

BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-043647
Article Type:	Original research
Date Submitted by the Author:	10-Aug-2020
Complete List of Authors:	Gao, Shuo; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Lu, Jiaxuan ; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Li, Pei; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Yu, Dongsheng; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Zhao, Wei; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology
Keywords:	Child protection < PAEDIATRICS, Anxiety disorders < PSYCHIATRY, PUBLIC HEALTH

SCHOLARONE™
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

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

Shuo Gao, Jiakuan Lu, Pei Li, Dongsheng Yu and Wei Zhao*

Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology, Sun Yat-sen University, Guangzhou, Guangdong, China; gaosh7@mail.sysu.edu.cn (S.G.)

Corresponding Authors:

Wei Zhao*, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology, Sun Yat-Sen University, No. 56, Lingyuan West Road, Yuexiu District, Guangzhou, Guangdong 510055, China.

Email: zhaowei3@mail.sysu.edu.cn

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

1
2
3
4 correlated with the clinical behavior level of Frankl. The prevalence of dental anxiety is 11.59%.
5
6 No significant differences in total CFSS-DS scores between females and males were found.
7
8
9 11-12-year-old children had significantly decreased scores compared to other age groups, and
10
11 there was a decline in the scores of 8-10-year-old group over time. The factor analysis divided 15
12
13 items of CFSS-DS into four factors, and the total scores of 'less invasive oral procedures' items
14
15 belonging to factor III decreased significantly over time in the 8-10-year-old group. This study is
16
17 one of the few large longitudinal studies to report the change for children's dental anxiety in a new
18
19 era of information.
20
21
22
23

24 **Conclusions** The results suggest that age is a significant determinant for children's dental anxiety,
25
26 and dental anxiety outcomes have improved for Chinese children aged 8-10 years.
27
28
29
30

31 32 **Strengths and limitations of this study**

- 33
34
35 ▶ We anticipate our study to be the first systematic longitudinal survey with representative data
36
37 obtained for comparison of time trends of children dental anxiety in multiple age groups.
38
39
40 ▶ The findings of this study have the potential to influence the direction and specific content of
41
42 oral health promotion.
43
44
45 ▶ The Chinese version CFSS-DS with facial image scale showed good applicability in clinical
46
47 practice.
48
49
50 ▶ Tri blindness paradigm was employed to avoid bias as much as possible.
51
52
53 ▶ The sample size of this survey, the region and age range of the research objects are limited.
54
55
56
57
58
59
60

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

1
2
3
4 study evaluated the dental anxiety of children and behavioral influence factors in dental settings in
5
6 china. Moreover, the trends of children's dental anxiety over time are poorly characterized.
7
8
9 Developing dental anxiety questionnaires will thoroughly assist dentists and researchers to study
10
11 the effectiveness of fear-reduction techniques. The objective of this research is to provide
12
13 normative data on dental anxiety of Chinese children, and describe and compare the influence of
14
15 relevant factors on dental anxiety in a decade.
16
17
18
19
20
21
22

23 **METHODS**

24 **Ethical Approval-Permissions**

25
26
27 The Ethics Committee of the Institute of Stomatological Research, Sun Yat-sen University, China,
28
29 gave approval for the study. Parents were distributed informative leaflets about the procedure and
30
31 were asked to provide written consent.
32
33
34
35
36
37
38
39
40
41

42 **Chinese version CFSS-DS with FIS**

43
44
45 The Chinese version CFSS-DS was adopted, which consists of 15 items and a five-point pictorial
46
47 scale, that is, the Facial Image Scale (FIS). The FIS consists of five drawings of a face, displaying
48
49 affective features ranging from extremely negative (score 5) through neutral to extremely positive
50
51 (score 1). The total score ranges from 15 to 75. Children are presented with the five images and
52
53 are asked to select which one best corresponds to how they are feeling. The FIS is a reliable and
54
55 valid method for children's self-report of dental anxiety in subjects as young as three years old [14,
56
57
58
59
60

1
2
3
4 15]. In this study, the pilot test of Chinese version CFSS-DS with FIS was carried on 32 children
5
6 and their parents, which revealed that young children were able to answer the CFSS-DS items
7
8 with reference to the facial images.
9
10

11 12 13 14 15 **Measures**

16
17
18 Children's dental anxiety over the ten-year period was investigated, which was a randomized
19
20 triple-blinded longitudinal study. The patients were selected randomly to participate in the study
21
22 who were treated in the department of Pediatric Stomatology, affiliated Stomatology Hospital of
23
24 Sun Yat-sen University. Inclusion criteria were children aged 5 to 12 years old; no mental
25
26 retardation or developmental disorders; no cognitive impairment or psychiatric history; no serious
27
28 congenital and acquired oral and maxillofacial deformities. Before entering the study, each parent
29
30 and child were well informed about the purpose of the study and affirmed that participation was
31
32 voluntary.
33
34
35
36
37
38
39

40
41 Upon entering the waiting room, the children were invited to complete the Chinese version
42
43 CFSS-DS with FIS. Any child experiencing difficulty in reading the questions was assisted by the
44
45 receptionist. At the same time, the parents (in almost all cases, the mother) provided a dental
46
47 health questionnaire related to demographic information and previous dental experiences. The
48
49 gender, age, and source of referral of the participants were recorded. After the completion of the
50
51 CFSS-DS, the children were invited into the operatory for regular dental examination. The dentist
52
53 and dental nurse were unaware of the children's responses to the questionnaire. During
54
55 examinations, the behavior and facial expressions of the children were recorded by video cameras,
56
57
58
59
60

1
2
3
4 which were later rated according to the Frankl scale [16]. To ensure sample “blindness”, the rater
5
6 did not have access to the CFSS-DS scores of the children. We assigned the children with
7
8 behaviors classified as “definitely positive” (the dentist and child share good rapport, the child is
9
10 laughing) and “positive” (willingness to comply, cautiousness) to the cooperative group, whereas
11
12 those with behaviors classified as “definitely negative” (fearful behavior, forceful crying) and
13
14 “negative” (reluctance and/or uncooperativeness, but not as severe as in the previous category)
15
16
17 were assigned to the uncooperative group.
18
19
20
21
22
23
24
25

26 **Data Processing and Statistical Analysis**

27
28
29 The data from all the children who had completed the Chinese version CFSS-DS and finished the
30
31 dental examination on one occasion were used to provide normative data. If there is one item in
32
33 one scale that is not answered, it will be treated as missing item, and the data of missing entries is
34
35 replaced by the mean of the remaining samples with complete data; if there are two or more items
36
37 that are not answered, it will be eliminated to the invalid scale.
38
39
40
41
42

43 Data management and analysis were conducted using SPSS version 16.0. The associations
44
45 between CFSS-DS scores and demographic variables were analysed using the t-tests and one-way
46
47 analysis of variances (ANOVA). When significant effects were found, Tukey post-hoc test was
48
49 used to determine significant intergroup mean differences. Factor analysis (principal components,
50
51 varimax rotation) was employed to assess the factor structure [17, 18], and factor scores above 0.5
52
53 indicate strong loading on a particular subset of items. Kruskal Wallis rank sum test was used to
54
55 evaluate the differences of gender groups and age groups among three time periods. $P < 0.05$ is
56
57
58
59
60

1
2
3
4 statistically significant.
5
6
7
8
9

10 **RESULTS**

13 **Characterization of the sample**

14
15
16
17 For the analysis of dental anxiety in children, the representative sample selected randomly who
18
19 were treated in Department of Pediatric Stomatology, and 1061 copies of the effective scale were
20
21 received from August 2008 to October 2017. Of those eligible, there were 533 (48.9%) male
22
23 participants and 528 (49.8%) female participants. There was no significant difference in the ratio
24
25 of patient's gender, or their evaluation of economic level by treatment status. 411 children aged
26
27 5-7 years accounted for 38.7%, 399 children aged 8-10 years accounted for 37.6% and 251 aged
28
29 11-12 years accounted for 23.7%. The mean age of the children was 7.8 years (SD 1.7). Gender
30
31 and age distributions remained stable over time, with increasing proportions of respondents in
32
33 higher family income categories.
34
35
36
37
38
39

40
41 From the 1061 children assessed, 238 were allocated to the uncooperative group and of the
42
43 remaining 833 children were allocated to the cooperative group according to the Frankl scale. The
44
45 distribution patterns of CFSS-DS scores were very different between the two groups (Table 1).
46
47 The results showed that the CFSS-DS scores were correlated negatively with the Frankl behavior
48
49 level. That is, there is a certain consistency between the CFSS-DS score and the clinical
50
51 performance.
52
53
54
55
56
57
58
59
60

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

Variables	2008-2011		2012-2014		2015-2017	
	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		
		I	II	III	IV	of 8-10-year-old children		
Items in CFSS-DS		(22.6)	(17.3)	(12.1)	(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

1
2
3
4 good feasibility. Children may be well able to assess their fear using the faces version CFSS-DS,
5
6 however, their incomprehension of the content of individual items is the main reason for the lack
7
8 of data, which focused on item 12 “Chocking”. In addition, It was found that in the preliminary
9
10 test children aged 4 and below can not accurately grasp the meaning of most items. This study
11
12 believes that as a self-assessment scale, CFSS-DS must be understood by the surveyed population.
13
14
15
16
17 In view of this, this study selected 5 to 12 years old children as the survey objects.
18
19

20
21 In this study, there is a negative correlation between the anxiety level of children obtained by
22
23 the CFSS-DS and the clinical behavior classification, indicating that children with high anxiety
24
25 levels have poor clinical cooperation. Our finding suggested that, the distribution patterns of the
26
27 total CFSS-DS scores were clearly different between the clinical behavior groups according to
28
29 Frankl scale. In the cooperative group, although the younger child patients exhibited high scores
30
31 of dental anxiety, they had the potential to overcome their resistance behaviors of dental treatment,
32
33 indicating that cooperative patients can have hidden dental anxiety. Therefore, even in the face of
34
35 cooperative children during dental treatment, it should be taken into account that clinicians may be
36
37 required to implement appropriate behavioral induction measures to reduce dental anxiety. It has
38
39 been suggested that dental anxiety decreases with repeated exposure to dental procedures [19].
40
41
42
43
44 However, in the uncooperative group older children seemed not to be able to overcome their
45
46 dental anxiety, which caused behavior management problems. At this time more risk factors
47
48 should be considered, such as previous medical experience, family structure, etc.
49
50
51
52
53

54
55 Demographically this study found no difference in dental anxiety between females and males,
56
57 that is supported by previous studies [10, 20-21]. This is however contrary to other studies which
58
59 have reported more girls than boys in the anxious group [8, 22, 23]. Contradictory research
60

1
2
3
4 findings may be explained by different study designs and methods of data collection, moreover,
5
6 gender influences should be regarded in combination with other factors such as local culture and
7
8 socioeconomic status of the family.
9

10
11
12 Bad dental experience is considered as one of life-long stress situations for children [24]. As
13
14 cultural and social behavioral norms can affect the development and expression of children's
15
16 dental anxiety, and as dental care systems can vary considerably across cultures, normative data in
17
18 each culture are needed. The main strength of this study was the continuous assessment over a
19
20 10-year period, which provides information on the development and progression of dental anxiety
21
22 during the important life course, when children transition from the primary to the permanent
23
24 dentition and mental state grows enormously. To our knowledge, this is the first study to use
25
26 representative data from China for comparison of time trends of children dental anxiety in
27
28 multiple age groups. The study showed that dental anxiety seems to decrease with increasing age
29
30 and this is in agreement with previous studies [22]. The results showed that 8-10-year-old children
31
32 recent years exhibited less fear and anxiety in dental procedures compared with children of the
33
34 same age in the initial period of this study, indicating that the change in social environment
35
36 experienced in these years influences the incidence and progression of dental anxiety and its
37
38 outcomes have improved for children in Guangdong Province. The researchers conclude that the
39
40 possible reasons for these findings would be the oral health education in the mass media,
41
42 especially the Internet, which has enhanced the cognition and acceptance of oral treatment for the
43
44 older children. But the effect was not obvious to preschool children because of their limited
45
46 cognitive ability. However, children dental anxiety were influenced by a multiplicity of interacting
47
48 environmental factors including words and deeds of people around; any single influence is
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4 dubious to clarify much divergence. So the positive trend of parents towards dental procedures
5
6 may be passed on to children indirectly, which may also be due to the growing public awareness.
7
8

9
10 Factor analyses, which are conventionally used to evaluate the construct validity of scales,
11
12 have been previously reported in CFSS-DS studies of different populations. In Netherlands and
13
14 Finland, investigators divided the scale items into three factors, and the connotation of them were
15
16 as follows: 1) fear of highly invasive procedures, 2) fear of potential 'victimization' and 3) fear of
17
18 less invasive procedures [17]. In the present research, factor analysis resulted in four factors.
19
20 There were 1) fear of highly invasive dental procedures, 2) fear of general medical aspects of
21
22 treatment, 3) fear of less invasive procedures and potential 'victimization', and 4) fear of strangers
23
24 or unfamiliar objects. Despite minor differences in populations and methods, similar results were
25
26 found in the aforementioned studies in other cultures [4, 25], indicating that the setting of
27
28 psychological and behavioral scale conforms to the theoretical conception of the design in this
29
30 study. The results of factor analysis also provided some support for the conclusion above: the less
31
32 invasive oral operation items (Factor III) showed the trend of decreasing dental anxiety scores,
33
34 while the changes of other factors were not significant. It can be explained that the image output in
35
36 oral health publicity is indeed considered to make patients have a certain degree of familiarity
37
38 with the treatment situation before coming to the hospital, so as to reduce the anxiety tendency to
39
40 a certain extent. This also suggests that future public oral health publicity should be introduced to
41
42 the scene of positive emotional feedback from the characters about the sight and noise of the
43
44 "drilling", in order to further reduce the public's fear of specific dental operations.
45
46
47
48
49
50
51
52
53
54
55

56
57 The limitation to our study design should be pointed out. The sample was taken from a single
58
59 medical institution, which the group of children represented by are more inclined to show the
60

1
2
3
4 behavior of visiting a dentist, probably because of lower levels of dental anxiety [26]. Hence, a
5
6 school sample is generally considered more representative. Future studies are required to further
7
8 relate CFSS-DS scores to broader risk factors and/or physiological observations of children during
9
10 dental treatment, then the tool will help clinicians recognize children in need of extra attention and
11
12 subsequently select the most appropriate treatment approach and evaluate the outcome of
13
14 interventions.
15
16
17
18
19
20
21
22

23 CONCLUSIONS

24
25
26 The assessment in this study provides an overall picture of dental anxiety in Chinese-speaking
27
28 populations, age is significant determinant for children's dental anxiety. Furthermore, in recent
29
30 years, parts of children's dental anxiety tends to decrease with time.
31
32
33
34
35
36

37 **Acknowledgments** The authors would like to thank the volunteers for their valuable participation, and Cuthbert
38
39 and Melamed for the original CFSS-DS design, and the individuals who piloted the surveys and provided further
40
41 feedback during the investigation.
42

43 **Contributors** SG contributed to the data analysis and manuscript preparation. JL and PL contributed to the
44
45 material preparation and data collection. WZ and DY supervised the data collection, data analysis and critical
46
47 revisions. All authors contributed to the study conception and design and approved the final manuscript.
48

49 **Funding** This study was supported by the Research Fund of Department of Health of Guangdong Province
50
51 (WSTJJ20061120), the National Natural Science Foundation of China (81974146, 81873711), the Natural Science
52
53 Foundation of Guangdong Province (2014A030313126) and the Science and Technology Planning Project of
54
55 Guangdong Province (2016A020215094) to ZhaoWei.
56

57 **Competing interests** None declared.
58

59 **Ethical approval and consent to participate** All procedures performed involving human participants were in
60

1
2
3
4 accordance with the ethical standards of the institutional research committee. Informed written consent was taken
5
6 from parents of each participating child.

7
8 **Provenance and peer review** Not commissioned; externally peer reviewed.

9
10 **Data availability statement** The datasets used and/or analyzed during the current study are available from the
11
12 corresponding author on reasonable request.

13 14 15 16 17 18 **REFERENCES**

- 19
20
21 1. Diagnostic and statistical manual of mental disorders. (2013). 5th ed. Arlington, VA: American Psychiatric
22
23 Publishing.
- 24
25 2. Xiang B, Wong HM, Perfecto AP, McGrath CPJ. (2020). The association of socio-economic status, dental
26
27 anxiety, and behavioral and clinical variables with adolescents' oral health-related quality of life. *Qual Life*
28
29 *Res*, Apr 19.
- 30
31 3. van Wijk AJ, J Hoogstraten. (2005). Experience With Dental Pain and Fear of Dental Pain. *J Dent Res*,
32
33 84(10), 947-50.
- 34
35 4. Wogelius P, Poulsen S, Sorensen HT. (2003). Prevalence of dental anxiety and behavior management
36
37 problems among six to eight years old Danish children. *Acta Odontol Scand*, 61(3), 178-83.
- 38
39 5. Celeste RK, Eyjólfsdóttir HS, Lennartsson C, Fritzell J. (2020). Socioeconomic Life Course Models and Oral
40
41 Health: A Longitudinal Analysis. *J Dent Res*, 99(3), 257-263.
- 42
43 6. Venham L, Bengston D, Cipes M. (1977). Children's response to sequential dental visits. *J Dent Res*, 56,
44
45 454-59.
- 46
47 7. Cuthbert MI, Melamed BG. (1982). A screening device: children at risk for dental fears and management
48
49 problems. *J Dent Child*, 49, 432-36.
- 50
51 8. Arapostathis KN, Coolidge T, Emmanouil D, Kotsanos N. (2008). Reliability and validity of the Greek
52
53 version of the Children's fear survey schedule-dental subscale. *Int J Paediatric Dent*, 18(5), 374-9.
- 54
55 9. Jia-xuan Lu, Dongsheng Yu, Wei Luo, Xiaofen Xiao, Wei Zhao. (2011). Development of Chinese Version of
56
57 Children's Fear Survey Schedule-Dental Subscale. *Zhonghua Kou Qiang Yi Xue Za Zhi*, 46(4), 218-21.
- 58
59 10. Boka V, Arapostathis K, Karagiannis V, Kotsanos N, van Loveren C, Veerkamp J. (2017). Dental fear and
60
61 caries in 6-12 year old children in Greece. Determination of dental fear cut-off points. *Eur J Paediatr Dent*,

- 1
2
3
4 18(1), 45.
- 5
6 11. Cianetti S, Lombardo G, Lupatelli E, Pagano S, Abraha I, Montedori A, et al. (2017). Dental fear/anxiety
7 among children and adolescents. A systematic review. *Eur J Paediatr Dent*, 18(2), 121-130.
- 8
9 12. Rajwar AS, Goswami M. (2017). Prevalence of dental fear and its causes using three measurement scales
10 among children in New Delhi. *J Indian Soc Pedod Prev Dent*, 35(2), 128-133.
- 11
12
13 13. Wu L, Gao X. (2018). Children's dental fear and anxiety: exploring family related factors. *BMC Oral*
14 *Health*, 18(1), 100.
- 15
16
17 14. Milgrom P, Mancl L, King B, Weinstein P. (1995). Origins of childhood dental fear. *Behav Res Ther*, 33,
18 313-19.
- 19
20
21 15. Yamada MKM. (2002). Cooperation during dental treatment: the Children's Fear Survey Schedule in
22 Japanese children. *Int J Paediatr Dent*, 12, 404-409.
- 23
24
25 16. Frankl SN, Shiere F, Fogels HR. (1962). Should the parent remain with the child in the dental operator? *J*
26 *Dent Child*, 29, 150-163.
- 27
28
29 17. Baier K, Milgrom P, Russell S, Mancl L, Yoshida T. (2004). Children's fear and behavior in private
30 pediatric dentistry practices. *Pediatr Dent*, 26(4), 316-21.
- 31
32
33 18. Locker D, Thomson WM, Poulton R. (2001). Psychological disorder, conditioning experiences, and the
34 onset of dental anxiety in early adulthood. *J Dent Res*, 80, 1588-92.
- 35
36
37 19. Buchanan H, Niven N. (2003). Further evidence for the validity of the Facial Image Scale. *Int J Paediatr*
38 *Dent*, 13, 368-9.
- 39
40
41 20. ten Berge M, Veerkamp JS, Hoogstraten J, Prins PJ. (2002). Childhood dental fear in the Netherlands:
42 prevalence and normative data. *Community Dent Oral Epidemiol*, 30(2), 101-7.
- 43
44
45 21. El-Housseiny AA, Merdad LA, Alamoudi NM, Farsi NM. (2015). Effect of child and parent characteristics
46 on child dental fear ratings: analysis of short and full versions of the children's fear survey schedule-dental
47 subscale. *Oral Health Dent Manage*, 14, 245-46.
- 48
49
50 22. Alshoraim MA, El-Housseiny AA, Farsi NM, Felemban OM, Alamoudi NM, Alandejani AA. (2018).
51 Effects of child characteristics and dental history on dental fear: cross-sectional study. *BMC Oral Health*,
52 18(1), 33.
- 53
54
55 23. AlMaummar M, AlThabit HO, Pani S. (2019). The impact of dental treatment and age on salivary cortisol
56 and alpha-amylase levels of patients with varying degrees of dental anxiety. *BMC Oral Health*, 19(1), 211.
- 57
58
59 24. Aminabadi NA, Sohrabi A, Erfanparast LK, Oskouei SG, Ajami BA. (2011). Can birth order affect
60

1
2
3
4 temperament, anxiety and behavior in 5 to 7-year-old children in the dental setting? *J Contemp Dent Pract*,
5
6 12, 225-231.

7
8 25. Alvesalo I, Murtomaa H, Milgrom P, Honkanen A, Karjalainen M, Tay K-M. (1993). The Dental Fear
9
10 Survey Schedule:a study with Finnish children. *Int J Paediatr Dent*, 3, 15-20.

11
12 26. Nakai Y, Hirakawa T, Milgrom P, Coolidge T, Heima M, Mori Y, et al. (2005). The children's fear survey
13
14 schedule–dental subscale in Japan. *Community Dent Oral Epidemiol*, 33, 196-204.

15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

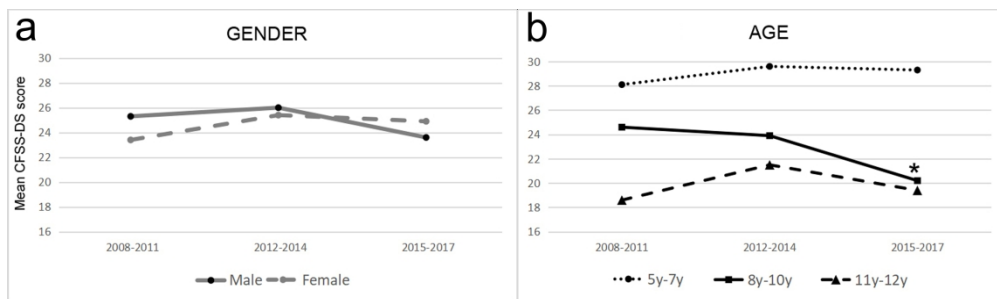


Fig. 1. CFSS-DS scores by gender and age. *Statistically significant (p < 0.05)

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) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —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 <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	5-6
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —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

1			
2	Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
3			5-6
4			
5	Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding
6			6-7
7			
8			
9			(b) Describe any methods used to examine subgroups and interactions
10			6
11			
12			(c) Explain how missing data were addressed
13			6
14			
15			(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed
16			
17			<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed
18			
19			<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy
20			
21			
22			
23			(e) Describe any sensitivity analyses
24			6

Continued on next page

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60**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) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	7
Outcome data	15 *	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	7-10
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —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

1
2 Funding 22 Give the source of funding and the role of the funders for the present study and, if
3 applicable, for the original study on which the present article is based
4
5
6

15

7 *Give information separately for cases and controls in case-control studies and, if applicable, for exposed and
8 unexposed groups in cohort and cross-sectional studies.
9

10
11
12
13 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and
14 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely
15 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at
16 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is
17 available at www.strobe-statement.org.
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-043647.R1
Article Type:	Original research
Date Submitted by the Author:	25-Nov-2020
Complete List of Authors:	Gao, Shuo; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Lu, Jiaxuan ; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Li, Pei; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Yu, Dongsheng; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Zhao, Wei; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology
Primary Subject Heading:	Dentistry and oral medicine
Secondary Subject Heading:	Dentistry and oral medicine
Keywords:	Child protection < PAEDIATRICS, Anxiety disorders < PSYCHIATRY, PUBLIC HEALTH

SCHOLARONE™
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1
2
3
4 **Prevalence and risk factors of children's dental anxiety in China: A**
5
6 **longitudinal study**
7
8
9

10
11
12 **Shuo Gao, Jiaxuan Lu, Pei Li, Dongsheng Yu and Wei Zhao***
13

14
15 Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology,
16
17 Guangdong Provincial Key Laboratory of Stomatology, Sun Yat-sen University, Guangzhou,
18
19 Guangdong, China; gaosh7@mail.sysu.edu.cn (S.G.)
20
21
22

23 **Corresponding Authors:**
24

25
26 Wei Zhao*, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of
27
28 Stomatology, Guangdong Provincial Key Laboratory of Stomatology, Sun Yat-Sen University,
29
30 No. 56, Lingyuan West Road, Yuexiu District, Guangzhou, Guangdong 510055, China.
31

32
33 Email: zhaowei3@mail.sysu.edu.cn
34
35
36
37
38

39 **ABSTRACT**
40
41

42 **Objectives** Dental anxiety remains widespread among children, may continue into adulthood and
43
44 affect their oral health-related quality of life and clinical management. The aim of the study was to
45
46 explore the trend of children's dental anxiety over time and potential risk factors.
47
48
49

50
51 **Design** Longitudinal study
52

53
54 **Methods** Children aged between 5 and 12 years were investigated with the Chinese version of
55
56 face version of Children's Fear Survey Schedule-Dental Subscale (CFSS-DS) and Frankl
57
58 Behavior Rating scale from 2008 to 2017, and influential factors were explored.
59
60

1
2
3
4 **Results** Clinical data were available from 1061 children, including 533 (50.2%) male participants
5
6 and 528 (49.8%) female participants. The total CFSS-DS scores ranged from 16 to 66, with a
7
8 mean of 24.8 ± 10.3 . The prevalence of dental anxiety is 11.59%. No significant differences in total
9
10 CFSS-DS scores between females and males were found. According to the Frankl scale, 238
11
12 children were allocated to the uncooperative group and the remaining 823 children were allocated
13
14 to the cooperative group. Scores of CFSS-DS were negatively correlated with the clinical behavior
15
16 level of Frankl. 11-12-year-old children had significantly decreased scores compared to other age
17
18 groups, and there was a decline in the scores of 8-10-year-old group over time. The factor analysis
19
20 divided 15 items of CFSS-DS into four factors, and the total scores of 'less invasive oral
21
22 procedures' items belonging to factor III decreased significantly over time in the 8-10-year-old
23
24 group.
25
26
27
28
29
30
31

32
33 **Conclusions** Age is a significant determinant for children's dental anxiety, and dental anxiety
34
35 outcomes have improved for Chinese children aged 8-10 years. This study is one of the few
36
37 reports on changes of children dental anxiety in a new era of information, but the results may be
38
39 extrapolated to other populations with caution.
40
41
42
43
44
45
46
47

48 **Strengths and limitations of this study**

- 49
50
51 ► This study is a systematic longitudinal survey with representative data obtained for comparison
52
53 of time trends of children dental anxiety in multiple age groups.
54
55
56
57 ► The duration of this observational study spanned a decade.
58
59
60

1
2
3
4 ▶ The Chinese version CFSS-DS with facial image scale showed good applicability in clinical
5
6 practice.

7
8
9
10 ▶ Tri blindness paradigm was employed to avoid bias as much as possible.

11
12
13 ▶ The sample size of this survey, the region and age range of the research objects are limited.
14
15

16 17 18 19 20 **INTRODUCTON**

21
22
23 Dental fear and anxiety refers to a feeling of dread and anticipation that something will happen,
24
25 combined with a sense of losing control in relation to dentistry. Dental phobia is defined as a more
26
27 severe form that leads to an out of proportion reaction and interferes with daily life [1]. A
28
29 significant problem in patient management as such patients are more likely to avoid or delay
30
31 dental treatment is related to dental anxiety, further leading to a vicious circle where the levels of
32
33 dental anxiety are reinforced as a result of greater disease severity and greater dental treatment
34
35 needs [2, 3].
36
37
38
39
40
41

42
43 Childhood dental anxiety has been shown to be widespread, and research has suggested the
44
45 adults often acquire such fears in childhood [4], and the early-life social and biological factors
46
47 have long-lasting effects on health later in life [5]. Child's dental anxiety predicts more dental
48
49 disease and poorer oral health in measures, such as decay experience, the presence of untreated
50
51 dental infection and treatment that carries more risk, that results in a detrimental effect on the
52
53 quality of the life of the individual and family and engagement in oral health-related behaviours
54
55 [6, 7]. For many years, dental anxiety in children has been recognized as a source of problems in
56
57
58
59
60

1
2
3
4 patient management [8]. Identifying anxiety in children at the earliest possible age is essential and
5
6 helpful to select methods of behavior management. In the literature of recent years, there is
7
8 considerable variation in the designs of study and target populations, particularly in the scales
9
10 used for measurement and the age of the children, so that the reported prevalence of dental fear
11
12 and anxiety in children varies widely, ranging from 7.4% [9] to 93.8% [10]. It can be said that
13
14 there is currently no fully ideal dental anxiety scale for children in use. Efforts should therefore
15
16 continue to be directed towards the development and validation of suitable instruments for the
17
18 detection of dental anxiety in children.
19
20
21
22
23
24

25 The Dental Sub-scale of Children's Fear Survey Schedule (CFSS-DS) is a frequently used
26
27 measure of children's dental anxiety [11]. Then the facial version CFSS-DS was first proposed by
28
29 Arapostathis in 2007 [12]. In several countries, the scale has demonstrated good reliability and
30
31 acceptable validity and has been used to estimate the prevalence of dental anxiety, and evaluate
32
33 the behavior-management procedures used for child patients. The Chinese version CFSS-DS was
34
35 established the cross-cultural adaptation and showed good psychometric properties [13]. The
36
37 prevalence of dental anxiety according to CFSS-DS varies considerably in the international
38
39 literature ranging from 2.4% to 28.3% in different populations and cultural backgrounds [9,
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
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

1
2
3
4 higher chance of dental anxiety [18]. Patterns of dental visits and previous experiences have also
5
6 important impact in dental fear occurrence [19]. Studies demonstrated that subjects with higher
7
8 social and financial resources show lower prevalence of dental anxiety [20]. The potential risk
9
10 factors of dental anxiety are likely to be different from each person. Thus, further investigation
11
12 into intrinsic and environmental factors associated with dental anxiety is needed. To date,
13
14 relatively few published study evaluated the dental anxiety of children and behavioral influence
15
16 factors in dental settings in China. Moreover, the trends of children's dental anxiety over time are
17
18 poorly characterized. The objective of this research is to provide normative data on dental anxiety
19
20 of Chinese children, and describe and compare the influence of relevant factors on dental anxiety
21
22 in a decade.
23
24
25
26
27
28
29
30
31
32

33 **METHODS**

34 **Participants and procedures**

35
36
37 The study was conducted at the department of Pediatric Stomatology, affiliated Stomatology
38
39 Hospital of Sun Yat-sen University, during 10 years (August 2008 - October 2017). The children
40
41 patients aged 5 to 12 years old were selected randomly to participate in the study. Inclusion
42
43 criteria were children with no mental retardation or developmental disorders; no cognitive
44
45 impairment or psychiatric history; no serious congenital and acquired oral and maxillofacial
46
47 deformities. The Ethics Committee of the Institute of Stomatological Research, Sun Yat-sen
48
49 University, China, gave approval for the study. Before entering the study, each parent and child
50
51 were well informed about the purpose of the study and affirmed that participation was voluntary.
52
53
54
55
56
57
58
59
60

1
2
3
4 Parents were distributed informative leaflets about the procedure and were asked to provide
5
6 written consent.
7
8
9

10 11 12 13 **Chinese version CFSS-DS with FIS** 14 15

16 The Chinese version CFSS-DS was adopted, which consists of 15 items and a five-point pictorial
17
18 scale, that is, the Facial Image Scale (FIS). The FIS consists of five drawings of a face, displaying
19
20 affective features ranging from extremely negative (score 5) through neutral to extremely positive
21
22 (score 1). The total score ranges from 15 to 75. Children are presented with the five images and
23
24 are asked to select which one best corresponds to how they are feeling. The FIS is a reliable and
25
26 valid method for children's self-report of dental anxiety in subjects as young as three years old
27
28 [21, 22]. In this study, the pilot test of Chinese version CFSS-DS with FIS was carried on 32
29
30 children and their parents, in order to clarify whether young children could answer the CFSS-DS
31
32 items with reference to the facial images (results not shown).
33
34
35
36
37
38
39
40
41
42
43

44 **Measures** 45 46

47 Children's dental anxiety over the ten-year period was investigated, which was a randomized
48
49 triple-blinded longitudinal study. Data collection included children's completion of the Chinese
50
51 version CFSS-DS with FIS and evaluation of behavior during dental visit. Upon entering the
52
53 waiting room, the children were invited to fill in the Chinese version CFSS-DS with FIS. Any
54
55 child experiencing difficulty in reading the questions was assisted by the receptionist. At the same
56
57 time, the parents (in almost all cases, the mother) provided a dental health questionnaire related to
58
59
60

1
2
3
4 demographic information and previous dental experiences. The gender, age, and source of referral
5
6 of the participants were recorded. After the completion of the CFSS-DS, the children were invited
7
8 into the operatory for regular dental examination. The dentist and dental nurse were unaware of
9
10 the children's responses to the questionnaire. During examinations, the behavior and facial
11
12 expressions of the children were recorded by video cameras, which were later rated according to
13
14 the Frankl scale [23]. To ensure sample "blindness", the rater did not have access to the CFSS-DS
15
16 scores of the children and assigned the children with behaviors classified as "definitely positive"
17
18 (the dentist and child share good rapport, the child is laughing) and "positive" (willingness to
19
20 comply, cautiousness) to the cooperative group, whereas those with behaviors classified as
21
22 "definitely negative" (fearful behavior, forceful crying) and "negative" (reluctance and/or
23
24 uncooperativeness, but not as severe as in the previous category) were assigned to the
25
26 uncooperative group.
27
28
29
30
31
32
33
34
35
36
37
38

39 **Data Processing and Statistical Analysis**

40
41
42 The data from all the children who had completed the Chinese version CFSS-DS and finished the
43
44 dental examination on one occasion were used to provide normative data. If there is one item in
45
46 one scale that is not answered, it will be treated as missing item, and the data of missing entries is
47
48 replaced by the mean of the remaining samples with complete data; if there are two or more items
49
50 that are not answered, it will be eliminated to the invalid scale.
51
52
53
54

55
56 Data management and analysis were conducted using SPSS version 16.0. The associations
57
58 between CFSS-DS scores and demographic variables were analysed using the t-tests and one-way
59
60

1
2
3
4 analysis of variances (ANOVA). When significant effects were found, Tukey post-hoc test was
5
6 used to determine significant intergroup mean differences. Factor analysis (principal components,
7
8 varimax rotation) was employed to assess the factor structure [24, 25], and factor scores above 0.5
9
10 indicate strong loading on a particular subset of items. Kruskal Wallis rank sum test was used to
11
12 evaluate the differences of gender groups and age groups among three time periods. $p < 0.05$ is
13
14 statistically significant.
15
16
17
18
19
20
21
22

23 **Patient and public involvement**

24
25
26 Participation in this survey is voluntary for each child and his/her parents. The receptionists or
27
28 assistants helped understand the items and complete the scale. The children and their parents were
29
30 not involved in the design, recruitment or conduct of the study.
31
32
33
34
35
36
37

38 **RESULTS**

39 **Characterization of the sample**

40
41
42 For the analysis of dental anxiety in children, the representative sample selected randomly who
43
44 were treated in Department of Pediatric Stomatology, and 1061 copies of the effective scale were
45
46 received from August 2008 to October 2017. Of those eligible, there were 533 (50.2%) male
47
48 participants and 528 (49.8%) female participants. There was no significant difference in the ratio
49
50 of patient's gender, or their evaluation of economic level by treatment status. 411 children aged
51
52 5-7 years accounted for 38.7%, 399 children aged 8-10 years accounted for 37.6% and 251 aged
53
54
55
56
57
58
59
60

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

1
2
3
4 dental anxiety in this sample is 11.59%, and 88.41% of the children did not suffer from it.
5
6
7 According to the Frankl scale, 238 children assessed were allocated to the uncooperative group
8
9 and the remaining 823 children were allocated to the cooperative group. The distribution patterns
10
11 of CFSS-DS scores were very different between the two groups. Children of the uncooperative
12
13 group tended to report dental anxiety, as compared with cooperative children (30.67% vs. 6.08%)
14
15 (Table 3). The results showed that the CFSS-DS scores were correlated negatively with the Frankl
16
17 behavior level. That is, there is a certain consistency between the CFSS-DS score and the clinical
18
19 performance.
20
21
22
23
24
25

26 **Table 2** Children's dental anxiety in the Chinese version CFSS-DS
27

		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

Variables	2008-2011		2012-2014		2015-2017	
	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		
		I	II	III	IV	of 8-10-year-old children		
Items in CFSS-DS		(22.6)	(17.3)	(12.1)	(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'					4.15	3.01	2.03*
4	Having someone examine your mouth	0.256	0.303	0.764	0.099			
5	Having to open your mouth	0.233	0.034	0.657	0.113			
IV	Distrust of strangers or unfamiliar objects					2.59	2.72	2.56
6	Having a stranger touch you	0.201	0.189	-0.037	0.821			
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

1
2
3
4 required to implement appropriate behavioral induction measures to reduce dental anxiety. It has
5
6 been suggested that dental anxiety decreases with repeated exposure to dental procedures [33].
7
8 However, in the uncooperative group older children seemed not to be able to overcome their
9
10 dental anxiety, which caused behavior management problems. At this time more risk factors
11
12 should be considered, such as previous medical experience, family structure, etc.
13
14
15
16

17
18 The CFSS-DS scores in the international literature in recent years varies with different
19
20 populations and dental situations. The mean score in the present study was 24.8 ± 10.3 , which was
21
22 comparatively lower than scores from studies in Brazil (29.3 ± 10.5) [34], Hong Kong (29.1 ± 11.0)
23
24 [16], Greece (27.1 ± 10.8) [14], Egypt (26.09 ± 10.70) [26] and Jeddah, Saudi Arabia (25.99 ± 9.3)
25
26 [17]. CFSS-DS scores in the current study did not differ greatly from data from these previous
27
28 studies, that may be due to the similar age range of the subjects and different cultural parameters.
29
30
31
32

33
34 It is necessary to determine the cut-off point for distinguishing between children who are
35
36 more prone to dental anxiety that is helpful for clinicians to choose appropriate behavior
37
38 management measures. Generally, dental anxiety is measured according to clear cut-off points on
39
40 continuous measure that acts as a categorical boundary. In view of the balance of the sensitivity
41
42 and specificity in the measurement of scale, different prevalence estimates depend on the different
43
44 cut-off values used to define "dental anxiety". Children dental anxiety cut-off points on CFSS-DS
45
46 are already defined in several researches, but the conclusions are not all the same. In the present
47
48 study, the participated children with CFSS-DS scores of 38 and higher [26-32] were considered as
49
50 dentally anxious. There is still a need for further research to find more desirable instrument for
51
52 understanding the dental anxiety of children and adolescents.
53
54
55
56
57
58
59
60

1
2
3
4 Demographically this study found no difference in dental anxiety between females and
5
6 males, that is supported by previous studies [14, 20, 34-39]. This is however contrary to other
7
8 studies which have reported more girls than boys in the anxious group [12, 17, 26]. Contradictory
9
10 research findings may be explained by different study designs and methods of data collection,
11
12 moreover, gender influences should be regarded in combination with other factors such as local
13
14 culture and socioeconomic status of the family.
15
16
17
18
19

20 Bad dental experience is considered as one of life-long stress situations for children [40]. As
21
22 cultural and social behavioral norms can affect the development and expression of children's
23
24 dental anxiety, and as dental care systems can vary considerably across cultures, normative data in
25
26 each culture are needed. The main strength of this study was the continuous assessment over a
27
28 10-year period, which provides information on the development and progression of dental anxiety
29
30 during the important life course, when children transition from the primary to the permanent
31
32 dentition and mental state grows enormously. To our knowledge, this is the first study to use
33
34 representative data from China for comparison of time trends of children dental anxiety in
35
36 multiple age groups. The study showed that dental anxiety seems to decrease with increasing age
37
38 and this is in agreement with previous studies [17]. The results showed that 8-10-year-old children
39
40 recent years exhibited less fear and anxiety in dental procedures compared with children of the
41
42 same age in the initial period of this study, indicating that the change in social environment
43
44 experienced in these years influences the incidence and progression of dental anxiety and its
45
46 outcomes have improved for children in Guangdong Province. The researchers conclude that the
47
48 possible reasons for these findings would be the oral health education in the mass media,
49
50 especially the Internet, which has enhanced the cognition and acceptance of oral treatment for the
51
52
53
54
55
56
57
58
59
60

1
2
3
4 older children. But the effect was not obvious to preschool children because of their limited
5
6 cognitive ability. However, children dental anxiety were influenced by a multiplicity of interacting
7
8 environmental factors including words and deeds of people around; any single influence is
9
10 dubious to clarify much divergence. So the positive trend of parents towards dental procedures
11
12 may be passed on to children indirectly, which may also be due to the growing public awareness.
13
14
15

16
17 Factor analyses, which are conventionally used to evaluate the construct validity of scales,
18
19 have been previously reported in CFSS-DS studies of different populations. In Netherlands and
20
21 Finland, investigators divided the scale items into three factors, and the connotation of them were
22
23 as follows: 1) fear of highly invasive procedures, 2) fear of potential ‘victimization’ and 3) fear of
24
25 less invasive procedures [24]. In the present research, factor analysis resulted in four factors.
26
27
28 There were 1) fear of highly invasive dental procedures, 2) fear of general medical aspects of
29
30 treatment, 3) fear of less invasive procedures and potential ‘victimization’, and 4) fear of strangers
31
32 or unfamiliar objects. Despite minor differences in populations and methods, similar results were
33
34 found in the aforementioned studies in other cultures [4, 41], indicating that the setting of
35
36 psychological and behavioral scale conforms to the theoretical conception of the design in this
37
38 study. The results of factor analysis also provided some support for the conclusion above: the less
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
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

1
2
3
4 “drilling”, in order to further reduce the public's fear of specific dental operations.
5
6

7 The limitation to our study design should be pointed out. The sample was taken from a single
8
9
10 medical institution, which the group of children represented by are more inclined to show the
11
12 behavior of visiting a dentist, probably because of lower levels of dental anxiety [42]. The
13
14 generalizability of our results cannot be directly extrapolated to broader urban populations. Hence,
15
16 a school sample is generally considered more representative. However, the school sample may
17
18 have introduced recall bias, and children without dental experience are likely to have difficulty
19
20 answering items such as "drilling" that they had never experienced previously [12, 43, 44]. There
21
22 may be a need for a comparative study between the clinic and school samples. Another limitation
23
24 of the present study is that the presence of parents when children respond to the scale reduces
25
26 privacy, which may lead to the children's answering in line with parents' expectations and social
27
28 expectations. Perhaps this problem could be mitigated by having the items interpreted by the
29
30 investigators rather than the parents. Future studies are required to further relate CFSS-DS scores
31
32 to broader risk factors and/or physiological observations of children during dental treatment, then
33
34 the tool will help clinicians recognize children in need of extra attention and subsequently select
35
36 the most appropriate treatment approach and evaluate the outcome of interventions.
37
38
39
40
41
42
43
44
45
46
47
48
49

50 **CONCLUSIONS**

51
52
53 The assessment in this study provides an overall picture of dental anxiety in Chinese-speaking
54
55 populations, age is significant determinant for children's dental anxiety. Furthermore, in recent
56
57 years, parts of children's dental anxiety tends to decrease with time.
58
59
60

1
2
3
4
5
6
7 **Acknowledgments** The authors would like to thank the volunteers and patient advisers for their valuable
8 participation, and Cuthbert and Melamed for the original CFSS-DS design, and the individuals who piloted the
9 surveys and provided further feedback during the investigation.
10
11

12
13 **Contributors** SG contributed to the data analysis and manuscript preparation. JL and PL contributed to the
14 material preparation and data collection. WZ and DY supervised the data collection, data analysis and critical
15 revisions. All authors contributed to the study conception and design and approved the final manuscript.
16
17
18

19
20 **Funding** This study was supported by the Research Fund of Department of Health of Guangdong Province
21 (WSTJJ20061120), the National Natural Science Foundation of China (81974146, 81873711), the Natural Science
22 Foundation of Guangdong Province (2014A030313126) and the Science and Technology Planning Project of
23 Guangdong Province (2016A020215094) to ZhaoWei.
24
25
26
27

28
29 **Competing interests** None declared.
30

31 **Ethical approval and consent to participate** All procedures performed involving human participants were in
32 accordance with the ethical standards of the institutional research committee. Informed written consent was taken
33 from parents of each participating child.
34
35
36

37
38 **Provenance and peer review** Not commissioned; externally peer reviewed.
39

40 **Data availability statement** The datasets used and/or analyzed during the current study are available from the
41 corresponding author on reasonable request.
42
43
44
45
46
47

48 REFERENCES

- 49
50
51 1. Diagnostic and statistical manual of mental disorders. (2013). 5th ed. Arlington, VA: American Psychiatric
52 Publishing.
53
54
55 2. Xiang B, Wong HM, Perfecto AP, McGrath CPJ. (2020). The association of socio-economic status, dental
56 anxiety, and behavioral and clinical variables with adolescents' oral health-related quality of life. *Qual Life*
57 *Res*, Apr 19.
58
59
60

- 1
2
3
4 3. van Wijk AJ, J Hoogstraten. (2005). Experience With Dental Pain and Fear of Dental Pain. *J Dent Res*,
5 84(10), 947-50.
6
7
- 8 4. Wogelius P, Poulsen S, Sorensen HT. (2003). Prevalence of dental anxiety and behavior management
9 problems among six to eight years old Danish children. *Acta Odontol Scand*, 61(3), 178-83.
10
11
- 12 5. Celeste RK, Eyjólfssdóttir HS, Lennartsson C, Fritzell J. (2020). Socioeconomic Life Course Models and Oral
13 Health: A Longitudinal Analysis. *J Dent Res*, 99(3), 257-263.
14
15
- 16 6. Coxon JD, Hosey MT, Newton JT. (2019). The impact of dental anxiety on the oral health of children aged 5
17 and 8 years: a regression analysis of the Child Dental Health Survey 2013. *Br Dent J*, 227(9), 818-22.
18
19
20
21
- 22 7. Coxon JD, Hosey MT, Newton JT. (2019). The oral health of dentally anxious five- and eight-year-olds: a
23 secondary analysis of the 2013 Child Dental Health Survey. *Br Dent J*, 226(7), 503-7.
24
25
26
- 27 8. Venham L, Bengston D, Cipes M. (1977). Children's response to sequential dental visits. *J Dent Res*, 56,
28 454-59.
29
30
- 31 9. Rajwar AS, Goswami M. (2017). Prevalence of dental fear and its causes using three measurement scales
32 among children in New Delhi. *J Indian Soc Pedod Prev Dent*, 35(2), 128-133.
33
34
35
- 36 10. Sarapultseva M, Yarushina M, Kritsky I, Ibragimov R, Sarapultsev A. (2020). Prevalence of Dental Fear
37 and Anxiety among Russian Children of Different Ages: The Cross-Sectional Study. *Eur J Dent*, 14(4),
38 621-5.
39
40
41
42
43
44
45
- 46 11. Cuthbert MI, Melamed BG. (1982). A screening device: children at risk for dental fears and management
47 problems. *J Dent Child*, 49, 432-36.
48
49
- 50 12. Arapostathis KN, Coolidge T, Emmanouil D, Kotsanos N. (2008). Reliability and validity of the Greek
51 version of the Children's fear survey schedule-dental subscale. *Int J Paediatric Dent*, 18(5), 374-9.
52
53
54
- 55 13. Jia-xuan Lu, Dongsheng Yu, Wei Luo, Xiaofen Xiao, Wei Zhao. (2011). Development of Chinese Version
56 of Children's Fear Survey Schedule-Dental Subscale. *Zhonghua Kou Qiang Yi Xue Za Zhi*, 46(4), 218-21.
57
58
59
60

- 1
2
3
4 14. Boka V, Arapostathis K, Karagiannis V, Kotsanos N, van Loveren C, Veerkamp J. (2017). Dental fear and
5 caries in 6-12 year old children in Greece. Determination of dental fear cut-off points. *Eur J Paediatr Dent*,
6 18(1), 45.
7
8
9
10 15. Cianetti S, Lombardo G, Lupatelli E, Pagano S, Abraha I, Montedori A, et al. (2017). Dental fear/anxiety
11 among children and adolescents. A systematic review. *Eur J Paediatr Dent*, 18(2), 121-130.
12
13
14 16. Wu L, Gao X. (2018). Children's dental fear and anxiety: exploring family related factors. *BMC Oral*
15 *Health*, 18(1), 100.
16
17
18
19 17. Alshoraim MA, El-Housseiny AA, Farsi NM, Felemban OM, Alamoudi NM, Alandejani AA. (2018).
20 Effects of child characteristics and dental history on dental fear: cross-sectional study. *BMC Oral Health*,
21 18(1), 33.
22
23
24
25
26 18. Soares FC, Lima RA, Salvador DM, de Barros MVG, Dahllöf G, Colares V. (2020). Reciprocal longitudinal
27 relationship between dental fear and oral health in schoolchildren. *Int J Paediatr Dent*, 30(3), 286-92.
28
29
30
31
32 19. Barreto KA, Dos Prazeres LD, Lima DS, Soares FC, Rediviyo RM, da Franca C, Colares V. (2017). Factors
33 associated with dental anxiety in Brazilian children during the first transitional period of the mixed dentition.
34
35
36
37
38 *Eur Arch Paediatr Dent*, 18(1), 39-43.
39
40
41 20. Soares FC, Lima RA, Santos Cda F, de Barros MV, Colares V. (2016). Predictors of dental anxiety in
42 Brazilian 5-7years old children. *Compr Psychiatry*, 67, 46-53.
43
44
45
46
47 21. Milgrom P, Mancl L, King B, Weinstein P. (1995). Origins of childhood dental fear. *Behav Res Ther*, 33,
48 313-19.
49
50
51 22. Yamada MKM. (2002). Cooperation during dental treatment: the Children's Fear Survey Schedule in
52 Japanese children. *Int J Paediatr Dent*, 12, 404-409.
53
54
55
56 23. Frankl SN, Shiere F, Fogels HR. (1962). Should the parent remain with the child in the dental operator? *J*
57 *Dent Child*, 29, 150-163.
58
59
60

- 1
2
3
4 24. Baier K, Milgrom P, Russell S, Mancl L, Yoshida T. (2004). Children's fear and behavior in private
5 pediatric dentistry practices. *Pediatr Dent*, 26(4), 316-21.
6
7
8 25. Locker D, Thomson WM, Poulton R. (2001). Psychological disorder, conditioning experiences, and the
9 onset of dental anxiety in early adulthood. *J Dent Res*, 80, 1588-92.
10
11
12
13 26. Alsadat FA, El-Housseiny AA, Alamoudi NM, Elderwi DA, Ainoso AM, Dardeer FM. (2018). Dental Fear
14 in Primary School Children and its Relation to Dental Caries. *Niger J Clin Pract*, 21(11), 1454-60.
15
16
17
18 27. Kakkar M, Wahi A, Thakkar R, Vohra I, Shukla AK. (2016). Prevalence of dental anxiety in 10-14 years
19 old children and its implications. *J Dent Anesth Pain Med*, 16(3), 199-202.
20
21
22
23 28. Ghaderi F, Fijan S, Hamedani S. (2015). How Do Children Behave Regarding Their Birth Order in Dental
24 Setting? *Dent Shiraz Univ Med Sci*, 16(4), 329-34.
25
26
27
28 29. Majstorovic M, Morse DE, Do D, Lim L, Herman NG, Moursi AM. (2014). Indicators of dental anxiety in
29 children just prior to treatment. *J Clin Pediatr Dent*, 39, 12-7.
30
31
32
33 30. Bajric E, Kobaslija S, Juric H. (2011). Reliability and validity of Dental Subscale of the Children's Fear
34 Survey Schedule (CFSS-DS) in children in Bosnia and Herzegovina. *Bosn J Basic Med Sci*, 11, 214-8.
35
36
37
38 31. Akbay Oba A, Dulgergil CT, Sonmez IS. (2009). Prevalence of dental anxiety in 7- to 11-year-old children
39 and its relationship to dental caries. *Med Princ Pract*, 18, 453-7.
40
41
42
43 32. Venham LL, Gaulin-Kremer E, Munster E, Bengston-Audia D, Cohan J. (1980). Interval rating scales for
44 children's dental anxiety and uncooperative behavior. *Pediatr Dent*, 2, 195-202.
45
46
47
48 33. Buchanan H, Niven N. (2003). Further evidence for the validity of the Facial Image Scale. *Int J Paediatr*
49 *Dent*, 13, 368-9.
50
51
52
53
54
55
56
57
58
59
60

- 1
2
3
4 34. Cademartori MG, Cara G, Pinto GDS, da Costa VPP. (2019). Validity of the Brazilian version of the Dental
5
6 Subscale of Children's Fear Survey Schedule. *Int J Paediatr Dent*, 29(6), 736-747.
7
8
9
10 35. ten Berge M, Veerkamp JS, Hoogstraten J, Prins PJ. (2002). Childhood dental fear in the Netherlands:
11
12 prevalence and normative data. *Community Dent Oral Epidemiol*, 30(2), 101-7.
13
14 36. El-Housseiny AA, Merdad LA, Alamoudi NM, Farsi NM. (2015). Effect of child and parent characteristics
15
16 on child dental fear ratings: analysis of short and full versions of the children's fear survey schedule-dental
17
18 subscale. *Oral Health Dent Manage*, 14, 245-46.
19
20 37. Yon MJY, Chen KJ, Gao SS, Duangthip D, Lo ECM, Chu CH. (2020). Dental Fear and Anxiety of
21
22 Kindergarten Children in Hong Kong: A Cross-Sectional Study. *Int J Environ Res Public Health*, 17(8),
23
24 2827.
25
26
27
28
29 38. Porritt J, Morgan A, Rodd H, Gupta E, Gilchrist F, Baker S, et al. (2018). Development and evaluation of
30
31 the children's experiences of dental anxiety measure. *Int J Paediatr Dent*, 28(2), 140-151.
32
33
34 39. Paglia L, Gallus S, de Giorgio S, Cianetti S, Lupatelli E, Lombardo G, et al. (2017). Reliability and validity
35
36 of the Italian versions of the Children's Fear Survey Schedule - Dental Subscale and the Modified Child
37
38 Dental Anxiety Scale. *Eur J Paediatr Dent*, 18(4), 305-312.
39
40
41
42 40. Aminabadi NA, Sohrabi A, Erfanparast LK, Oskouei SG, Ajami BA. (2011). Can birth order affect
43
44 temperament, anxiety and behavior in 5 to 7-year-old children in the dental setting? *J Contemp Dent Pract*,
45
46 12, 225-231.
47
48
49
50
51
52 41. Alvesalo I, Murtomaa H, Milgrom P, Honkanen A, Karjalainen M, Tay K-M. (1993). The Dental Fear
53
54 Survey Schedule: a study with Finnish children. *Int J Paediatr Dent*, 3, 15-20.
55
56
57
58
59 42. Nakai Y, Hirakawa T, Milgrom P, Coolidge T, Heima M, Mori Y, et al. (2005). The children's fear survey
60

1
2
3
4 schedule–dental subscale in Japan. *Community Dent Oral Epidemiol*, 33, 196-204.
5
6

7 43. Katsouda M, Tollili C, Coolidge T, Simos G, Kotsanos N, Arapostathis KN. (2019). Gagging prevalence
8 and its association with dental fear in 4-12-year-old children in a dental setting. *Int J Paediatr Dent*, 29,
9
10
11
12 169-76.
13
14

15
16 44. Klingberg G, Berggren U, Norén J. (1994). Dental fear in an urban Swedish child population: prevalence
17 and concomitant factors. *Community Dent Health*, 11, 208-14.
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

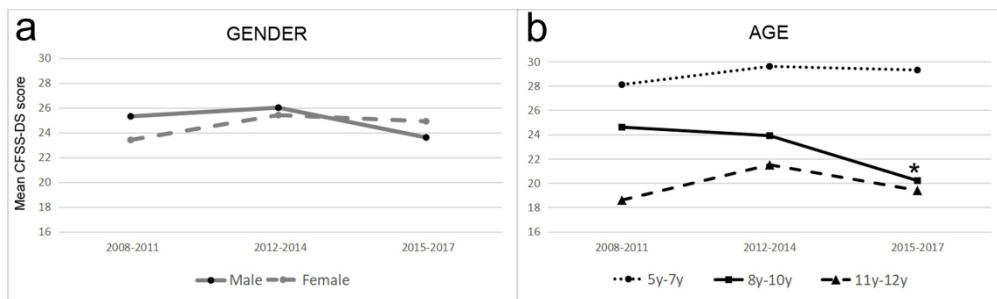


Fig. 1. CFSS-DS scores by gender and age. *Statistically significant (p < 0.05)

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) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —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 <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6-7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —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

1			
2	Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
3			
4			
5	Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding
6			
7			
8			
9			(b) Describe any methods used to examine subgroups and interactions
10			
11			(c) Explain how missing data were addressed
12			
13			(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed
14			
15			
16			<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed
17			
18			
19			
20			<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy
21			
22			
23			(e) Describe any sensitivity analyses
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
51			
52			
53			
54			
55			
56			
57			
58			
59			
60			

Continued on next page

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60**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) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	9, 12-13
Outcome data	15 *	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	10-14
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —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

1
2 Funding 22 Give the source of funding and the role of the funders for the present study and, if
3 applicable, for the original study on which the present article is based
4
5
6

20

7 *Give information separately for cases and controls in case-control studies and, if applicable, for exposed and
8 unexposed groups in cohort and cross-sectional studies.
9

10
11
12
13 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and
14 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely
15 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at
16 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is
17 available at www.strobe-statement.org.
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-043647.R2
Article Type:	Original research
Date Submitted by the Author:	04-Mar-2021
Complete List of Authors:	Gao, Shuo; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Lu, Jiaxuan ; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Li, Pei; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Yu, Dongsheng; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology Zhao, Wei; Sun Yat-Sen University, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology, Guangdong Provincial Key Laboratory of Stomatology
Primary Subject Heading:	Dentistry and oral medicine
Secondary Subject Heading:	Dentistry and oral medicine
Keywords:	Child protection < PAEDIATRICS, Anxiety disorders < PSYCHIATRY, PUBLIC HEALTH

SCHOLARONE™
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1
2
3
4 **Prevalence and risk factors of children's dental anxiety in China: A**
5
6 **longitudinal study**
7
8
9

10
11
12 **Shuo Gao, Jiakuan Lu, Pei Li, Dongsheng Yu and Wei Zhao***
13

14
15 Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of Stomatology,
16
17 Guangdong Provincial Key Laboratory of Stomatology, Sun Yat-sen University, Guangzhou,
18
19 Guangdong, China; gaosh7@mail.sysu.edu.cn (S.G.)
20
21
22

23 **Corresponding Authors:**
24

25
26 Wei Zhao*, Department of Pediatric Dentistry, Hospital of Stomatology, Guanghua School of
27
28 Stomatology, Guangdong Provincial Key Laboratory of Stomatology, Sun Yat-Sen University,
29
30 No. 56, Lingyuan West Road, Yuexiu District, Guangzhou, Guangdong 510055, China.
31

32
33 Email: zhaowei3@mail.sysu.edu.cn
34
35
36
37
38

39 **ABSTRACT**
40
41

42 **Objectives** Dental anxiety remains widespread among children, may continue into adulthood and
43
44 affect their oral health-related quality of life and clinical management. The aim of the study was to
45
46 explore the trend of children's dental anxiety over time and potential risk factors.
47
48
49

50
51 **Design** Longitudinal study
52

53
54 **Methods** Children aged between 5 and 12 years were investigated with the Chinese version of
55
56 face version of Children's Fear Survey Schedule-Dental Subscale (CFSS-DS) and Frankl
57
58 Behavior Rating scale from 2008 to 2017, and influential factors were explored.
59
60

1
2
3
4 **Results** Clinical data were available from 1061 children, including 533 (50.2%) male participants
5
6 and 528 (49.8%) female participants. The total CFSS-DS scores ranged from 16 to 66, with a
7
8 mean of 24.8 ± 10.3 . The prevalence of dental anxiety is 11.59%. No significant differences in total
9
10 CFSS-DS scores between females and males were found. According to the Frankl scale, 238
11
12 children were allocated to the uncooperative group and the remaining 823 children were allocated
13
14 to the cooperative group. Scores of CFSS-DS were negatively correlated with the clinical behavior
15
16 level of Frankl. 11-12-year-old children had significantly decreased scores compared to other age
17
18 groups, and there was a decline in the scores of 8-10-year-old group over time. The factor analysis
19
20 divided 15 items of CFSS-DS into four factors, and the total scores of 'less invasive oral
21
22 procedures' items belonging to factor III decreased significantly over time in the 8-10-year-old
23
24 group.
25
26
27
28
29
30
31
32

33 **Conclusions** Age is a significant determinant for children's dental anxiety, and dental anxiety
34
35 outcomes have improved for Chinese children aged 8-10 years. This study is one of the few
36
37 reports on changes of children dental anxiety in a new era of information, but the results may be
38
39 extrapolated to other populations with caution.
40
41
42
43
44
45
46
47

48 **Strengths and limitations of this study**

- 49
50
51 ► This study is a systematic longitudinal survey with representative data obtained for comparison
52
53 of time trends of children dental anxiety in multiple age groups.
54
55
56
57 ► The duration of this observational study spanned a decade.
58
59
60

1
2
3
4 ▶ The Chinese version CFSS-DS with facial image scale showed good applicability in clinical
5
6 practice.
7

8
9
10 ▶ Tri blindness paradigm was employed to avoid bias as much as possible.
11

12
13 ▶ The sample size of this survey, the region and age range of the research objects are limited.
14
15

16 17 18 19 20 **INTRODUCTON** 21

22
23 Dental fear and anxiety refers to a feeling of dread and anticipation that something will happen,
24 combined with a sense of losing control in relation to dentistry. Dental phobia is defined as a more
25 severe form that leads to an out of proportion reaction and interferes with daily life [1]. A
26 significant problem in patient management as such patients are more likely to avoid or delay
27 dental treatment is related to dental anxiety, further leading to a vicious circle where the levels of
28 dental anxiety are reinforced as a result of greater disease severity and greater dental treatment
29 needs [2, 3].
30
31
32
33
34
35
36
37
38
39
40
41

42 Childhood dental anxiety has been shown to be widespread, and research has suggested the
43 adults often acquire such fears in childhood [4], and the early-life social and biological factors
44 have long-lasting effects on health later in life [5]. Child's dental anxiety predicts more dental
45 disease and poorer oral health in measures, such as decay experience, the presence of untreated
46 dental infection and treatment that carries more risk, that results in a detrimental effect on the
47 quality of the life of the individual and family and engagement in oral health-related behaviours
48 [6, 7]. For many years, dental anxiety in children has been recognized as a source of problems in
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4 patient management [8]. Identifying anxiety in children at the earliest possible age is essential and
5
6 helpful to select methods of behavior management. In the literature of recent years, there is
7
8 considerable variation in the designs of study and target populations, particularly in the scales
9
10 used for measurement and the age of the children, so that the reported prevalence of dental fear
11
12 and anxiety in children varies widely, ranging from 7.4% [9] to 93.8% [10]. It can be said that
13
14 there is currently no fully ideal dental anxiety scale for children in use. Efforts should therefore
15
16 continue to be directed towards the development and validation of suitable instruments for the
17
18 detection of dental anxiety in children.
19
20
21
22
23
24

25 The Dental Sub-scale of Children's Fear Survey Schedule (CFSS-DS) is a frequently used
26
27 measure of children's dental anxiety [11]. Then the facial version CFSS-DS was first proposed by
28
29 Arapostathis in 2007 [12]. In several countries, the scale has demonstrated good reliability and
30
31 acceptable validity and has been used to estimate the prevalence of dental anxiety, and evaluate
32
33 the behavior-management procedures used for child patients. The Chinese version CFSS-DS was
34
35 established the cross-cultural adaptation and showed good psychometric properties [13]. The
36
37 prevalence of dental anxiety according to CFSS-DS varies considerably in the international
38
39 literature ranging from 2.4% to 28.3% in different populations and cultural backgrounds [9,
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
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

1
2
3
4 higher chance of dental anxiety [18]. Patterns of dental visits and previous experiences have also
5
6 important impact in dental fear occurrence [19]. Studies demonstrated that subjects with higher
7
8 social and financial resources show lower prevalence of dental anxiety [20]. The potential risk
9
10 factors of dental anxiety are likely to be different from each person. Thus, further investigation
11
12 into intrinsic and environmental factors associated with dental anxiety is needed. To date,
13
14 relatively few published study evaluated the dental anxiety of children and behavioral influence
15
16 factors in dental settings in China. Moreover, the trends of children's dental anxiety over time are
17
18 poorly characterized. The objective of this research is to provide normative data on dental anxiety
19
20 of Chinese children, and describe and compare the influence of relevant factors on dental anxiety
21
22 in a decade.
23
24
25
26
27
28
29
30
31
32

33 **METHODS**

34 **Participants and procedures**

35
36
37 The study was conducted at the department of Pediatric Stomatology, affiliated Stomatology
38
39 Hospital of Sun Yat-sen University, during 10 years (August 2008 - October 2017). The children
40
41 patients aged 5 to 12 years old were selected randomly to participate in the study. Inclusion
42
43 criteria were children with no mental retardation or developmental disorders; no cognitive
44
45 impairment or psychiatric history; no serious congenital and acquired oral and maxillofacial
46
47 deformities. The Ethics Committee of the Institute of Stomatological Research, Sun Yat-sen
48
49 University, China, gave approval for the study. Before entering the study, each parent and child
50
51 were well informed about the purpose of the study and affirmed that participation was voluntary.
52
53
54
55
56
57
58
59
60

1
2
3
4 Parents were distributed informative leaflets about the procedure and were asked to provide
5
6 written consent.
7
8
9

10 11 12 13 **Chinese version CFSS-DS with FIS** 14 15

16 The Chinese version CFSS-DS was adopted, which consists of 15 items and a five-point pictorial
17
18 scale, that is, the Facial Image Scale (FIS). The FIS consists of five drawings of a face, displaying
19
20 affective features ranging from extremely negative (score 5) through neutral to extremely positive
21
22 (score 1). The total score ranges from 15 to 75. Children are presented with the five images and
23
24 are asked to select which one best corresponds to how they are feeling. The FIS is a reliable and
25
26 valid method for children's self-report of dental anxiety in subjects as young as three years old
27
28 [21, 22]. In this study, the pilot test of Chinese version CFSS-DS with FIS was carried on 32
29
30 children and their parents, in order to clarify whether young children could answer the CFSS-DS
31
32 items with reference to the facial images (results not shown).
33
34
35
36
37
38
39
40
41
42
43

44 **Measures** 45 46

47 Children's dental anxiety over the ten-year period was investigated, which was a randomized
48
49 triple-blinded longitudinal study. Data collection included children's completion of the Chinese
50
51 version CFSS-DS with FIS and evaluation of behavior during dental visit. Upon entering the
52
53 waiting room, the children were invited to fill in the Chinese version CFSS-DS with FIS. Any
54
55 child experiencing difficulty in reading the questions was assisted by the receptionist. At the same
56
57 time, the parents (in almost all cases, the mother) provided a dental health questionnaire related to
58
59
60

1
2
3
4 demographic information and previous dental experiences. The gender, age, and source of referral
5
6 of the participants were recorded. After the completion of the CFSS-DS, the children were invited
7
8 into the operatory for regular dental examination. The dentist and dental nurse were unaware of
9
10 the children's responses to the questionnaire. During examinations, the behavior and facial
11
12 expressions of the children were recorded by video cameras, which were later rated according to
13
14 the Frankl scale [23]. To ensure sample "blindness", the rater did not have access to the CFSS-DS
15
16 scores of the children and assigned the children with behaviors classified as "definitely positive"
17
18 (the dentist and child share good rapport, the child is laughing) and "positive" (willingness to
19
20 comply, cautiousness) to the cooperative group, whereas those with behaviors classified as
21
22 "definitely negative" (fearful behavior, forceful crying) and "negative" (reluctance and/or
23
24 uncooperativeness, but not as severe as in the previous category) were assigned to the
25
26 uncooperative group.
27
28
29
30
31
32
33
34
35
36
37
38

39 **Data Processing and Statistical Analysis**

40
41
42 The data from all the children who had completed the Chinese version CFSS-DS and finished the
43
44 dental examination on one occasion were used to provide normative data. If there is one item in
45
46 one scale that is not answered, it will be treated as missing item, and the data of missing entries is
47
48 replaced by the mean of the remaining samples with complete data; if there are two or more items
49
50 that are not answered, it will be eliminated to the invalid scale.
51
52
53
54

55
56 Data management and analysis were conducted using SPSS version 16.0. The associations
57
58 between CFSS-DS scores and demographic variables were analysed using the t-tests and one-way
59
60

1
2
3
4 analysis of variances (ANOVA). When significant effects were found, Tukey post-hoc test was
5
6 used to determine significant intergroup mean differences. Factor analysis (principal components,
7
8 varimax rotation) was employed to assess the factor structure [24, 25], and factor scores above 0.5
9
10 indicate strong loading on a particular subset of items. Kruskal Wallis rank sum test was used to
11
12 evaluate the differences of gender groups and age groups among three time periods. $p < 0.05$ is
13
14 statistically significant.
15
16
17
18
19
20
21
22

23 **Patient and public involvement**

24
25
26 Participation in this survey is voluntary for each child and his/her parents. The receptionists or
27
28 assistants helped understand the items and complete the scale. The children and their parents were
29
30 not involved in the design, recruitment or conduct of the study.
31
32
33
34
35
36
37

38 **RESULTS**

39 **Characterization of the sample**

40
41
42 For the analysis of dental anxiety in children, the representative sample selected randomly who
43
44 were treated in Department of Pediatric Stomatology, and 1061 copies of the effective scale were
45
46 received from August 2008 to October 2017. Of those eligible, there were 533 (50.2%) male
47
48 participants and 528 (49.8%) female participants. There was no significant difference in the ratio
49
50 of patient's gender, or their evaluation of economic level by treatment status. 411 children aged
51
52 5-7 years accounted for 38.7%, 399 children aged 8-10 years accounted for 37.6% and 251 aged
53
54
55
56
57
58
59
60

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

1
2
3
4 dental anxiety in this sample is 11.59%, and 88.41% of the children did not suffer from it.
5
6
7 According to the Frankl scale, 238 children assessed were allocated to the uncooperative group
8
9 and the remaining 823 children were allocated to the cooperative group. The distribution patterns
10
11 of CFSS-DS scores were very different between the two groups. Children of the uncooperative
12
13 group tended to report dental anxiety, as compared with cooperative children (30.67% vs. 6.08%)
14
15 (Table 3). The results showed that the CFSS-DS scores were correlated negatively with the Frankl
16
17 behavior level. That is, there is a certain consistency between the CFSS-DS score and the clinical
18
19 performance.
20
21
22
23
24
25

26 **Table 2** Children's dental anxiety in the Chinese version CFSS-DS
27

		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

Variables	2008-2011		2012-2014		2015-2017	
	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		
		I	II	III	IV	of 8-10-year-old children		
Items in CFSS-DS		(22.6)	(17.3)	(12.1)	(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

1
2
3
4 required to implement appropriate behavioral induction measures to reduce dental anxiety. It has
5
6 been suggested that dental anxiety decreases with repeated exposure to dental procedures [33].
7
8 However, in the uncooperative group older children seemed not to be able to overcome their
9
10 dental anxiety, which caused behavior management problems. At this time more risk factors
11
12 should be considered, such as previous medical experience, family structure, etc.
13
14
15
16

17
18 The CFSS-DS scores in the international literature in recent years varies with different
19
20 populations and dental situations. The mean score in the present study was 24.8 ± 10.3 , which was
21
22 comparatively lower than scores from studies in Brazil (29.3 ± 10.5) [34], Hong Kong (29.1 ± 11.0)
23
24 [16], Greece (27.1 ± 10.8) [14], Egypt (26.09 ± 10.70) [26] and Jeddah, Saudi Arabia (25.99 ± 9.3)
25
26 [17]. CFSS-DS scores in the current study did not differ greatly from data from these previous
27
28 studies, that may be due to the similar age range of the subjects and different cultural parameters.
29
30
31
32

33
34 It is necessary to determine the cut-off point for distinguishing between children who are
35
36 more prone to dental anxiety that is helpful for clinicians to choose appropriate behavior
37
38 management measures. Generally, dental anxiety is measured according to clear cut-off points on
39
40 continuous measure that acts as a categorical boundary. In view of the balance of the sensitivity
41
42 and specificity in the measurement of scale, different prevalence estimates depend on the different
43
44 cut-off values used to define "dental anxiety". Children dental anxiety cut-off points on CFSS-DS
45
46 are already defined in several researches, but the conclusions are not all the same. In the present
47
48 study, the participated children with CFSS-DS scores of 38 and higher [26-32] were considered as
49
50 dentally anxious. There is still a need for further research to find more desirable instrument for
51
52 understanding the dental anxiety of children and adolescents.
53
54
55
56
57
58
59
60

1
2
3
4 Demographically this study found no difference in dental anxiety between females and
5
6 males, that is supported by previous studies [14, 20, 34-39]. This is however contrary to other
7
8 studies which have reported more girls than boys in the anxious group [12, 17, 26]. Contradictory
9
10 research findings may be explained by different study designs and methods of data collection,
11
12 moreover, gender influences should be regarded in combination with other factors such as local
13
14 culture and socioeconomic status of the family.
15
16
17
18
19

20 Bad dental experience is considered as one of life-long stress situations for children [40]. As
21
22 cultural and social behavioral norms can affect the development and expression of children's
23
24 dental anxiety, and as dental care systems can vary considerably across cultures, normative data in
25
26 each culture are needed. The main strength of this study was the continuous assessment over a
27
28 10-year period, which provides information on the development and progression of dental anxiety
29
30 during the important life course, when children transition from the primary to the permanent
31
32 dentition and mental state grows enormously. To our knowledge, this is the first study to use
33
34 representative data from China for comparison of time trends of children dental anxiety in
35
36 multiple age groups. The study showed that dental anxiety seems to decrease with increasing age
37
38 and this is in agreement with previous studies [17]. The results showed that 8-10-year-old children
39
40 recent years exhibited less fear and anxiety in dental procedures compared with children of the
41
42 same age in the initial period of this study, indicating that the change in social environment
43
44 experienced in these years influences the incidence and progression of dental anxiety and its
45
46 outcomes have improved for children in Guangdong Province. The researchers conclude that the
47
48 possible reasons for these findings would be the oral health education in the mass media,
49
50 especially the Internet, which has enhanced the cognition and acceptance of oral treatment for the
51
52
53
54
55
56
57
58
59
60

1
2
3
4 older children. But the effect was not obvious to preschool children because of their limited
5
6 cognitive ability. However, children dental anxiety were influenced by a multiplicity of interacting
7
8 environmental factors including words and deeds of people around; any single influence is
9
10 dubious to clarify much divergence. So the positive trend of parents towards dental procedures
11
12 may be passed on to children indirectly, which may also be due to the growing public awareness.
13
14
15

16
17 Factor analyses, which are conventionally used to evaluate the construct validity of scales,
18
19 have been previously reported in CFSS-DS studies of different populations. In Netherlands and
20
21 Finland, investigators divided the scale items into three factors, and the connotation of them were
22
23 as follows: 1) fear of highly invasive procedures, 2) fear of potential ‘victimization’ and 3) fear of
24
25 less invasive procedures [24]. In the present research, factor analysis resulted in four factors based
26
27 on deep sources of children dental anxiety. There were 1) fear of highly invasive dental
28
29 procedures, 2) fear of general medical aspects of treatment, 3) fear of less invasive procedures and
30
31 potential ‘victimization’, and 4) fear of strangers or unfamiliar objects. Despite minor differences
32
33 in populations and methods, similar results were found in the aforementioned studies in other
34
35 cultures [4, 41], indicating that the setting of psychological and behavioral scale conforms to the
36
37 theoretical conception of the design in this study. The results of factor analysis also provided some
38
39 support for the conclusion above: in the 8-10 year old group, the less invasive oral operation items
40
41 (Factor III) showed the trend of decreasing dental anxiety scores, while the changes of other
42
43 factors were not significant, thus indicating that the downward trend in the total CFSS-DS scores
44
45 may have originated from the items of Factor III. It can be explained that the image output in oral
46
47 health publicity is indeed considered to make patients have a certain degree of familiarity with the
48
49 treatment situation before coming to the hospital, so as to reduce the anxiety tendency to a certain
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4 extent. This also suggests that future public oral health publicity should be introduced to the scene
5
6 of positive emotional feedback from the characters about the sight and noise of the “drilling”
7
8 (Factor I), in order to further reduce the public's fear of specific dental operations.
9
10

11
12 The limitation to our study design should be pointed out. The sample was taken from a single
13
14 medical institution, which the group of children represented by are more inclined to show the
15
16 behavior of visiting a dentist, probably because of lower levels of dental anxiety [42]. The
17
18 generalizability of our results cannot be directly extrapolated to broader urban populations. Hence,
19
20 a school sample is generally considered more representative. However, the school sample may
21
22 have introduced recall bias, and children without dental experience are likely to have difficulty
23
24 answering items such as "drilling" that they had never experienced previously [12, 43, 44]. There
25
26 may be a need for a comparative study between the clinic and school samples. Another limitation
27
28 of the present study is that the presence of parents when children respond to the scale reduced
29
30 privacy, which may lead to the children's answering in line with parents' expectations and social
31
32 expectations. Perhaps this problem could be mitigated by having the items interpreted by the
33
34 investigators rather than the parents. Additionally, Considering that dental anxiety is multi-causal,
35
36 such as the kind of treatment, previous dental experience of children and other events involved,
37
38 future studies are required to further relate CFSS-DS scores to broader risk factors and/or
39
40 physiological observations of children during dental treatment, then the tool will help clinicians
41
42 recognize children in need of extra attention and subsequently select the most appropriate
43
44 treatment approach and evaluate the outcome of interventions.
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

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.

Acknowledgments The authors would like to thank the volunteers and patient advisers for their valuable participation, and Cuthbert and Melamed for the original CFSS-DS design, and the individuals who piloted the surveys and provided further feedback during the investigation.

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.

Funding This study was supported by the Research Fund of Department of Health of Guangdong Province (WSTJJ20061120), the National Natural Science Foundation of China (81974146, 81873711), the Natural Science Foundation of Guangdong Province (2014A030313126) and the Science and Technology Planning Project of Guangdong Province (2016A020215094) to ZhaoWei.

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.

Provenance and peer review Not commissioned; externally peer reviewed.

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

REFERENCES

- 1
2
3
4 1. Diagnostic and statistical manual of mental disorders. (2013). 5th ed. Arlington, VA: American Psychiatric
5
6 Publishing.
- 7
8 2. Xiang B, Wong HM, Perfecto AP, McGrath CPJ. (2020). The association of socio-economic status, dental
9
10 anxiety, and behavioral and clinical variables with adolescents' oral health-related quality of life. *Qual Life*
11
12 *Res*, Apr 19.
- 13
14 3. van Wijk AJ, J Hoogstraten. (2005). Experience With Dental Pain and Fear of Dental Pain. *J Dent Res*,
15
16 84(10), 947-50.
- 17
18 4. Wogelius P, Poulsen S, Sorensen HT. (2003). Prevalence of dental anxiety and behavior management
19
20 problems among six to eight years old Danish children. *Acta Odontol Scand*, 61(3), 178-83.
- 21
22 5. Celeste RK, Eyjólfsdóttir HS, Lennartsson C, Fritzell J. (2020). Socioeconomic Life Course Models and Oral
23
24 Health: A Longitudinal Analysis. *J Dent Res*, 99(3), 257-263.
- 25
26 6. Coxon JD, Hosey MT, Newton JT. (2019). The impact of dental anxiety on the oral health of children aged 5
27
28 and 8 years: a regression analysis of the Child Dental Health Survey 2013. *Br Dent J*, 227(9), 818-22.
- 29
30 7. Coxon JD, Hosey MT, Newton JT. (2019). The oral health of dentally anxious five- and eight-year-olds: a
31
32 secondary analysis of the 2013 Child Dental Health Survey. *Br Dent J*, 226(7), 503-7.
- 33
34 8. Venham L, Bengston D, Cipes M. (1977). Children's response to sequential dental visits. *J Dent Res*, 56,
35
36 454-59.
- 37
38 9. Rajwar AS, Goswami M. (2017). Prevalence of dental fear and its causes using three measurement scales
39
40 among children in New Delhi. *J Indian Soc Pedod Prev Dent*, 35(2), 128-133.
- 41
42 10. Sarapultseva M, Yarushina M, Kritsky I, Ibragimov R, Sarapultsev A. (2020). Prevalence of Dental Fear
43
44 and Anxiety among Russian Children of Different Ages: The Cross-Sectional Study. *Eur J Dent*, 14(4),
45
46 621-5.
- 47
48 11. Cuthbert MI, Melamed BG. (1982). A screening device: children at risk for dental fears and management
49
50
51
52
53
54
55
56
57
58
59
60

- 1
2
3
4 problems. *J Dent Child*, 49, 432-36.
5
6
7 12. Arapostathis KN, Coolidge T, Emmanouil D, Kotsanos N. (2008). Reliability and validity of the Greek
8 version of the Children's fear survey schedule-dental subscale. *Int J Paediatric Dent*, 18(5), 374-9.
9
10
11 13. Jia-xuan Lu, Dongsheng Yu, Wei Luo, Xiaofen Xiao, Wei Zhao. (2011). Development of Chinese Version
12 of Children's Fear Survey Schedule-Dental Subscale. *Zhonghua Kou Qiang Yi Xue Za Zhi*, 46(4), 218-21.
13
14
15
16 14. Boka V, Arapostathis K, Karagiannis V, Kotsanos N, van Loveren C, Veerkamp J. (2017). Dental fear and
17 caries in 6-12 year old children in Greece. Determination of dental fear cut-off points. *Eur J Paediatr Dent*,
18 18(1), 45.
19
20
21
22 15. Cianetti S, Lombardo G, Lupatelli E, Pagano S, Abraha I, Montedori A, et al. (2017). Dental fear/anxiety
23 among children and adolescents. A systematic review. *Eur J Paediatr Dent*, 18(2), 121-130.
24
25
26
27 16. Wu L, Gao X. (2018). Children's dental fear and anxiety: exploring family related factors. *BMC Oral*
28 *Health*, 18(1), 100.
29
30
31
32 17. Alshoraim MA, El-Housseiny AA, Farsi NM, Felemban OM, Alamoudi NM, Alandejani AA. (2018).
33 Effects of child characteristics and dental history on dental fear: cross-sectional study. *BMC Oral Health*,
34 18(1), 33.
35
36
37
38
39 18. Soares FC, Lima RA, Salvador DM, de Barros MVG, Dahllöf G, Colares V. (2020). Reciprocal longitudinal
40 relationship between dental fear and oral health in schoolchildren. *Int J Paediatr Dent*, 30(3), 286-92.
41
42
43
44
45 19. Barreto KA, Dos Prazeres LD, Lima DS, Soares FC, Redivivo RM, da Franca C, Colares V. (2017). Factors
46 associated with dental anxiety in Brazilian children during the first transitional period of the mixed dentition.
47
48
49
50
51 *Eur Arch Paediatr Dent*, 18(1), 39-43.
52
53
54 20. Soares FC, Lima RA, Santos Cda F, de Barros MV, Colares V. (2016). Predictors of dental anxiety in
55 Brazilian 5-7years old children. *Compr Psychiatry*, 67, 46-53.
56
57
58
59 21. Milgrom P, Mancl L, King B, Weinstein P. (1995). Origins of childhood dental fear. *Behav Res Ther*, 33,
60

- 1
2
3
4 313-19.
5
6
7 22. Yamada MKM. (2002). Cooperation during dental treatment: the Children's Fear Survey Schedule in
8 Japanese children. *Int J Paediatr Dent*, 12, 404-409.
9
10
11 23. Frankl SN, Shiere F, Fogels HR. (1962). Should the parent remain with the child in the dental operator? *J*
12 *Dent Child*, 29, 150-163.
13
14
15 24. Baier K, Milgrom P, Russell S, Mancl L, Yoshida T. (2004). Children's fear and behavior in private
16 pediatric dentistry practices. *Pediatr Dent*, 26(4), 316-21.
17
18
19 25. Locker D, Thomson WM, Poulton R. (2001). Psychological disorder, conditioning experiences, and the
20 onset of dental anxiety in early adulthood. *J Dent Res*, 80, 1588-92.
21
22
23 26. Alsadat FA, El-Housseiny AA, Alamoudi NM, Elderwi DA, Ainosam AM, Dardeer FM. (2018). Dental Fear
24 in Primary School Children and its Relation to Dental Caries. *Niger J Clin Pract*, 21(11), 1454-60.
25
26
27 27. Kakkar M, Wahi A, Thakkar R, Vohra I, Shukla AK. (2016). Prevalence of dental anxiety in 10-14 years
28 old children and its implications. *J Dent Anesth Pain Med*, 16(3), 199-202.
29
30
31 28. Ghaderi F, Fijan S, Hamedani S. (2015). How Do Children Behave Regarding Their Birth Order in Dental
32 Setting? *Dent Shiraz Univ Med Sci*, 16(4), 329-34.
33
34
35 29. Majstorovic M, Morse DE, Do D, Lim L, Herman NG, Moursi AM. (2014). Indicators of dental anxiety in
36 children just prior to treatment. *J Clin Pediatr Dent*, 39, 12-7.
37
38
39 30. Bajric E, Kobaslija S, Juric H. (2011). Reliability and validity of Dental Subscale of the Children's Fear
40 Survey Schedule (CFSS-DS) in children in Bosnia and Herzegovina. *Bosn J Basic Med Sci*, 11, 214-8.
41
42
43 31. Akbay Oba A, Dulgergil CT, Sonmez IS. (2009). Prevalence of dental anxiety in 7- to 11-year-old children
44 and its relationship to dental caries. *Med Princ Pract*, 18, 453-7.
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

- 1
2
3
4 32. Venham LL, Gaulin-Kremer E, Munster E, Bengston-Audia D, Cohan J. (1980). Interval rating scales for
5
6 children's dental anxiety and uncooperative behavior. *Pediatr Dent*, 2, 195-202.
7
8
9
10 33. Buchanan H, Niven N. (2003). Further evidence for the validity of the Facial Image Scale. *Int J Paediatr*
11
12 *Dent*, 13, 368-9.
13
14 34. Cademartori MG, Cara G, Pinto GDS, da Costa VPP. (2019). Validity of the Brazilian version of the Dental
15
16 Subscale of Children's Fear Survey Schedule. *Int J Paediatr Dent*, 29(6), 736-747.
17
18 35. ten Berge M, Veerkamp JS, Hoogstraten J, Prins PJ. (2002). Childhood dental fear in the Netherlands:
19
20 prevalence and normative data. *Community Dent Oral Epidemiol*, 30(2), 101-7.
21
22
23 36. El-Housseiny AA, Merdad LA, Alamoudi NM, Farsi NM. (2015). Effect of child and parent characteristics
24
25 on child dental fear ratings: analysis of short and full versions of the children's fear survey schedule-dental
26
27 subscale. *Oral Health Dent Manage*, 14, 245-46.
28
29
30 37. Yon MJY, Chen KJ, Gao SS, Duangthip D, Lo ECM, Chu CH. (2020). Dental Fear and Anxiety of
31
32 Kindergarten Children in Hong Kong: A Cross-Sectional Study. *Int J Environ Res Public Health*, 17(8),
33
34 2827.
35
36
37
38 38. Porritt J, Morgan A, Rodd H, Gupta E, Gilchrist F, Baker S, et al. (2018). Development and evaluation of
39
40 the children's experiences of dental anxiety measure. *Int J Paediatr Dent*, 28(2), 140-151.
41
42
43
44 39. Paglia L, Gallus S, de Giorgio S, Cianetti S, Lupatelli E, Lombardo G, et al. (2017). Reliability and validity
45
46 of the Italian versions of the Children's Fear Survey Schedule - Dental Subscale and the Modified Child
47
48 Dental Anxiety Scale. *Eur J Paediatr Dent*, 18(4), 305-312.
49
50
51
52 40. Aminabadi NA, Sohrabi A, Erfanparast LK, Oskouei SG, Ajami BA. (2011). Can birth order affect
53
54 temperament, anxiety and behavior in 5 to 7-year-old children in the dental setting? *J Contemp Dent Pract*,
55
56
57
58
59
60

1
2
3
4 12, 225-231.
5
6

7 41. Alvesalo I, Murtomaa H, Milgrom P, Honkanen A, Karjalainen M, Tay K-M. (1993). The Dental Fear
8

9
10 Survey Schedule:a study with Finnish children. *Int J Paediatr Dent*, 3, 15-20.
11

12
13 42. Nakai Y, Hirakawa T, Milgrom P, Coolidge T, Heima M, Mori Y, et al. (2005). The children's fear survey
14

15
16 schedule-dental subscale in Japan. *Community Dent Oral Epidemiol*, 33, 196-204.
17

18
19 43. Katsouda M, Tollili C, Coolidge T, Simos G, Kotsanos N, Arapostathis KN. (2019). Gaggling prevalence
20

21
22 and its association with dental fear in 4-12-year-old children in a dental setting. *Int J Paediatr Dent*, 29,
23

24
25 169-76.
26

27
28 44. Klingberg G, Berggren U, Norén J. (1994). Dental fear in an urban Swedish child population: prevalence
29

30
31 and concomitant factors. *Community Dent Health*, 11, 208-14.
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

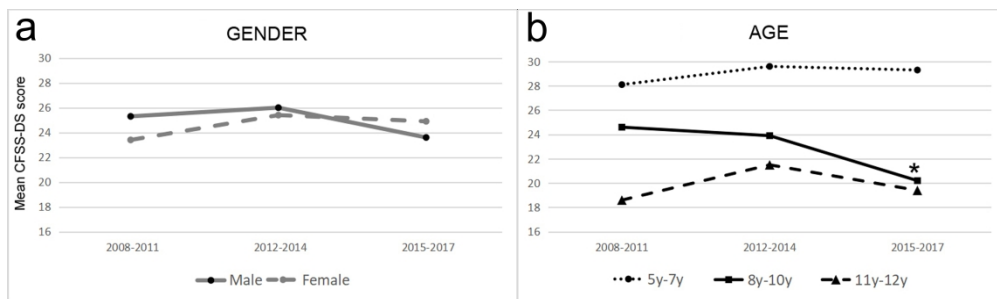


Fig. 1. CFSS-DS scores by gender and age. *Statistically significant (p < 0.05)

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) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —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 <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6-7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —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

1			
2	Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
3			7-8
4			
5	Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding
6			8-9
7			
8			
9			(b) Describe any methods used to examine subgroups and interactions
10			8-9
11			
12			(c) Explain how missing data were addressed
13			8-9
14			
15			(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed
16			6-7
17			
18			<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed
19			
20			<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy
21			
22			
23			(e) Describe any sensitivity analyses
24			8-9

Continued on next page

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

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) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	9, 12-13
Outcome data	15 *	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	10-14
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —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

1
2 Funding 22 Give the source of funding and the role of the funders for the present study and, if
3 applicable, for the original study on which the present article is based
4
5
6
7

20

8 *Give information separately for cases and controls in case-control studies and, if applicable, for exposed and
9 unexposed groups in cohort and cross-sectional studies.
10
11
12

13 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and
14 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely
15 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at
16 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is
17 available at www.strobe-statement.org.
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60