Associated Factors of Oral Health-related Quality of Life in Chinese Adolescents Aged 12-15 Years

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Objective: *To evaluate the status of oral health–related quality of life (OHRQoL) in Chinese adolescents aged 12 to 15 years based on the 4th National Oral Health Survey and to explore its associated factors.*

Methods: *Students aged 12 to 15 years were recruited using to a multistage stratified random sampling method. All the subjects received oral examination and completed a questionnaire. Information relating to OHRQoL was collected through a Mandarin version of the child oral impacts on daily performances (Child-OIDP) questionnaire. The relationship between the Child-OIDP scores and independent variables was assessed using a Mann-Whitney U-test, Kruskal-Wallis test and a multivariate Poisson regression.*

Results: *A total of 89,582 subjects were included in the analysis, of whom 76.6% reported oral impacts in the last 6 months. Eating was the most affected daily performance. The results of the regression analysis showed that factors associated with adolescents' OHRQoL included sex, location of residence, region, only child status, parents' level of education, frequency of sugar consumption, self-perception of general/oral health, dental appointments in the past 12 months, oral health knowledge status, age, decayed, missing and filled teeth (DMFT) index and number of teeth with gingival bleeding.*

Conclusion: *Oral impacts were common among Chinese adolescents, although most were not so severe. Eating was the most commonly affected performance. Sex, location of residence, region, only child status, parents' level of education, frequency of sugar consumption, self-perception of general/oral health status, dental appointments in the previous 12 months, oral health knowledge status, age, DMFT index and number of teeth with gingival bleeding were found to be associated with OHRQoL.*

Key words: *adolescents, associated factors, child OIDP, China, oral health–related quality of life*

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Oral health enables people to speak, eat and socialise without active disease, discomfort or embarrassment[1]. The traditional indicators for the evaluation of oral diseases do not consider the effects of diseases on patients' psychological and social activity. To evaluate how oral disease affects oral function, aesthetic appearance and aspects of social life including self-esteem, social interaction, school and job performance, the concept of oral health–related quality of life (OHRQoL) was created around two decades ago[2]. In recent years, scientists have developed different OHRQoL questionnaires to determine the interaction between oral health conditions and psychological, social and contextual factors[3].

Adolescents experience physical and mental changes, and also bear the burden of academic pressure. Oral diseases may cause significant pain and have a negative impact on aesthetics, thus contributing to underperformance at school and mental health problems[4-7]. Moreover, specific oral health demands and concerns, such as orthodontic care and risk of trauma, have been observed for teenagers[8]; thus, attention should be paid to adolescents' OHRQoL.

Currently, the four most widely used scales specifically for adolescents are the child oral impacts on daily performances questionnaire (Child-OIDP)[9], child perception questionnaire (CPQ)[10-14], Michigan OHRQoL[11] and child oral health impact profile (COHIP)[12]. Among these, the Child-OIDP has become the most widely adapted measurement system, the reliability and validity of which have been fully verified in different countries and populations. With a sound theoretical framework and acceptable psychometric properties, the Child-OIDP scale has been proven reliable in many cultural backgrounds[13-17]. Considering this study as part of the overall questionnaire investigation in the Fourth National Oral Survey, it was short, quick and easy to understand and thus suitable for use in cross-sectional surveys with the intention of differentiating populations. Although the Child-OIDP was first designed as an interviewer-administered index, research has also indicated that the self- and interviewer-administered Child-OIDP had a high level of agreement[18].

OHRQoL can be applied to evaluate the effect of clinical treatment, compare quality of life after different treatments, estimate the impact of specific oral diseases (caries, malocclusion, temporomandibular disorders, etc.) and evaluate their impacts on daily performance in the general population. In China, the association between malocclusion and adolescents' OHRQoL has been studied extensively[19-22]. Malocclusion has a significant impact on teenagers' emotional status and social situation; however, it does not have an obvious impact on oral symptoms and function[19,20]. Sun et al[19] found that malocclusion has a widespread effect on children's quality of daily life, especially with regard to their tooth cleaning, diet and smile. In addition, Cao et al[22] found that dental caries and periodontal conditions were the most important factors affecting the OHRQoL in children aged 11 to 14 years.

OHRQoL is now universally recognised as a complement to clinical indicators in assessing personal oral health status, making clinical decisions and evaluating dental interventions[23]. It is therefore important to explore the relative contribution of demographic, socioeconomic, psychological and clinical factors to OHRQoL. Previous studies have shown that psychosocial characteristics such as experience of bullying, mother's education level, socioeconomic status and income are associated with OHRQoL in adolescents[24-31]. However, existing studies of adolescents in China have mainly focused on malocclusion, and few have examined the comprehensive determinants of OHRQOL in adolescents. Furthermore, many aspects of OHRQoL may present varied results in China due to the country's vast territory and large population.

This study aimed to evaluate the OHRQoL status of a representative sample of Chinese adolescents aged 12 to 15 years and to identify its associated factors using data from the 4th National Oral Health Survey (2015 to 2016) which first introduced the Child-OIDP for evaluating OHRQoL. It is hoped that the findings may provide feasible strategies for future policy making.

Materials and methods

Sampling procedure

The 4th National Oral Health Survey, conducted from 2015 to 2016, covered all 31 provinces, municipalities and autonomous regions in mainland China. A multistage stratified random sampling method was used to select 12- to 15-year-old adolescents. Two districts and two counties were randomly selected from each province, and then three secondary schools were randomly selected from each county or district. Finally, cluster sampling was used to randomly select 12-, 13-, 14- and 15-year-old students from each secondary school. The specific methodology has been documented in previous publications[32-34].

Procedures for obtaining consent and ethical approval were approved by the Ethics Committee of Chinese Stomatological Association (Approval No 2014-003). A total of 118,601 adolescents signed the informed con-

sent forms and participated in the national survey. All of them received oral examination and a questionnaire.

Oral examination

Following the 5th World Health Organisation (WHO) standardised criteria[35], the oral examination was carried out by trained and licensed dentists using flat dental mirrors and community periodontal index (CPI) probes in a mobile dental chair under artificial light. Caries was assessed using the number of decayed, missing and filled teeth (DMFT), and periodontal status was determined from by the number of teeth with gingival bleeding and calculus. The results of the clinical examination were included as independent variables to establish the relationship with OHRQoL.

Prior to the survey, all examiners received standard training and passed the consistency test. The kappa value for caries was higher than 0.8. In the study, participants were examined by one dentist first, then 5% of them were randomly selected to receive another examiner's review at a retest rate of 5%, and the kappa value between the two examinations was calculated. The results showed that the kappa value for the second caries test in children aged 12 to 15 years was 0.94.

Questionnaire

A questionnaire was designed to obtain information about independent variables from questions answered by the participants themselves. Adolescents' demographic information (i.e., age, sex, only child status), concept of health (i.e., knowledge, attitude, behaviour), socioeconomic information (i.e., parents' level of education, location of residence, region) and self-perception of oral/general health status were investigated for the subsequent analysis.

OHRQoL

The OHRQoL scale used in the study was the Child-OIDP, as part of the questionnaire. The dependent variable was the Child-OIDP score. Nine questions concerning eating, pronouncing, tooth brushing or rinsing, doing housework, schooling, sleeping, smiling, emotions and socialising were designed to assess the impacts caused by oral disorders. Each question had five possible answers which were scored from 1 to 5, which meant severe influence, moderate influence, slight influence, no influence and unclear influence, respectively. Participants who did not complete all the items or who reported "unclear influence" in the Child-OIDP questionnaire were excluded from the study because this answer could not be classified into any extent category. The sample size included in the analysis was 89,562.

A new four-point scale (0 = no influence, 1 = slight influence, 2 = moderate influence, 3 = severe influence) was applied to assess participants' OHRQoL status. The total Child-OIDP score (range 0 to 27) was the sum of the scores for the nine questions, and the final impact score was the Child-OIDP score divided by 27 and multiplied by 100. Higher scores suggested more severe impacts caused by oral disease. Participants were defined as affected by oral disease when they scored more than 0 for any question. Based on the data from all nine questions, we calculated the overall prevalence of OHRQoL.

Questions related to personal knowledge and attitudes were processed using a scoring system to facilitate statistical analysis. A score of 1 point was allocated for each correct answer; otherwise, no points were given. The total scores for the eight knowledge-related questions ranged from 0 to 8. We classified the scores into three levels: scores of 0 to 2, 3 to 5 and 6 to 8 (for poor, moderate and good levels of knowledge, respectively). A similar approach was applied for the attitude-related questions. A score of 0 to 2 points was regarded as a negative attitude, a score of 3 as a moderate attitude and a score of 4 as a positive attitude.

As sampling weights were not taken into account during the investigation, in order to reduce the sampling error, the samples were post-stratified according to sex, province and location (urban or rural area). Survey weights were then calculated by comparing the population of each stratum in the sample with the population of the stratum determined in the 6th population census of China. A descriptive analysis was performed to characterise the sample distribution of each category. Because the sample did not satisfy the normal distribution, the bivariate association between the independent variables and Child-OIDP score was assessed using a Mann Whitney U and Kruskal-Wallis test. All the independent variables associated with OHRQoL were included in the next analysis. The incidence rate ratio (IRR) and 95% confidence interval (CI) were reported. Most answers were reported as no influence, which indicated that most people's OHRQoL was not affected by oral disease, and this is consistent with the Poisson hypothesis of distribution. A multivariate Poisson regression model was used to identify the characteristics related with OHRQoL. All *P* values reported are two-tailed and the level of statistical significance was set at 0.05. The statistical analyses were performed using Stata 16 (Stata, College Station, TX, USA).

Table 1 Distribution of Child-OIDP scores in Chinese adolescents.

Activity	Prevalence of impact (%)	Severe (%)	95% CI	Moderate (%)	95% CI	Slight (%)	95% CI	None (%)	95% CI	Mean score
Overall impact	76.6	19.7	[19.4–20.0]	25.2	[24.8–25.6]	31.7	[31.4–32.1]	23.4	[23.0–23.7]	16.11
Eating	57.4	8.5	[8.2–8.7]	19.1	[18.7–19.4]	29.9	[29.6–30.3]	42.5	[42.1–42.9]	3.41
Pronouncing	24.5	2.2	[2.1–2.3]	7.4	[7.1–7.6]	14.9	[14.6–15.2]	75.5	[75.2–75.9]	1.33
Brushing/rinsing	39.8	6.4	[6.1–6.6]	12.1	[11.8–12.4]	21.3	[21.0–21.7]	60.2	[59.8–60.6]	2.37
Doing housework	8.7	0.6	[0.6–0.7]	2.4	[2.2–2.5]	5.7	[5.5–5.9]	91.3	[91.1–91.6]	0.48
Schooling	19.1	2.5	[2.3–2.6]	5.4	[5.2–5.6]	11.2	[10.9–11.5]	80.9	[80.6–81.3]	1.11
Sleeping	25.0	3.9	[3.7–4.0]	7.0	[6.8–7.2]	14.1	[13.9–14.4]	75.0	[74.7–75.4]	1.48
Smiling	37.6	6.5	[6.3–6.7]	10.3	[10.1–10.6]	20.8	[20.5–21.1]	62.4	[62.0–62.8]	2.22
Emotion	36.3	5.8	[5.7–6.1]	10.6	[10.3–10.8]	19.9	[19.5–20.2]	63.7	[63.3–64.1]	2.11
Socialising	27.1	4.6	[4.3–4.7]	7.7	[7.5–8.0]	14.8	[14.5–15.1]	72.9	[72.6–73.3]	1.59

Results

A total of 89,582 participants were included in the analysis. The prevalence and extent of each oral impact are presented in Table 1. The mean overall Child-OIDP score was 16.11. A total of 76.6% of participants reported at least one oral impact in the last 6 months, and 19.7% reported at least one severe impact. The highest impact reported was eating, followed by tooth brushing/rinsing, whereas the lowest impact was doing housework.

Most indicators were associated with Child-OIDP scores in the bivariate analysis. Only "oral health attitude status" had statistical significance. Table 2 shows the distribution and *P* values. Of the participants, 50.5% were girls and 52.9% lived in urban areas. The majority (60.4%) were not only children. The proportion of parents with a bachelor's degree or higher was 22.0%. With regard to oral health habits, most participants (64.5%) brushed their teeth once a day or less, and 48.6% of the participants consumed sugary food/drinks once a day or more. Only 25.0% of the participants reported having attended dental appointments in the previous 12 months. Many students had at least a moderate level of oral health knowledge and had a positive attitude towards oral health. The clinical examination results found that 41.8% of participants suffered from dental caries.

Table 3 summarises the results of the Poisson regression model. Statistically significant variables included in this model were sex, location of residence, region, only child status, parents' level of education, frequency of sugar consumption, self-perception of general health, self-perception of oral health, dental appointments in the previous 12 months, oral health knowledge status, age, DMFT index and number of teeth with gingival bleeding. Daily frequency of tooth brushing, oral health attitude status and number of teeth with calculus showed no statistically significant association.

Discussion

It has been argued that whenever a scale or index is used in a new context or with a different population, its psychometric properties should be evaluated[13]. Studies have shown that the Chinese Child-OIDP is also a valid and reliable index that can be used with adolescents[36,37]. In addition, impacts in the original questionnaire were divided into five groups: very severe, severe, moderate, slight and little. However, children who selected the middle option often gave a different answer when filling in the questionnaire for a second time, leading to low reliability[38]. Thus, researchers have improved the questionnaire by dividing severity of impact into four groups (severe, moderate, slight and little) to achieve higher reliability[38]. The reliability and validity of the modified instrument has also been confirmed.

Oral health was commonly found to impact the daily activities of Chinese adolescents, although most impacts were not severe. Studies conducted in other countries show similar results; for example, the impact of oral health on the daily life of adolescents was found to be 85.2% in Thailand[15], 80.7% in Brazil[26] and 73.2% in France[39]. However, children in England reported a 40.4% prevalence[17], which was lower than our results; this might be partly due to the sample size and location of residence. The participants in the aforementioned study attended schools in London and there were only 228 of them[17]. Studies of adults also showed that cultural background was related to differences[40,41]. The main impacts caused by oral disorders concerned eating and tooth brushing/rinsing, which was in line with other studies[15,42]. Doing housework was included in our daily performance items because some experts suggested including 'doing light physical activity' as an extra performance[13].

The influence of sex on adolescents' OHRQoL impacts is consistent with the results of other studies

Table 2 Bivariate association between independent variables and Child-OIDP scores.

Variable		n (%)			*P* value
		Total	OHRQoL	No OHRQoL	
Sex	Male	44365 (49.5)	32463 (48.7)	11902 (51.9)	< 0.001
	Female	45217 (50.5)	34204 (51.3)	11013 (48.1)	
Location of residence	Urban	47385 (52.9)	22921 (34.4)	10722 (46.8)	< 0.001
	Rural	42197 (47.1)	26500 (39.7)	7108 (31.0)	
Region	Eastern	33643 (37.6)	17246 (25.9)	5085 (22.2)	< 0.001
	Western	33608 (37.5)	34154 (51.2)	13231 (57.7)	
	Central	22331 (24.9)	32513 (48.8)	9684 (42.3)	
Only child status	Yes	35479 (39.6)	24312 (36.5)	11167 (48.7)	< 0.001
	No	54103 (60.4)	42335 (63.5)	11748 (51.3)	
Patients' level of education	Low	43006 (48.0)	33800 (50.7)	9206 (40.2)	< 0.001
	Moderate	26864 (30.0)	19271 (28.9)	7593 (33.1)	
	High	19712 (22.0)	13596 (20.4)	6116 (26.7)	
Daily toothbrushing frequency	Twice or more	57765 (64.5)	44454 (66.7)	13311 (58.1)	< 0.001
	Less than twice	31817 (35.5)	22213 (33.3)	9604 (41.9)	
Frequency of consumption of sugary food/drinks	Low	9510 (10.6)	6485 (9.7)	3025 (13.2)	< 0.001
	Moderate	36512 (40.8)	27089 (40.6)	9423 (41.1)	
	High	43560 (48.6)	33093 (49.6)	10467 (45.7)	
Self-perception of general health	Good	55276 (61.7)	39061 (58.6)	16215 (70.8)	< 0.001
	Moderate	31185 (34.8)	24925 (37.4)	6260 (27.3)	
	Poor	3121 (3.5)	2681 (4.0)	440 (1.9)	
Self-perception of oral health	Good	32477 (36.3)	20815 (31.2)	11662 (50.9)	< 0.001
	Moderate	45252 (50.5)	35176 (52.8)	10076 (44.0)	
	Poor	11853 (13.2)	10676 (16.0)	1177 (5.1)	
Dental appointment in the previous 12 months	Yes	22358 (25.0)	17420 (26.1)	4938 (21.5)	< 0.001
	No	67224 (75.0)	49247 (73.9)	17977 (78.5)	
Oral health knowledge status	Poor	7741 (8.6)	5327 (8.0)	2414 (10.5)	< 0.001
	Moderate	41755 (46.6)	31761 (47.6)	9994 (43.6)	
	Good	40086 (44.7)	29579 (44.4)	10507 (45.9)	
Oral health attitude status	Poor	5415 (6.0)	3905 (5.9)	1510 (6.6)	0.067
	Moderate	22901 (25.6)	17061 (25.6)	5840 (25.5)	
	Good	61266 (68.4)	45701 (68.6)	15565 (67.9)	
Age	12 y	20258 (22.6)	15364 (23.0)	4894 (21.4)	< 0.001
	13 y	22908 (25.6)	17092 (25.6)	5816 (25.4)	
	14 y	23537 (26.3)	17383 (26.1)	6154 (26.9)	
	15 y	22879 (25.5)	16828 (25.2)	6051 (26.4)	
DMFT index	= 0	52148 (58.2)	37499 (56.2)	14649 (63.9)	< 0.001
	> 0	37434 (41.8)	29168 (43.8)	8266 (36.1)	
Number of teeth with gingival bleeding	= 0	35594 (39.7)	26061 (39.1)	9533 (41.6)	< 0.001
	> 0	53988 (60.3)	40606 (60.9)	13382 (58.4)	
Number of teeth with calculus	= 0	29970 (33.5)	21645 (32.5)	8325 (36.3)	< 0.001
	> 0	59612 (66.5)	45022 (67.5)	14590 (63.7)	

showing a greater impact on girls' quality of life[30,43]. This association may be explained by the greater experience of caries among girls in the present study. Girls have also been found to be more sensitive to their appearance and oral health status[31,43], and it is therefore unsurprising that their self-perception of oral impacts tended to be high. More frequent sugar intake was found to be significantly associated with more serious oral impacts on daily performance in our study. It is well established that high sugar consumption increases the incidence of caries. Without prompt treatment, people may feel pain from hot or cold stimulation and their chewing and tooth cleaning may be affected.

Location of residence, region and parents' level of education reflected participants' personal socioeconomic background. Individuals with a low socioeconomic status will not only be more likely to be exposed to risk factors affecting oral health, but also have limited access to health knowledge and resources[44]. The more severe the oral disease, the greater the impact it

Table 3 Poisson regression model between independent variables and Child-OIDP scores. For each variable, the empty cells indicate baseline values that acted as a basis for comparison with the other values.

Variable		IRR	Standard error	*P* value	95% CI
Constant		7.83	0.265	< 0.001	[7.33–8.37]
Sex	Male				
	Female	1.05	0.010	< 0.001	[1.03–1.07]
Residence location	Urban				
	Rural	1.13	0.011	< 0.001	[1.11–1.15]
Region	Eastern				
	Western	1.14	0.013	< 0.001	[1.12–1.17]
	Central	1.12	0.013	< 0.001	[1.09–1.14]
Only child status	Yes				
	No	1.13	0.012	< 0.001	[1.10–1.15]
Parents' education level	Low				
	Moderate	0.95	0.011	< 0.001	[0.93–0.97]
	High	0.89	0.012	< 0.001	[0.86–0.92]
Daily toothbrushing frequency	Twice or more				
	Less than twice	1.00	0.011	0.658	[0.97–1.02]
Frequency of consumption of sugary food/drinks	Low				
	Moderate	1.12	0.020	< 0.001	[1.08–1.15]
	High	1.24	0.022	< 0.001	[1.20–1.28]
Self-perception of general health	Good				
	Moderate	1.09	0.012	< 0.001	[1.07–1.12]
	Poor	1.34	0.029	< 0.001	[1.29–1.40]
Self-perception of oral health	Good				
	Moderate	1.13	0.014	< 0.001	[1.10–1.16]
	Poor	1.48	0.023	< 0.001	[1.43–1.52]
Dental appointment in the previous 12 months	No				
	Yes	1.14	0.012	< 0.001	[1.12–1.17]
Oral health knowledge status	Poor				
	Moderate	1.08	0.021	< 0.001	[1.04–1.13]
	Good	1.12	0.022	< 0.001	[1.08–1.17]
Oral health attitude status	Poor				
	Moderate	0.98	0.021	0.340	[0.94–1.02]
	Good	1.03	0.021	0.216	[0.99–1.07]
Age	12 y				
	13 y	1.04	0.014	< 0.05	[1.01–1.07]
	14 y	1.05	0.014	< 0.001	[1.02–1.08]
	15 y	1.10	0.015	< 0.001	[1.07–1.13]
DMFT index		1.01	0.003	< 0.001	[1.01–1.02]
Number of teeth with gingival bleeding		1.00	0.001	< 0.05	[1.00–1.00]
Number of teeth with calculus		1.00	0.001	0.551	[1.00–1.00]

will have on daily performance. Furthermore, parents' level of education was linked to household income and occupational status[31], which determine family environment characteristics. Adolescents' health behaviour and perception of health were reported to be influenced by their home environment[45,46].

The association between low self-perception and negatively impacted OHRQoL could be explained by two hypotheses: that poor self-perceived oral health may cause a low emotional state, and a low emotional state will contribute to poor self-perceived oral health[47]. A previous study showed that increased pain caused by oral disease may be responsible for increased depressive symptoms and more impaired OHRQoL[48].

In the present study, age was also a determinant of impact in the regression model. Older adolescents experienced more serious impacts in daily life than younger adolescents. Some scholars uphold the hypothesis of dynamic change of quality of life[49]. Research conducted in other countries found that children experi-

enced higher impacts than older adolescents[16,39]. Other researchers have suggested that impacts are less severe in adolescents aged 15 to 18 years than those aged 12 to 15 years[50]. As impacts accumulate, not only adolescents' daily life but also their psychological development, social skills and academic performance are ultimately involved, so the importance of regular dental visits should be emphasised.

A limitation of the present study is the fact that the frequency of impacts was not documented. Impacts were merely estimated by extent rather than by multiplying extent and frequency, which would have provided a more accurate index. Additionally, we were not able to identify the specific reason for these impacts. If a list of impairments contributing to impacts (e.g., toothache, malocclusion, dental trauma) were listed and participants were able to select which they had experienced in the previous 6 months, the association between the oral disorders and the different impacts would be more precise, making the analysis more profound. As the model of medical science has transformed in recent years, it is necessary to pay closer attention to patients' feelings and needs. We hope our findings will provide intervention cues for dental professionals and policy makers.

Conclusion

In general, oral impacts were common among Chinese adolescents, although most of them were not so severe. Eating and tooth brushing/rinsing were the most commonly affected performances. Sex, location of residence, region, only child status, parents' level of education, frequency of sugar consumption, self-perception of general/oral health status, dental appointments in the previous 12 months, oral health knowledge status, age, DMFT index and number of teeth with gingival bleeding were found to be associated with OHRQoL.

Conflicts of interest

The authors declare no conflicts of interest related to this study.

Author contribution

Dr Hui Jing WU drafted the manuscript; Drs Meng Lin CHENG and Chun Zi ZHANG revised the article; Drs Hui Jing WU, Meng Lin CHENG, Meng Ru XU, Xiao Li GAO, Chun Zi ZHANG, Shuo DU and Min DING analysed the data; Drs Xing WANG, Xi Ping FENG, Bao Jun TAI, De Yu HU, Huan Cai LIN, Bo WANG, Shu Guo ZHENG, Xue Nan LIU, Wen Sheng RONG, Wei Jian WANG, Chun Xiao WANG and Yan SI trained the investigators and designed and supervised the survey; Drs Tao XU and Yan SI designed and directed the study. All authors read and approved the final manuscript for submission.

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