=367		N=395	
Variables	N (%)	CFSS-DS score Mean (SD)	N (%)	CFSS-DS score Mean (SD)	N (%)	CFSS-DS score Mean (SD)
Gender						
Male	152 (50.8%)	25.3 (10.2)	172 (46.9%)	26.0 (10.1)	209 (52.9%)	23.6 (10.3)
Female	147 (49.2%)	23.4 (9.9)	195 (53.1%)	25.4 (9.9)	186 (47.1%)	24.9 (10.5)
Age (years)						
5-7	113 (37.8%)	28.1 (9.7)	148 (40.3%)	29.6 (10.2)	180 (45.6%)	29.3 (10.3)
8-10	110 (36.8%)	24.6 (10.4)	143 (39.0%)	23.9 (9.8)	146 (37.0%)	**20.2** (10.6)*
11-12	76 (25.4%)	18.6 (10.4)	76 (20.7%)	21.5 (10.1)	69 (17.4%)	19.4 (10.3)
Mean		24.4 (10.0)		25.7 (10.2)		24.2 (10.4)

N total number of children; SD Standard Deviation

Fig. 1. CFSS-DS scores by gender and age. *Statistically significant ($p < 0.05$)

Factor analysis

This study conducted factor analysis of the Chinese version CFSS-DS (maximum variation method). The 15 items were divided into four factors, which accounted for 58.7% of the total scale variance. Factor I, accounting for 22.6% of the variance, consists of items pertaining to highly invasive dental procedures, such as “Dentists” and “Drilling”. Factor II consists of items related to general medical aspects of treatment, such as “Doctors”. Factor III consists of items pertaining to less invasive procedures and potential ‘victimization’, such as “Having someone examine your mouth”. Factor IV consists of items related to the distrust of strangers or unfamiliar objects, which were unrelated to general medical aspects of treatment, such as “Having a stranger touch you”. Corrected item-domain correlation ranged from 0.58 to 0.90. A certain logical relationship among

the items in the same factors was observed. When stratified analysis was carried out in the 8-10-year-old group, the children in 2015-2017 reported significantly lower summed scores on items belonging to factor III compared with peers in 2008-2011, while no significant differences were seen in items for the other three factors, indicating a decreasing trend in anxiety levels over time for the "less invasive procedures" items (factor III) (Table 5, p =0.041).

Table 5 Factor analysis and scores of items with respect to the factors in 8-10y age group

Rotated CFSS–DS factor matrix		**Factors** (% total scale variance)				**Mean CFSS-DS score** of 8-10-year-old children		
	Items in CFSS-DS	**I** (22.6)	**II** (17.3)	**III** (12.1)	**IV** (7.9)	2008-2011	2012-2014	2015-2017
I	**Highly invasive dental procedures**							
1	Dentists	**0.492**	0.451	0.285	0.031			
8	Dentist drilling	**0.816**	0.187	0.123	0.074			
9	Sight of the dentist drilling	**0.792**	0.113	0.084	0.165	12.63	12.06	11.08
10	Noise of the dentist drilling	**0.608**	0.242	0.136	0.045			
11	Having somebody put instruments in your mouth	**0.714**	0.138	0.202	0.087			
12	Choking	**0.513**	0.311	-0.146	0.378			
15	Having the nurse clean your teeth	**0.442**	0.191	0.285	0.011			
II	**General medical aspects of treatment**							
2	Doctors	0.341	**0.568**	0.099	0.151	5.31	6.21	5.23
3	Injections	0.124	**0.633**	0.021	0.012			
13	Having to go to the hospital	0.169	**0.696**	0.118	0.156			
14	People in white uniforms	0.086	**0.618**	0.304	0.077			
III	**Less invasive procedures and potential 'victimization'**							
4	Having someone examine your mouth	0.256	0.303	**0.764**	0.099	4.15	3.01	**2.03***
5	Having to open your mouth	0.233	0.034	**0.657**	0.113			
IV	**Distrust of strangers or unfamiliar objects**							
6	Having a stranger touch you	0.201	0.189	-0.037	**0.821**	2.59	2.72	2.56
7	Having somebody look at you	0.021	0.016	0.270	**0.807**			

*Statistically significant ($p < 0.05$)

DISCUSSION

Children commonly experience anxiety when receiving professional dental treatment. Effectively recognizing an anxious patient, while being based on the validity of clinical observations is a recognized problem for both dentists and researchers. CFSS-DS is an international survey tool for children's dental anxiety that covers basically all aspects of dental events and can be used for epidemiological investigations, controlled trials, and longitudinal prospective studies. This study adopted the Chinese version CFSS-DS that has undergone cross-cultural adaptation, and the results showed that the high rate of the scale recovery and the low rate of missing items indicating good feasibility. Children may be well able to assess their fear using the face version CFSS-DS, however, their incomprehension of the content of individual items is the main reason for the lack of data, which focused on item 12 "Chocking". In addition, It was found that in the preliminary test children aged 4 and below can not accurately grasp the meaning of most items. This study believes that as a self-assessment scale, CFSS-DS must be understood by the surveyed population. In view of this, this study selected 5 to 12 years old children as the survey objects.

In this study, there is a negative correlation between the anxiety level of children obtained by the CFSS-DS and the clinical behavior classification, indicating that children with high anxiety levels have poor clinical cooperation. Our finding suggested that, the distribution patterns of the total CFSS-DS scores were clearly different between the clinical behavior groups according to Frankl scale. In the cooperative group, although the younger child patients exhibited high scores of dental anxiety, they had the potential to overcome their resistance behaviors of dental treatment, indicating that cooperative patients can have hidden dental anxiety. Therefore, even in the face of cooperative children during dental treatment, it should be taken into account that clinicians may be

required to implement appropriate behavioral induction measures to reduce dental anxiety. It has been suggested that dental anxiety decreases with repeated exposure to dental procedures [33]. However, in the uncooperative group older children seemed not to be able to overcome their dental anxiety, which caused behavior management problems. At this time more risk factors should be considered, such as previous medical experience, family structure, etc.

The CFSS-DS scores in the international literature in recent years varies with different populations and dental situations. The mean score in the present study was 24.8±10.3, which was comparatively lower than scores from studies in Brazil (29.3±10.5) [34], Hong Kong (29.1±11.0) [16], Greece (27.1±10.8) [14], Egypt (26.09±10.70) [26] and Jeddah, Saudi Arabia (25.99 ± 9.3) [17]. CFSS-DS scores in the current study did not differ greatly from data from these previous studies, that may be due to the similar age range of the subjects and different cultural parameters.

It is necessary to determine the cut-off point for distinguishing between children who are more prone to dental anxiety that is helpful for clinicians to choose appropriate behavior management measures. Generally, dental anxiety is measured according to clear cut-off points on continuous measure that acts as a categorical boundary. In view of the balance of the sensitivity and specificity in the measurement of scale, different prevalence estimates depend on the different cut-off values used to define "dental anxiety". Children dental anxiety cut-off points on CFSS-DS are already defined in several researches, but the conclusions are not all the same. In the present study, the participated children with CFSS-DS scores of 38 and higher [26-32] were considered as dentally anxious. There is still a need for further research to find more desirable instrument for understanding the dental anxiety of children and adolescents.

Demographically this study found no difference in dental anxiety between females and males, that is supported by previous studies [14, 20, 34-39]. This is however contrary to other studies which have reported more girls than boys in the anxious group [12, 17, 26]. Contradictory research findings may be explained by different study designs and methods of data collection, moreover, gender influences should be regarded in combination with other factors such as local culture and socioeconomic status of the family.

Bad dental experience is considered as one of life-long stress situations for children [40]. As cultural and social behavioral norms can affect the development and expression of children's dental anxiety, and as dental care systems can vary considerably across cultures, normative data in each culture are needed. The main strength of this study was the continuous assessment over a 10-year period, which provides information on the development and progression of dental anxiety during the important life course, when children transition from the primary to the permanent dentition and mental state grows enormously. To our knowledge, this is the first study to use representative data from China for comparison of time trends of children dental anxiety in multiple age groups. The study showed that dental anxiety seems to decrease with increasing age and this is in agreement with previous studies [17]. The results showed that 8-10-year-old children recent years exhibited less fear and anxiety in dental procedures compared with children of the same age in the initial period of this study, indicating that the change in social environment experienced in these years influences the incidence and progression of dental anxiety and its outcomes have improved for children in Guangdong Province. The researchers conclude that the possible reasons for these findings would be the oral health education in the mass media, especially the Internet, which has enhanced the cognition and acceptance of oral treatment for the

older children. But the effect was not obvious to preschool children because of their limited cognitive ability. However, children dental anxiety were influenced by a multiplicity of interacting environmental factors including words and deeds of people around; any single influence is dubious to clarify much divergence. So the positive trend of parents towards dental procedures may be passed on to children indirectly, which may also be due to the growing public awareness.

Factor analyses, which are conventionally used to evaluate the construct validity of scales, have been previously reported in CFSS-DS studies of different populations. In Netherlands and Finland, investigators divided the scale items into three factors, and the connotation of them were as follows: 1) fear of highly invasive procedures, 2) fear of potential 'victimization' and 3) fear of less invasive procedures [24]. In the present research, factor analysis resulted in four factors based on deep sources of children dental anxiety. There were 1) fear of highly invasive dental procedures, 2) fear of general medical aspects of treatment, 3) fear of less invasive procedures and potential 'victimization', and 4) fear of strangers or unfamiliar objects. Despite minor differences in populations and methods, similar results were found in the aforementioned studies in other cultures [4, 41], indicating that the setting of psychological and behavioral scale conforms to the theoretical conception of the design in this study. The results of factor analysis also provided some support for the conclusion above: in the 8-10 year old group, the less invasive oral operation items (Factor III) showed the trend of decreasing dental anxiety scores, while the changes of other factors were not significant, thus indicating that the downward trend in the total CFSS-DS scores may have originated from the items of Factor III. It can be explained that the image output in oral health publicity is indeed considered to make patients have a certain degree of familiarity with the treatment situation before coming to the hospital, so as to reduce the anxiety tendency to a certain

extent. This also suggests that future public oral health publicity should be introduced to the scene of positive emotional feedback from the characters about the sight and noise of the “drilling” (Factor I), in order to further reduce the public's fear of specific dental operations.

The limitation to our study design should be pointed out. The sample was taken from a single medical institution, which the group of children represented by are more inclined to show the behavior of visiting a dentist, probably because of lower levels of dental anxiety [42]. The generalizability of our results cannot be directly extrapolated to broader urban populations. Hence, a school sample is generally considered more representative. However, the school sample may have introduced recall bias, and children without dental experience are likely to have difficulty answering items such as "drilling" that they had never experienced previously [12, 43, 44]. There may be a need for a comparative study between the clinic and school samples. Another limitation of the present study is that the presence of parents when children respond to the scale reduced privacy, which may lead to the children's answering in line with parents' expectations and social expectations. Perhaps this problem could be mitigated by having the items interpreted by the investigators rather than the parents. Additionally, Considering that dental anxiety is multi-causal, such as the kind of treatment, previous dental experience of children and other events involved, future studies are required to further relate CFSS-DS scores to broader risk factors and/or physiological observations of children during dental treatment, then the tool will help clinicians recognize children in need of extra attention and subsequently select the most appropriate treatment approach and evaluate the outcome of interventions.

CONCLUSIONS

The assessment in this study provides an overall picture of dental anxiety in Chinese-speaking populations, age is significant determinant for children's dental anxiety. Furthermore, in recent years, parts of children's dental anxiety tends to decrease with time.

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Competing interests None declared.

Ethical approval and consent to participate All procedures performed involving human participants were in accordance with the ethical standards of the Ethics Committee of the Institute of Stomatological Research, Sun Yat-sen University, China. Informed written consent was taken from parents of each participating child.

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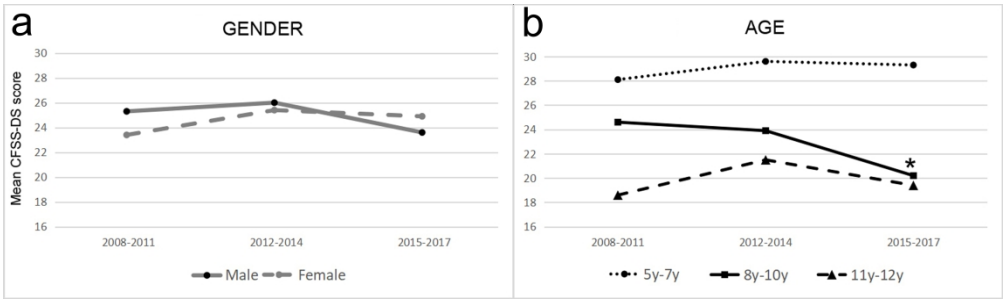

Fig. 1. CFSS-DS scores by gender and age. *Statistically significant ($p < 0.05$)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5-6
Methods			
Study design	4	Present key elements of study design early in the paper	6-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6-7
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-9
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	6-8

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	8-9
		(*c*) Explain how missing data were addressed	8-9
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	6-7
		(*e*) Describe any sensitivity analyses	8-9

Continued on next page

Results			
Participants	13 *	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9-10
		(b) Give reasons for non-participation at each stage	9-10
		(c) Consider use of a flow diagram	
Descriptive data	14 *	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-10
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	9, 12-13
Outcome data	15 *	*Cohort study*—Report numbers of outcome events or summary measures over time	10-14
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-14
		(*b*) Report category boundaries when continuous variables were categorized	10-13
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	11-14
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	15-18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.