

Relationship between mental health risk factors and oral symptoms in adolescents: Korea Youth Risk Behavior Web-based Survey, 2013

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Objective: To investigate the relationship between mental health risk factors and Korean adolescents' oral health. **Basic research design:** Cross-sectional study was based on the 9th Korea Youth Risk Behavior Web-based Survey (2013). **Participants:** Data were selected for 66,951 adolescents (33,777 males and 33,174 females; aged 13-18 years) out of 72,435 participants were analysed, after excluding cases with missing values. **Main outcome measures:** Oral health (experience of one or more of six oral symptoms), demographic characteristics (seven factors), and mental health risk (five factors). **Method:** Logistic regression analysis determined the effects of mental health risk factors on subjects' oral symptoms after adjustment for general characteristics. **Results:** The adjusted odds ratio (AOR) was 1.52 (95%CI 1.50,1.54) for sleep satisfaction self-described as "not sufficient at all" and AOR 2.64 (95%CI 2.59,2.69) for those reporting very high stress levels. The AOR was 1.26 times (95%CI 1.24,1.27) higher for those using the internet on weekends for non-study purposes for >6 hours than those using it for one hour. The AOR for experiencing oral symptoms was 1.44 times (95%CI 1.41,1.47) higher for those who had experienced school violence than for those who had not. **Conclusions:** Mental health risk factors were associated with oral symptoms. These results should inform the development of school health policies and comprehensive adolescent health promotion programs in Korea

Key words: adolescent, mental health, oral health, psychological stress, sleep, Republic of Korea

Introduction

Adolescence is a transitional stage during which a child develops into an adult incurring dramatic physical and emotional changes. Adolescents typically experience considerable stress from their lack of social skills and the psychological changes accompanying this stage (Cho and Sung, 1999). Mental health risk factors such as stress are closely associated with oral health. Compromised oral health can diminish quality of life and directly or indirectly affect physical health (Hong, 2013). The 9th (2013) Korea Youth Risk Behavior Web-based Survey (KCDCP, 2014) showed that 58.6% of male students and 60.6% of female students had experienced one or more oral symptoms (chipped or broken teeth, tooth pain when eating, toothache, aching or bleeding gums, a painful tongue or pain inside the mouth, and bad breath) within the past 12 months (MHW *et al.*, 2013). In previous studies, adolescents who had experienced oral pain reported lower oral health-related quality of life than did those without oral pain experiences (Jung *et al.*, 2015). Another study showed that leaving school early and absence from school were associated with bleeding gums or tooth pain (Lim *et al.*, 2013), demonstrating oral health problems' negative effects on adolescents' daily lives, including their education. Therefore, it is important to understand mental health risk factors for adolescents' oral health and the relationships between those and oral health.

Mental health problems such as stress, depression, anxiety and sleep deprivation could apparently influence oral health

conditions such as stomatitis, gingivitis, periodontitis, and bad breath (Alshahrani and Baccaglini, 2014; Dolic *et al.*, 2005; Inglehart and Tedesco, 1995; Reners and Brex, 2007; Wiener, 2015). More specifically, psychological stress can affect daily life and oral hygiene habits, and long-term exposure to excessive stress can result in depression (Reners and Brex, 2007). In turn, depression could hamper self-regulation, personal hygiene, oral health behaviors, oral hygiene and hence periodontal status (Doric *et al.*, 2005; Sundararajan *et al.*, 2015; Quine and Morrell, 2009).

Sleep is also essential for maintaining health and well-being. Sleep deprivation can negatively affect health rendering the immune system vulnerable to infections that could cause the onset of inflammatory diseases such as periodontitis (Irwin, 2002; Wiener, 2015). Proper sleep reduces fatigue and stress levels, and alleviates bad breath, stomatitis, and xerostomia (Acar *et al.*, 2015; Lee *et al.*, 2014). Those with gingivitis or periodontitis sleep worse than healthier individuals and plausible biological mechanisms for this association have been suggested (Grover *et al.*, 2015).

Lately, Korean adolescents' internet addiction is considered a societal problem, possibly affecting adolescent health (Kim and Suh, 2012; (Park and Jeon, 2013; Woo and Kim, 2012; Yoo *et al.* 2014). Prolonged internet use could lead to addiction and therefore anxiety, depression, suicidal thoughts, sleep deprivation, tiredness, and reduced physical activity. These symptoms could negatively affect oral health (Park, 2014; Yoo *et al.* 2014).

School violence can also indirectly influence adolescents' mental and physical health. Compared to others, subjects experiencing school violence were more prone to depression, anxiety, suicidal thoughts and social phobias besides having higher stress levels, lower self-esteem, headaches, gastrointestinal disorders, atrial tachycardia, constipation and hypertension (Han and Jeon, 2012; Olweus, 1996 ; Vivolo-Kantor et al., 2016). As shown above, stress, sleep deprivation, school violence, and internet overuse during adolescence can interfere with the formation of good health habits, thereby influencing oral health. However, previous research was mainly on stress and depression, conducted on middle-aged adults and elderly people. Moreover, no studies have been conducted on mental health risk factors such as school violence or internet overuse, and research with small samples may be unrepresentative, limiting generalizability. Therefore, this study sought to determine the relationship between oral health and mental health risk factors (stress, sleep satisfaction, experiences of school violence, and the duration of non-study weekend internet use), using the 9th Korea Youth Risk Behavior Web-based Survey. The survey is comprehensively maps the behaviors and health condition of Korean adolescents.

Methods

This study was based on data from the 9th Korea Youth Risk Behavior Web-based Survey, which is an anonymous online national survey conducted each year since 2005 to understand the current status of, and trends in, health behaviors of Korean adolescents (MWH *et al.*, 2014). The survey was considered suitably comprehensive for this study, given that the questionnaire contains of 126 questions that assess 15 topics, including smoking, drinking, physical activity, diet, and damage.

Samples were extracted from the data of middle and high schools nationwide, as of April 2012. The sampling process was divided into population stratification, sample allocation, and sample extraction. In the stratification stage, the population was divided into 129 categories, using 43 local areas and 3 types of schools (middle, general high and specialized high schools) as stratification variables, to minimize sampling error. The primary extraction unit was school, the secondary extraction unit the class. After setting an extraction interval, the primary extract systematically sampled 400 middle schools and 400 high schools. During secondary extraction, one classroom per grade was selected from those schools. Absentees, learners with special needs, and learners with disabilities were excluded from those sampled. More details about the nationwide survey's sampling methodology and the survey process are available elsewhere (KDCDP, 2014).

The survey targeted 75,149 adolescents in middle and high schools and had a participation rate of 96.4%, with 72,435 students (36,655 males, 35,780 females) from 799 schools. After excluding cases with missing data, the responses of 66,951 students (33,777 males, 33,174 females) were included in the final analysis (89.1%). The study was approved by the Institutional Review Board of the Catholic University of Korea (MC14EISI0095).

In the current study, the choice of the six oral symp-

toms used as oral health factors was informed by the World Health Organization's oral health predictors to enable international comparisons (Chen *et al.*, 1997). Subjects were asked if they had experienced chipped or broken teeth, tooth pain when eating, toothache, aching or bleeding gums, pain on the tongue or inside of the mouth, and bad breath. A positive response to one or more of these was categorized as "experienced oral symptoms" or "not experienced" if none were experienced.

Demographic characteristics used as variables included gender, grade (middle school 1st/2nd/3rd grade then high school: 1st/2nd/3rd grade being a proxy for age), perceived family economic status (high, middle, or low, reclassified from the survey's original high, upper-middle, middle, low-middle, and low), self-rated academic performance (high, moderate, or low, reclassified from the survey's original high, upper-middle, middle, low-middle, or low), mother's education (up to middle school, high school, university/college, unknown), alcohol consumption (yes/no), and whether one had ever smoked (yes/no).

The mental health risk factors considered were sleep satisfaction, stress levels, experience of school violence, internet use on weekends for non-studying purposes, and drug use. Sleep satisfaction was assessed by asking, "*Do you think your level of refreshment after sleep was sufficient during the past 7 days?*" with response categories: completely sufficient, sufficient, moderate, not sufficient, or not at all sufficient. Stress was also categorized to five levels: none, low, moderate, high, and very high stress. Experience of school violence (yes/no) were assessed with the question "*Have you had to visit the hospital after experiencing violence (assault, threat, bullying, etc.) by a friend, senior, or adult at school within the past 12 months?*" Duration of weekend internet use for non-study purposes was self-evaluated as 1, 1-2, 2-4, 4-6 or more than six hours. Experience of drug use (yes/no) was assessed through the question, "*Have you ever taken drugs or inhaled butane gas, glue, and so forth, habitually and intentionally?*"

Statistical analyses used chi-square tests and logistic regression analyses. The former to test for significant differences in the distribution of demographic characteristics and mental health risk factors according to the subjects' reported oral symptoms. Binary logistic regression analysis was conducted to ascertain whether mental health risk factors (for which significant results were not obtained through use of the chi-square test) had a significant impact on oral symptoms after adjusting for covariates (gender, grade, academic performance, economic conditions, mother's education, alcohol, and smoking) by using weighted values of the odds ratio (OR) and a 95% confidence interval (CI). All variables were entered concurrently into the model. Statistical significance was set at $p < 0.05$. All analyses were conducted using PASW Statistics v.18.0 (IBM Co., Armonk, NY, USA).

Results

More oral symptoms were reported by females than males (65.8% vs. 58.3%), older students (in the higher grades), by low rather than high academic performers (63.9% vs. 61.8%) and those with lower socio-economic status, lower maternal education, alcohol experience and smoking experience (all $p < 0.001$, Table 1).

Table 1. Number of individuals experiencing oral symptoms by demographic characteristics (N=66,951)

Variable	Category	% ¹	With oral symptoms, % ²	P
Gender	Male	50.5	58.3	<0.001
	Female	49.5	65.8	
School grade	Middle 1 st	17.1	54.5	<0.001
	Middle 2 nd	16.9	57.8	
	Middle 3 rd	16.8	61.8	
	High 1 st	16.6	63.5	
	High 2 nd	16.2	67.4	
	High 3 rd	16.4	67.6	
Academic performance	High	35.3	61.8	<0.001
	Moderate	28.2	59.8	
	Low	36.5	63.9	
Economic conditions	High	32.7	56.8	<0.001
	Moderate	48.3	61.4	
	Low	18.9	72.5	
Maternal education	Middle School	3.6	69.2	<0.001
	High School	43.2	63.7	
	University/College	37.7	61.3	
	Unknown	15.5	57.2	
Alcohol	Yes	43.1	67.7	<0.001
	No	56.9	57.7	
Smoking	Yes	20.6	67.9	<0.001
	No	79.4	60.5	

¹Distribution of categories across variable; ² Percentage in category experiencing one or more oral symptoms

Subjects reporting their sleep satisfaction as “not at all sufficient” were more likely to have experienced oral symptoms than those reporting it as “completely sufficient” (71.5% vs. 49.4%, $p<0.001$). Subjects who rated their stress level as very high were nearly twice as likely to report oral symptoms than those reporting no stress (72.2% vs. 38.1%, $p<0.001$). Compared to those who had not, those who had experienced school violence also showed a higher risk of having oral symptoms ($p<0.005$). Non-study weekend internet use for more than six hours was associated with increased risk of experiencing oral symptoms over one hour’s use (68.1% vs. 62.2%, $p<0.001$). No association was found between oral health and drug use (Table 2).

A regression analysis was conducted to assess the impact of mental health risk factors on oral symptoms after adjustment for general demographic characteristics. The adjusted odds ratios (AORs) and across the range of their scales had values of 2.64 for stress; 1.52 for insufficient sleep; 1.44 for experience of violence; and 1.26 related to duration of internet use.

Discussion

This study investigated the relationship between adolescents’ mental health risk factors and oral symptoms. The risk of experiencing oral symptoms was 1.52 times higher for subjects reporting unsatisfactory sleep than those reporting completely sufficient sleep. However, Weiner’s study (2016), found similar risks of contracting periodontal disease among 30-year-olds needing over seven hours of sleep a day and those needing less.

The relationship between stress and oral health is well known. (Alsharani and Baccaglioni, 2014; Doric *et*

Table 2. Oral symptoms experienced (number, percentage of subjects) according to mental health risk factors (N=66,951)

Variable	Category	% ¹	With oral symptoms ² , %	P
Sleep satisfaction	Completely sufficient	7.0	49.4	<0.001
	Sufficient	18.8	54.3	
	Moderate	32.1	60.6	
	Not sufficient	29.0	67.4	
	Not at all sufficient	13.1	71.5	
Stress levels	No stress	3.0	38.1	<0.001
	Low	14.3	49.1	
	Moderate	41.5	59.7	
	High	29.9	70.0	
Experienced violence ³	Yes	3.0	65.0	0.005
	No	97.0	61.9	
Internet usage ⁴	≥1 hour	12.4	62.2	<0.001
	1-2 hours	18.8	59.6	
	2-4 hours	39.4	62.9	
	4-6 hours	18.0	66.3	
	>6 hours	11.4	68.1	
Drug experience ⁵	Yes	1.0	60.8	0.52
	No	99.0	62.0	

¹Distribution of categories across variable; ²Percentage in category experiencing one or more oral symptoms; ³Violence experienced at school; ⁴Non-study weekend internet use per day, N=48,533; ⁵Drug experience including hallucinogens

Table 3. Risk of oral symptoms according to mental health risk factors

Variable	Category	AOR ¹	95%CI ²
Sleep satisfaction, Ref. Completely sufficient = 1	Sufficient	1.09	1.08,1.10
	Moderate	1.21	1.19,1.22
	Not sufficient	1.44	1.43,1.46
	Not at all sufficient	1.52	1.50,1.54
Stress levels, Ref. No stress = 1	Low	1.35	1.33,1.37
	Moderate	1.86	1.83,1.89
	High	2.66	2.62,2.71
	Very high	2.64	2.59,2.69
School violence experience	No	1	
	Yes	1.44	1.41,1.47
Weekend internet usage time/per day, Ref. ≥1 hour = 1	1-2 hours	0.90	0.89,0.90
	2-4 hours	1.06	1.05,1.07
	4-6 hours	1.23	1.21,1.24
	More than 6 hours	1.26	1.24,1.27

¹AOR, Weighted Adjusted Odds Ratio: adjusted for gender, grade, academic performance, economic conditions, mother’s education, alcohol use and smoking

²95%CI: 95% confidence interval.

al., 2005; Gallo *et al.*, 2009; Kontoangelos *et al.*, 2014; Oh *et al.*, 2001) and in this study, those with very high stress levels had a 2.64 times the risk of experiencing oral symptoms than those reporting no stress. As elucidated above, stress can have a negative impact on oral hygiene and thus oral health besides depressing immune responses via mental ill-health, smoking, malnourishment, etc. resulting in increased periodontal disease (Reners and Brex, 2007).

References

- In the current study, subjects who experienced school violence had a 44% higher risk of experiencing oral symptoms concurring with the aforementioned studies associating these two parameters. Elsewhere experience of peer victimization doubled the risk (OR=1.94) of psychotic symptoms, rising to an AOR of 4.60 for chronic/severe victimization (Schreier *et al.*, 2009). However, no supporting evidence shows a direct relationship between these two factors.
- The AOR was 26% higher for those who used the internet for more than six hours a day on weekends, for non-study purposes, compared to those using it for one hour. The adolescent internet addiction rate had reportedly increased to 12.5% by 2014, almost twice that of adults, and such addiction presents a serious social problem (KISA, 2014). Adolescence is a period marked by psychological immaturity, curiosity, and lack of self-control. Adolescents are quite likely to take risks or take to drinking, smoking, drugs, violence and internet overuse and internet addiction can lead to stress, sleep deprivation, depression, low self-esteem, and anxiety (Park and Jeon, 2013; Woo and Kim, 2012; Yoo *et al.*, 2014). However, evidence is mixed as adolescents recently associated appropriate internet use for 1-3 hours with lower stress and greater happiness (Park, 2015).
- This cross-sectional study is not capable of identifying causal relationship between mental health risk factors and oral health. Moreover, use of single-item questionnaires could compromise reliability and validity. Nonetheless, this study found associations between mental health risk factors and oral health among the sample's Korean adolescents and these results may be generalized, at least, to all Korean adolescents.
- The current study's use of school violence and internet usage on weekends for non-studying purposes as mental health risk factors in studying the relationship between the latter and oral health condition is unprecedented. This study also differs from previous related studies, having used as dependent variables six oral symptoms (i.e., chipped or broken teeth, tooth pain when eating, toothache, aching or bleeding gums, tongue pain or pain in the inside of the mouth, and bad breath) cited by the World Health Organization as predictors of oral disease (irreversible chronic diseases) for international comparisons (Chen *et al.*, 1997; MHW *et al.*, 2013). Follow-up studies should include factors related to daily life (e.g., conflict with parents, relationships with friends, conflict with teachers, financial problems, anxiety about the future, and academic performance) that could aggravate adolescents' stress levels. Studies could also add more detailed questions on internet usage purposes and use a measure to screen for internet addiction, for accurate diagnoses.
- ### Conclusions
- There are several key results in this study. The risk of experiencing oral symptoms increases with sleep deprivation, exacerbated stress, internet overuse, and school violence. These results will be useful in the development of a comprehensive health program aimed at lowering adolescents' stress levels and promoting good sleeping habits. Policies should be implemented to address internet addiction and school violence. Moreover, adolescents who are experiencing school violence and are at risk of internet overuse should receive support such as counseling and be monitored continuously.
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