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TheAssociationBetweenMentalHealthandCaries:APreliminaryStudyof Graduate Students in China

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1. Abstract

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

Methods: Three structured psychological scales, includ-ing 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 question- naires, 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. De- cayed-missing-filled teeth and decayed-missing-filled surfaces indices were recorded by the International Caries Detection and AssessmentSystemII.SPSS20.0softwarewasusedforstatistical analyses.

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 thetotalscoresoftheSymptomChecklist90scaleandthehostility factorweresignificantlyassociatedwithcariessusceptibility(P< 0.05).Amultiplelinearregressionanalysisrevealedno statistical-

ly significant associations between the psychological scales and Decayed-missing-filledteethanddecayed-missing-filledsurfaces.

Conclusions: There were no direct correlations between the psychological scales and Decayed-missing-filled teeth and decayed-missing-filledsurfaces.Nonetheless,hostilitymayincrease caries susceptibility.

2. Introduction

Dental caries is a progressive breakdown of the hard tissues of teethduetobacterialactivityasthemainpathogenandmulti-fac- tor influence. Dental caries is one of the top three diseases that threatenhumanhealth,asdeterminedbytheWorldHealthOrganization (WHO). It has a high incidence among the general popula- tion. The incidence of caries is approximately 35.47%-47.87% in college students in China [1-4]. Previous studies on the relation- ship between mental stress factors and oral diseases mainly focus onperiodontaldiseasesuchaschronicperiodontitis[5]andnecrotizingulcerativegingivitis[6],oralmucosaldiseasesuchasstress ulcer[7]andlichenplanus[8],temporomandibularjoint disorders [9]andcaries.AstudyconductedinKoreain2016suggestedthat mental health factors, such as age, family income, and depression disordermayinfluencetheincidenceofdentalcaries[10].Thomsonetal.alsobelievedthatcertainpersonalitytraitswereriskfactorsfororaldiseases, includingtoothlossdue tocaries[11]. High

academic pressure, young age, and low saliva flow rate have also beenreportedasriskfactorspredisposingundergraduatestodental caries [12]. On the basis of previous experiments [13], our study attempted to explore whether mental factors affect the caries susceptibility,orwhetheritcandirectlyinfluencetheoccurrenceand development of caries.

3. MaterialsandMethods

1500full-timegraduatestudentsaged21–29yearswererecruited 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 tristimania. 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, psy- chological scales were regarded as independent variable, caries susceptibility tests and caries examinations were regarded as de- pendent variable, oral questionnaires were regarded as potential confoundingfactors(Figure1).Psychologicalscalesusedwerethe SCL-90, PSSS, and GWB. The SCL-90 scale includes 90 items thatcanbeplacedintoninegroupsincludingsomatization,obses- sive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, terror, paranoia, and psychoticism. Each itemis 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 thenine 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.Ascoring system ranging from 1 to 7 is used,wherein1means"stronglydisagree"and7means"strongly agree." The GWB scale, which was revised by Jianhua Duan, includes 18 items. It is divided into six factors: anxiety, depression, positivewell-being,self-control,vitality,andgeneralhealth.Car- ies susceptibility tests were initially performed using Cariostat® (Sankin; Tokyo, Japan). The tests were carried out in accordance withtheCariostat®instructions.Whencomparingtheresultstothe standardcolorimetriccard,thelowervalueprevailedifthecolorimetric 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 CariesDetectionandAssessmentSystem(ICDAS-II)wasusedfor the caries examination. The examination was completed by four trained examiners, including a senior examiner and three inspectors.TrainerslearnedICDASIIsystemfromhttp://www.icdas.org website , andobtainedp=0.81,whichmeetstherequirementsof 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,thenumbersof DMFTandDMFSwererecordedfor permanent teeth. The WHO diagnostic criteria for caries are consistentwiththediagnosticcriteriaforcodes3-6intheICDAS-IIsys- tem, but do not include early non-cavitated caries lesions (codes1 and 2).Oral questionnaires included 91 items used to assess oral health, oral hygiene concepts, and oral habits. The questions included"Howdoyouassessyouroralhealth?","Doyoubelieve it is necessary to visit the dentist regularly," and "How often do youdrinkcarbonatedbeverages?"Thesequestionswerebasedon 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 analysesofvariancewasusedtoanalyzetheassociationsbetween 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, DMFTand DMFS.The level of statistical significance was $P < 0.05$.

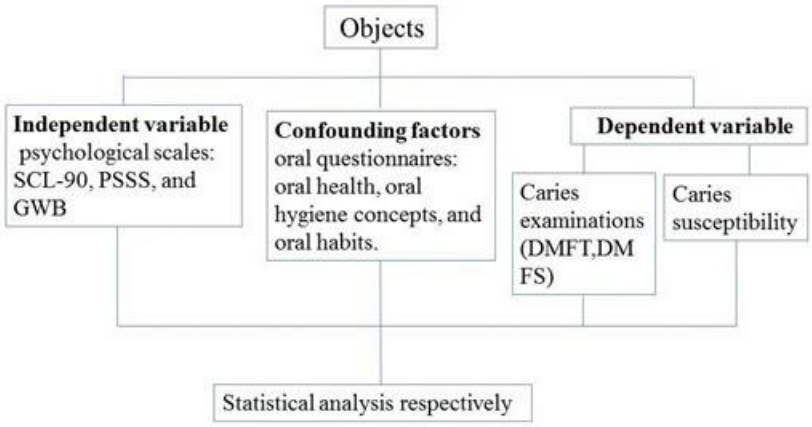

Figure1: Flowchartand contentofthe studydesign ofour research.

4. Results

Eventually we obtained 354 valid responses. The average age of thesubjectswas23.90±1.32years,including100men(24.26± 1.42y,28.25%)and254women(23.82±1.36y,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 prevalencerateofcarieswas78.53%,theaverageDMFTwas16.08 ± 4.05, and the average DMFS was 21.40 ± 6.55. The population wasdividedintofourgroupsaccordingtotheCariostattests:safetymargin(n=18,5.08%),noticemargin(n=49,13.84%),risk margin(n=204,57.63%),andhigh-riskmargin(n=83,23.45%). The univariate analysis showed that confounding factors for car- ies 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 conceptofprotectingteethandthefrequencyofeatingfreshfruit. ConfoundingfactorsforDMFSweretheconceptofprotecting 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 indicatedthattherewerenostatisticallysignificantassociationsbetween mental health and DMFT or DMFS. The total scores of SCL-90, PSSS, and GWB had no statistically significant associations with anyofthefactorsinthethreepsychologicalscales(Table1-4).The multiple logistic regression analysis indicated that the total score ofSCL-90wasrelatedtocariessusceptibility(Table5)($P<0.05$). SpecificallythetotalscoreofSCL-90wasrelatedtonoticemargin andhigh-riskmargin($p=0.015$,$p=0.014$).Whenconsideringrelationships between each of the factors of the three psychological scales and caries susceptibility, the hostility factor was related to cariessusceptibility(Table6)($P<0.05$).Andhostilityfactorrelat- ed to notice margin, risk margin and high-risk margin ($p = 0.049$, $p = 0.016$, and $p = 0.007$).

Table1. MultiplelinearregressionsbetweenDMFTandthetotalscoresofthreepsychologicalscalesunderadjustmentforcertainpotentialconfound- ing 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	-.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
TotalscoreofGWB	-0.027	-0.603	0.547	1.026
TotalscoreofSCL	0.009	0.846	0.398	1.117
Totalscoreof PSSS	0.035	1.300	0.194	1.139

B:thepartialregressioncoefficient.VIF: VarianceInflationFactor.GWB:GeneralWell-BeingSchedule.SCL:SymptomChecklist90.PSSS:Perceived Social Support Scale.

Table 2. Multiple linear regressions between DMFTand 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:thepartialregressioncoefficient,VIF:VarianceInflationFactor.

Table3. MultiplelinearregressionsbetweenDMFSandthetotalscoresofthreepsychologicalscalesunderadjustmentforcertainpotentialconfound- ing 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
TotalscoreofGWB	0.020	0.278	0.781	1.026
TotalscoreofSCL	0.015	0.890	0.374	1.120
Totalscoreof PSSS	0.061	1.393	0.165	1.157

B:thepartialregressioncoefficient.VIF: VarianceInflationFactor.GWB:GeneralWell-BeingSchedule.SCL:SymptomChecklist90.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	-.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:thepartialregressioncoefficient,VIF:VarianceInflationFactor.

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

	Noticemarginofcariessusceptibility			Riskmarginofcariessusceptibility			High-riskmarginofcaries 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
Totalscoreof GWB	0.049	0.468	1.050	0.049	0.413	1.051	0.026	0.676	1.027
Totalscoreof SCL	0.049	0.015	1.050	0.037	0.052	1.038	0.048	0.014	1.049
Totalscoreof PSSS	0.019	0.653	1.019	-0.015	0.684	0.985	-0.003	0.945	0.997

B:thepartialregressioncoefficient.Exp(B):odsratio.GWB:GeneralWell-BeingSchedule.SCL:SymptomChecklist90.PSSS:PerceivedSocial Support Scale.

Table6. Multiplelogisticregressionsbetweencariessusceptibilityandeachfactorofthreepsychologicalscalesunderadjustmentforcertainpotential confounding factors.

	Noticemarginofcariessusceptibility			Riskmarginofcariessusceptibility			High-riskmarginofcaries 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:thepartialregressioncoefficient.Exp(B):odsratio

5. Discussion

Previous studies have demonstrated that the incidence of cariesis high among college students [1-4]. However, few studies have focusedongraduates,whoformaspecialgroupofstudents.Compared toundergraduates,graduatesmaysuffermorepressurefrom courses and research. In addition, social problems, such as failureinloveandemploymentpressureexacerbatethesituation.We chose graduates as out study population, as they have high caries rates and high levels of mental pressure. Some oral habits, suchas 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. Theassociationbetweenmentalhealthandcariesstillremainsafter adjustment for these potential confounding factors. The total score of SCL-90, and particularly the hostility factor, was related tocariessusceptibility.Inthepresentstudy,wefoundthatmental healthhadnoassociationwithDMFTorDMFS.Previousstudies, however, have indicated that mental health is related to DMFTor 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 18–22years[12].In2011,Thomsonconcludedthatpersonalityis associated with dental caries and its sequelae in 26-year-old and 32-year-oldsubjects[15].In2007,asurveyofchildrenaged1to5 years conducted by Finlayson et al. indicated that social and psychosocial factors render children liable to early-onset childhood caries,andaresimilartoconventionalcariogenicfactors[16].The observeddifferencesaremainlyduetodifferencesinstudypopulations, regions, and lifestyle. Our findings indicate that the total scoreofSCL-90,andparticularly thehostilityfactor,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 differentlevelsofcariessusceptibility,andtheORincreasedwith increasing levels of caries susceptibility (133.586, 315.400, and 715.302,respectively).Thesefindingsmaybeexplainedbyoneof 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 hygienehabits.Thesehabitsmayincludeoralcleaningandregular appointments with the dentist. This may then indirectly influence susceptibility to caries. Second, some studies indicate that negativementalhealthduetolifestressandnegativeemotionsmay 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.Thissuggeststhathighlevelsofmentalstressmayinfluence the immune system. In addition, when there is negative mental health, the secretion of catecholamine neurotransmitters such as adrenalineandnoradrenalinewilldecrease.Thismaythenleadto decreased salivary flow, which may then result in changes in the oxidation-reductionandbufferingcapacitiesofsalivaandeventu- ally increase susceptibility to caries [20,24-27]. Hostility factors, suchasirascibilityandcontentiousmood,mightalsoinfluencethe secretionofcatecholamineneurotransmittersandadecreaseinthe salivaryflowrate,whichmaythenincreasesusceptibilitytocaries. WefoundthattheORforthehostilityfactorincreasedalongwith 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 studieswithimprovedresearchdesignsarerequiredtoperfectour findings.

6. Conclusion

Therewerenodirectcorrelationsbetweenthepsychologicalscales and Decayed-missing-filled teeth and decayed-missing-filled surfaces. Nonetheless, hostility may increase caries susceptibility.

7. Ethical Statement

TheresearchwasapprovedbyMedicalEthicsCommitteeofTian- jin Medical University Stomatological Hospital in Tianjin, China (Ethical no: TMUSHhMEC2014050).

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