

The Association Between Mental Health and Caries: A Preliminary Study of Graduate Students in China

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1. Abstract

1.1. Aims: The aim of this study was to analyze the association between mental health and dental caries in graduate students in China.

1.2. Methods: Three structured psychological scales, including the Symptom Checklist 90, Perceived Social Support Scale, and General Well-Being Schedule were administered to evaluate mental health. Dental caries consists of three parts, oral questionnaires, caries susceptibility tests and caries examinations. Oral questionnaires assessing oral health, oral hygiene, and oral habits were regarded as potential confounding factors. Cariostat caries susceptibility test was used to evaluate caries susceptibility. Decayed-missing-filled teeth and decayed-missing-filled surfaces indices were recorded by the International Caries Detection and Assessment System II. SPSS 20.0 software was used for statistical analyses.

1.3. Results: The population, 354 graduate students aged 21–29 years was divided into four groups: safety margin, notice margin, risk margin, and high-risk margin based on caries susceptibility classifications. Multiple logistic regression analysis showed that the total scores of the Symptom Checklist 90 scale and the hostility factor were significantly associated with caries susceptibility ($P < 0.05$). A multiple linear regression analysis revealed no statistical-

ly significant associations between the psychological scales and Decayed-missing-filled teeth and decayed-missing-filled surfaces.

1.4. Conclusions: There were no direct correlations between the psychological scales and Decayed-missing-filled teeth and decayed-missing-filled surfaces. Nonetheless, hostility may increase caries susceptibility.

2. Introduction

Dental caries is a progressive breakdown of the hard tissues of teeth due to bacterial activity as the main pathogen and multi-factor influence. Dental caries is one of the top three diseases that threaten human health, as determined by the World Health Organization (WHO). It has a high incidence among the general population. The incidence of caries is approximately 35.47%–47.87% in college students in China [1–4]. Previous studies on the relationship between mental stress factors and oral diseases mainly focus on periodontal disease such as chronic periodontitis [5] and necrotizing ulcerative gingivitis [6], oral mucosal disease such as stress ulcer [7] and lichen planus [8], temporomandibular joint disorders [9] and caries. A study conducted in Korea in 2016 suggested that mental health factors, such as age, family income, and depression disorder may influence the incidence of dental caries [10]. Thomson et al. also believed that certain personality traits were risk factors for oral diseases, including tooth loss due to caries [11]. High

academic pressure, young age, and low saliva flow rate have also been reported as risk factors predisposing undergraduates to dental caries [12]. On the basis of previous experiments [13], our study attempted to explore whether mental factors affect the caries susceptibility, or whether it can directly influence the occurrence and development of caries.

3. Materials and Methods

1500 full-time graduate students aged 21–29 years were recruited from Tianjin Medical University, Tianjin University, and Tianjin Armed Police School of Medicine. Participants who met the following criteria were excluded: (i) invalid questionnaires; (ii) the presence of systematic disease or self-report of previously diagnosed systematic disease; and (iii) mental disease, such as trisomania. Informed consent was obtained from all participants. This study was registered as a clinical trial (ChiCTR-EOC-15006143) in the Chinese Clinical Trial Registration database (www.chictr.org.cn) on March 25, 2015. Our study consist of three parts, psychological scales were regarded as independent variable, caries susceptibility tests and caries examinations were regarded as dependent variable, oral questionnaires were regarded as potential confounding factors (Figure 1). Psychological scales used were the SCL-90, PSSS, and GWB. The SCL-90 scale includes 90 items that can be placed into nine groups including somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, terror, paranoia, and psychoticism. Each item is scored on a scale ranging from 1 to 5. A score of 1 indicates “none” and a score of 5 indicates “severe”. The scores for the nine grouped factors were calculated separately. The factor score equals the total score of the various items within that factor divided by the number of items in the factor. The PSSS contains 12 self-assessment items, which can be categorized as either family support or social support. A scoring system ranging from 1 to 7 is used, wherein 1 means “strongly disagree” and 7 means “strongly agree.” The GWB scale, which was revised by Jianhua Duan, includes 18 items. It is divided into six factors: anxiety, depression, positive well-being, self-control, vitality, and general health. Caries susceptibility tests were initially performed using Cariostat® (Sankin; Tokyo, Japan). The tests were carried out in accordance with the Cariostat® instructions. When comparing the results to the standard colorimetric card, the lower value prevailed if the colo-

rimetric result was between two values, and the results were recorded. The results were classified into four groups: blue, caries activity test (CAT) 0 (pH 7.0, safety margin); green, CAT+1 (pH 5.5, notice margin); yellow-green, CAT+2 (pH 4.5, risk margin); and yellow, CAT+3 (pH 4, high-risk margin). The International Caries Detection and Assessment System (ICDAS-II) was used for the caries examination. The examination was completed by four trained examiners, including a senior examiner and three inspectors. Trainers learned ICDAS II system from <http://www.icdas.org> website, and obtained $p=0.81$, which meets the requirements of the system. The training process for the ICDAS-II system is described in another study [14]. The ICDAS-II codes range from 0 to 6. The descriptions of the ICDAS-II codes follow: 0 = sound, 1 = first visual change in enamel, 2 = distinct visual change in enamel, 3 = localized enamel breakdown (without clinical visual signs of dentinal involvement), 4 = underlying dark shadow from dentin, 5 = distinct cavity with visible dentin, and 6 = extensive distinct cavity with visible dentin. The most common index for dental caries examination is the WHO diagnostic criteria, which include the DMFT and DMFS indices. According to ICDAS-II criteria, the numbers of DMFT and DMFS were recorded for permanent teeth. The WHO diagnostic criteria for caries are consistent with the diagnostic criteria for codes 3-6 in the ICDAS-II system, but do not include early non-cavitated caries lesions (codes 1 and 2). Oral questionnaires included 91 items used to assess oral health, oral hygiene concepts, and oral habits. The questions included “How do you assess your oral health?”, “Do you believe it is necessary to visit the dentist regularly,” and “How often do you drink carbonated beverages?” These questions were based on various oral questionnaire surveys used in other studies [1-4]. All questionnaires were tested for reliability, validity and repeatability. Kruskal-Wallis tests were used to analyze the associations between confounding factors and caries susceptibility, and one-way analyses of variance was used to analyze the associations between confounding factors and DMFT or DMFS. After adjustment for potential confounding factors, multiple logistic regression analysis was used to examine the relationships between mental health and caries susceptibility, and multiple linear regression was used to analyze the psychological scales, DMFT and DMFS. The level of statistical significance was $P < 0.05$.

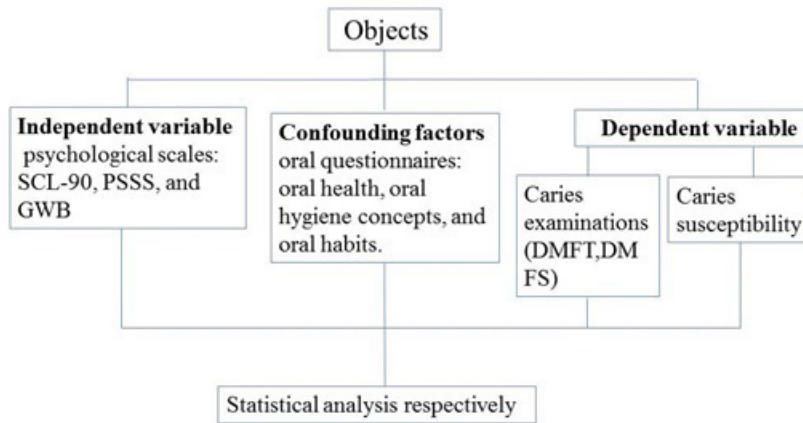


Figure 1: Flow chart and content of the study design of our research.

4. Results

Eventually we obtained 354 valid responses. The average age of the subjects was 23.90 ± 1.32 years, including 100 men (24.26 ± 1.42 y, 28.25%) and 254 women (23.82 ± 1.36 y, 71.75%). The average total scores for the 354 subjects on the SCL-90, PSSS, and GWB scales were 121.19 ± 21.75 , 66.76 ± 8.50 , and 82.56 ± 10.93 , respectively. Based on the ICDAS-II test results, the prevalence rate of caries was 78.53%, the average DMFT was 16.08 ± 4.05 , and the average DMFS was 21.40 ± 6.55 . The population was divided into four groups according to the Cariostat tests: safety margin (n = 18, 5.08%), notice margin (n = 49, 13.84%), risk margin (n = 204, 57.63%), and high-risk margin (n = 83, 23.45%). The univariate analysis showed that confounding factors for caries susceptibility were the degree of education of parents, the frequency of drinking juice and carbonated beverages, and regular oral examination. Confounding factors for DMFT were the concept of protecting teeth and the frequency of eating fresh fruit.

Confounding factors for DMFS were the concept of protecting teeth, the frequency of eating fresh fruit and sweet milk drinks, and self-judgment of oral state ($P < 0.05$). When we adjusted for the confounding factors, the multiple linear regressions indicated that there were no statistically significant associations between mental health and DMFT or DMFS. The total scores of SCL-90, PSSS, and GWB had no statistically significant associations with any of the factors in the three psychological scales (Table 1-4). The multiple logistic regression analysis indicated that the total score of SCL-90 was related to caries susceptibility (Table 5) ($P < 0.05$). Specifically the total score of SCL-90 was related to notice margin and high-risk margin ($p = 0.015$, $p = 0.014$). When considering relationships between each of the factors of the three psychological scales and caries susceptibility, the hostility factor was related to caries susceptibility (Table 6) ($P < 0.05$). And hostility factor related to notice margin, risk margin and high-risk margin ($p = 0.049$, $p = 0.016$, and $p = 0.007$).

Table 1. Multiple linear regressions between DMFT and the total scores of three psychological scales under adjustment for certain potential confounding factors.

	B	t	Sig.	VIF
Constant	7.207	1.121	0.263	
Concept on protecting teeth	0.610	2.090	0.037	1.037
Frequency of eating fresh fruit	-0.041	-0.185	0.854	1.119
Sex	0.110	0.215	0.830	1.147
Age	0.200	1.193	0.234	1.053
Total score of GWB	-0.027	-0.603	0.547	1.026
Total score of SCL	0.009	0.846	0.398	1.117
Total score of PSSS	0.035	1.300	0.194	1.139

B: the partial regression coefficient. VIF: Variance Inflation Factor. GWB: General Well-Being Schedule. SCL: Symptom Checklist 90. PSSS: Perceived Social Support Scale.

Table 2. Multiple linear regressions between DMFT and each factor of three psychological scales under adjustment for certain potential confounding factors.

	B	t	Sig.	VIF
Constant	6.924	1.024	0.307	
Sex	0.404	0.766	0.444	1.221
Age	0.214	1.251	0.212	1.092
Concept on protecting teeth	0.456	1.458	0.146	1.193
Frequency of eating fresh fruit	-0.003	-0.011	0.991	1.200
Somatization	-1.220	-0.959	0.338	2.146
Obsessive-compulsive symptoms	1.031	1.161	0.246	2.458
Interpersonal sensitivity	0.383	0.355	0.723	3.136
Depression	-1.523	-1.144	0.253	3.558
Anxiety	0.901	0.670	0.503	3.384
Hostility	-1.237	-1.442	0.150	1.811
Terror	1.848	1.754	0.080	2.146
Paranoia	1.917	1.726	0.085	2.288
Psychoticism	-1.601	-1.135	0.257	2.240
Family support	0.045	0.626	0.532	1.575
Social support	0.008	0.158	0.874	1.878
Anxiety	-0.002	-0.017	0.987	1.243
vitality	0.088	0.761	0.447	1.157
Positive well-being	-0.113	-0.651	0.516	1.735
General health	-0.006	-0.055	0.956	1.905
Self-control	0.002	0.011	0.991	1.706
Depression	-0.108	-1.116	0.265	1.122

B:the partial regression coefficient, VIF: Variance Inflation Factor.

Table 3. Multiple linear regressions between DMFS and the total scores of three psychological scales under adjustment for certain potential confounding factors.

	B	t	Sig.	VIF
Constant	-3.431	-0.333	0.740	
Sex	0.522	0.639	0.523	1.151
Age	0.327	1.218	0.224	1.058
Self-judgment of oral states	0.538	1.452	0.148	1.054
Concept on protecting teeth	1.102	2.348	0.019	1.154
Frequency of eating fresh fruit	-0.029	-0.081	0.936	1.051
Frequency of sweet milk drinks	0.656	2.389	0.017	1.032
Total score of GWB	0.020	0.278	0.781	1.026
Total score of SCL	0.015	0.890	0.374	1.120
Total score of PSSS	0.061	1.393	0.165	1.157

B:the partial regression coefficient. VIF: Variance Inflation Factor. GWB: General Well-Being Schedule. SCL: Symptom Checklist 90. PSSS: Perceived Social Support Scale.

Table 4. Multiple linear regressions between DMFS and each factor of three psychological scales under adjustment for certain potential confounding factors.

	B	t	Sig.	VIF
Constant	-4.407	-0.403	0.687	
Sex	0.712	0.837	0.403	1.226
Age	0.319	1.156	0.249	1.096
Self-judgment of oral states	1.053	2.068	0.039	1.216
Concept on protecting teeth	-0.088	-0.236	0.813	1.238
Frequency of eating fresh fruit	0.627	1.610	0.108	2.149
Frequency of sweet milk drinks	0.631	2.214	0.028	2.460
Somatization	-0.424	-0.207	0.836	3.148
Obsessive-compulsive symptoms	0.757	0.529	0.597	3.583
Interpersonal sensitivity	0.590	0.339	0.735	3.467
Depression	-2.238	-1.039	0.299	1.831
Anxiety	1.085	0.495	0.621	2.148
Hostility	-0.974	-0.700	0.484	2.316
Terror	0.234	0.138	0.890	2.247
Paranoia	1.738	.965	0.335	1.591
Psychoticism	1.147	0.504	0.615	1.882
Family support	0.129	1.122	0.263	1.279
Social support	0.011	0.128	0.898	1.158
Anxiety	0.012	0.068	0.946	1.760

vitality	0.219	1.171	0.242	1.912
Positive well-being	-0.079	-0.279	0.780	1.723
General health	0.047	0.268	0.789	1.140
Self-control	0.135	0.561	0.575	1.136
Depression	-0.147	-0.933	0.351	1.087

B:the partial regression coefficient, VIF: Variance Inflation Factor.

Table 5. Multiple logistic regressions between caries susceptibility and the total scores of three psychological scales under adjustment for certain potential confounding factors.

	Notice margin of caries susceptibility			Risk margin of caries susceptibility			High-risk margin of caries susceptibility		
	B	Sig.	Exp(B)	B	Sig.	Exp(B)	B	Sig.	Exp(B)
Intercept	-10.992	0.277	-	0.916	0.908		0.315	0.970	
Age	-0.204	0.377	0.815	-0.219	0.288	0.803	-0.259	0.241	0.772
Sex	-0.472	0.485	0.624	0.010	0.987	1.010	-0.646	0.304	0.524
Total score of GWB	0.049	0.468	1.050	0.049	0.413	1.051	0.026	0.676	1.027
Total score of SCL	0.049	0.015	1.050	0.037	0.052	1.038	0.048	0.014	1.049
Total score of PSSS	0.019	0.653	1.019	-0.015	0.684	0.985	-0.003	0.945	0.997

B:the partial regression coefficient. Exp(B): ods ratio. GWB: General Well-Being Schedule. SCL: Symptom Checklist 90. PSSS: Perceived Social Support Scale.

Table 6. Multiple logistic regressions between caries susceptibility and each factor of three psychological scales under adjustment for certain potential confounding factors.

	Notice margin of caries susceptibility			Risk margin of caries susceptibility			High-risk margin of caries susceptibility		
	B	Sig.	Exp(B)	B	Sig.	Exp(B)	B	Sig.	Exp(B)
Intercept	-10.992	0.277		-2.422	0.790		-4.954	0.609	
Age	-0.250	0.321	0.779	-0.234	0.296	0.792	-0.270	0.262	0.764
Sex	-.0333	0.660	0.717	0.154	0.815	1.166	-0.472	0.504	0.623
Somatization	0.139	0.952	1.149	0.523	0.809	1.687	0.436	0.846	1.547
Obsessive-compulsive symptoms	1.913	0.233	6.773	1.742	0.244	5.707	1.998	0.198	7.376
Interpersonal sensitivity	2.444	0.265	11.524	1.462	0.480	4.316	1.091	0.608	2.978
Depression	1.921	0.467	6.829	0.508	0.837	1.663	0.721	0.776	2.057
Anxiety	-3.002	0.255	0.050	-2.955	0.233	0.052	-3.345	0.189	0.035
Hostility	4.895	0.049	133.586	5.754	0.016	315.400	6.573	0.007	715.302
Terror	-0.183	0.924	0.833	-0.304	0.863	0.738	-0.675	0.711	0.509
Paranoia	-3.540	0.072	0029	-2.166	0.224	0.115	-2.268	0.224	0.103
Psychoticism	0.622	0.819	1.862	0.452	0.859	1.571	1.391	0.594	4.018
Family support	0.020	0.871	1.020	-0.008	0.940	0.992	0.065	0.584	1.067
Social support	0.064	0.431	1.067	0.010	0.888	1.010	0.025	0.745	1.026
Anxiety	-0.082	0.597	0.921	0.042	0.764	1.043	-0.070	0.636	0.933
vitality	0.072	0.702	1.074	-0.008	0.963	0.992	0.046	0.794	1.047
Positive well-being	0.163	0.542	1.177	0.133	0.585	1.142	0.046	0.858	1.047
General health	0.146	0.384	1.158	0.064	0.669	1.066	-0.038	0.806	0.962
Self-control	0.261	0.292	1.298	0.147	0.517	1.158	0.267	0.260	1.306
Depression	0.053	0.728	1.054	0.027	0.844	1.027	0.065	0.654	1.067

B:the partial regression coefficient. Exp(B): ods ratio

5. Discussion

Previous studies have demonstrated that the incidence of caries is high among college students [1-4]. However, few studies have focused on graduates, who form a special group of students. Compared to undergraduates, graduates may suffer more pressure from courses and research. In addition, social problems, such as failure in love and employment pressure exacerbate the situation. We chose graduates as our study population, as they have high caries rates and high levels of mental pressure. Some oral habits, such as the frequency of intake of juices, carbonated beverages, fresh fruit, and sweet milk, awareness of the need for regular oral examinations, consciousness of dental protection, educational level of parents, and self-judgment of oral health, are related to caries. The association between mental health and caries still remains after adjustment for these potential confounding factors. The total score of SCL-90, and particularly the hostility factor, was related to caries susceptibility. In the present study, we found that mental health had no association with DMFT or DMFS. Previous studies, however, have indicated that mental health is related to DMFT or the occurrence of dental caries. In 2012, Mejia-Rubalcava et al. demonstrated that high levels of academic stress represent a risk factor for DMFT in undergraduate dental surgery students aged 18–22 years [12]. In 2011, Thomson concluded that personality is associated with dental caries and its sequelae in 26-year-old and 32-year-old subjects [15]. In 2007, a survey of children aged 1 to 5 years conducted by Finlayson et al. indicated that social and psychosocial factors render children liable to early-onset childhood caries, and are similar to conventional cariogenic factors [16]. The observed differences are mainly due to differences in study populations, regions, and lifestyle. Our findings indicate that the total score of SCL-90, and particularly the hostility factor, is related to caries susceptibility. The total score of SCL-90 was associated with the notice margin and high-risk margin levels of caries susceptibility, although it had no association with the risk margin level of caries susceptibility. The hostility factor was related to different levels of caries susceptibility, and the OR increased with increasing levels of caries susceptibility (133.586, 315.400, and 715.302, respectively). These findings may be explained by one of two lines of evidence. First, previous research indicated that negative mental health may affect eating habits, result in an increase in sugar intake, and eventually increase susceptibility of caries [17,18]. Deinzer et al [19] and Hugo et al. [20] have shown that negative mental health may increase the risk of plaque accumulation and susceptibility to plaque-related diseases. We suspect that negative mental health, as indicated by a high total score on the SCL-90, might lead to the individual ignoring some healthy oral hygiene habits. These habits may include oral cleaning and regular appointments with the dentist. This may then indirectly influence susceptibility to caries. Second, some studies indicate that negative mental health due to life stress and negative emotions may

change the endocrine and immune systems [21,22]. Glaser [23] found that the function of T lymphocytes was inhibited and the activity of natural killer cells was decreased during the examination. This suggests that high levels of mental stress may influence the immune system. In addition, when there is negative mental health, the secretion of catecholamine neurotransmitters such as adrenaline and noradrenaline will decrease. This may then lead to decreased salivary flow, which may then result in changes in the oxidation-reduction and buffering capacities of saliva and eventually increase susceptibility to caries [20,24-27]. Hostility factors, such as irascibility and contentious mood, might also influence the secretion of catecholamine neurotransmitters and a decrease in the salivary flow rate, which may then increase susceptibility to caries. We found that the OR for the hostility factor increased along with increasing caries susceptibility. Our study had some limitations. First, different conclusions may result from differences in study populations, regions, sample sizes, and sample quality. Since our study was limited by the research region and our sample size, our conclusion is open to question. Second, although we adjusted for many confounding factors, there may have been some potential confounding factors that we ignored. Finally, most of the results were obtained using questionnaires. As a result, our results may have been subject to selection bias and information bias. Further studies with improved research designs are required to perfect our findings.

6. Conclusion

There were no direct correlations between the psychological scales and Decayed-missing-filled teeth and decayed-missing-filled surfaces. Nonetheless, hostility may increase caries susceptibility.

7. Ethical Statement

The research was approved by Medical Ethics Committee of Tianjin Medical University Stomatological Hospital in Tianjin, China (Ethical no: TMUSHhMEC2014050).

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