

Relationship between chewing ability and depressive symptoms

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Objective: Depression, as one of the most common mental health problems, has many related factors. Recent studies have suggested chewing difficulties as a risk factor for depression in the elderly. This study seeks to investigate whether chewing ability is associated with depressive symptoms in a Korean population. **Methods:** This study used data from the Fifth Korean National Health and Nutrition Examination Survey (KNHANES V) conducted in 2010. Self-reported questionnaires assessed depressive symptoms and chewing ability for the purposes of this study. A total of 6,255 subjects aged over 19 years were included for this study (2,704 males and 3,551 females). **Results:** Comparing depressive symptoms with chewing ability (i.e., very poor, poor, moderate, good, and very good), the adjusted odds ratios (ORs) and confidence intervals (CI) were 1.05 (95%CI: 0.84–1.32) for good vs. very good (as a reference), 1.31 (95%CI: 1.00–1.73) for moderate vs. very good, 1.41 (95%CI: 1.12–1.78) for poor vs. very good, and 1.76 (95%CI: 1.16–2.76) for very poor vs. very good. **Conclusion:** This study suggests that subjects with reduced chewing ability were more susceptible to having depressive symptoms.

Key words: chewing ability, depressive symptoms, Korea

Introduction

Depression is one of the most common mental health disorders. Risk factors for depression are diverse and include biochemical, genetic, and environmental factors. These risk factors are interrelated and result in a complex etiological model that is not completely understood (KNA, 2005). Masticatory dysfunction may cause disabilities in multiple mental and physical behaviors, and in general health (Minoru, 1998). In animal experiments, mastication had a positive, anti-stress effect (noted by Sasaki-Otomaru *et al.*, 2011). Only a few studies have examined the relationship between chewing ability and depression in humans. Kimura and her coworkers (2009) found that community-dwelling over 65 year-olds with chewing difficulty showed higher values on the Geriatric Depression Scale. In addition, their other study of community-dwelling over 75 year-olds showed similar results (Kimura *et al.*, 2013). However these studies were each restricted to several hundred of the elderly in community-dwelling settings from a particular area. For these reasons, further studies are needed to confirm whether chewing ability is a risk factor for depression more generally. In this study, we investigated the association between chewing ability and depressive symptoms in Korean adults using a representative sample of Koreans from the Fifth Korea Health and Nutrition Examination Survey (KNHANES V), which was administered nationwide in Korea.

Methods

This study used data from KNHANES V, which was conducted in 2010 and is a nationwide survey drawn from different census populations and housing units that takes into account the proportions of each subgroup. The survey

is carried out by the Centers of Disease Control of Korea to obtain statistically reliable and representative data on the health, food, and lifestyles of the Korean population. Out of 10,938 individuals approached, 8,473 (77.5%) participated in the study. Oral inspections were administered to 6,740 adults over 19 years of age. Excluding 485 subjects who provided unusable answers, 6,255 subjects were finally analysed (2,704 males, 43.2%, and 3,551 females). Depressive symptoms were based on the question, “Have you ever felt sad or depressed for two weeks or more such that it interfered with your everyday life during the past year?” with responses of “Yes” or “No” (McChargue and Werth Cook, 2007). Expert consultations formulated the self-reported question assessing chewing ability: “Have you felt difficulty in your chewing ability due to your teeth, dentures or any other problem? (If you use dentures, please answer the question as if you were wearing your dentures)” with responses on the five-point scale: very good, good, moderate, poor, and very poor.

The Institutional Review Board of Inha University Hospital approved the study protocol. Chi-square tests compared differences in the depressive symptoms associated with sociodemographic characteristics. Odds ratios (ORs) were calculated using a multiple logistic regression model adjusted for potential confounders. All analyses used SPSS for Windows v.12.0 with the level of statistical significance set at 0.05.

Results

To identify the correlation between chewing ability and depressive symptoms, the factors of age, gender, marital status, income, education, stress, and occupation were investigated as potential confounders in relation to de-

pressive symptoms. Those having increased depressive symptoms tended to be aged ≥ 50 years, female, married, in the low income bracket, less educated, reported being highly stressed or unemployed (Table 1). Table 2 shows the ORs and 95% confidence intervals (95%CI) from logistic regression analyses of the association between chewing ability and depressive symptoms. Compared with participants who reported very good chewing ability, those with moderate or worse chewing ability showed significantly increased ORs of self-reported depressive symptoms. After adjusting for all covariates (i.e. age, gender, marital status, income, education, stress and occupation), the adjusted ORs were lower than the crude ORs, the OR for those with very poor chewing ability being 1.76 (95%CI: 1.16–2.76) compared to those reporting very good chewing ability.

Discussion

This study is the first to evaluate the correlation between chewing ability and depressive symptoms among all adults aged ≥ 19 years. It confirmed across a wider population the observation in the elderly that worse chewing ability may be related to increased depressive symptoms. This finding remained significant after adjusting for sociodemographic variables. To the best of our knowledge, only two cross-sectional studies on the elderly have evaluated the relationship between chewing ability and depressive symptoms (Kimura *et al.*, 2009; 2013). However, other related studies have shown that chewing gum may improve depressive symptoms. In intervention studies those who chewed gum showed fewer depressive symptoms than those who did not chew gum (Smith *et al.*, 2012;

Table 1. Sociodemographic characteristics and depressive symptoms

Sociodemographic characteristics	Depressive symptoms				p value
	No, n	(%)	Yes, n	(%)	
<i>Age</i>					
≤ 29	681	(88.3)	80	(11.7)	<0.001
30 - 39	1134	(90.4)	120	(9.6)	
40 - 49	1028	(88.5)	134	(11.5)	
50 - 59	989	(84.2)	185	(15.8)	
≥ 60	1597	(84.3)	297	(15.7)	
<i>Gender</i>					
male	2824	(91.9)	220	(8.1)	<0.001
female	2945	(82.9)	606	(17.1)	
<i>Marital status</i>					
married	4664	(86.4)	734	(13.6)	0.024
single	761	(89.2)	92	(10.8)	
<i>Income</i>					
low	1272	(82.8)	264	(17.2)	<0.001
lower middle	1343	(87.0)	200	(13.0)	
upper middle	1375	(87.9)	189	(12.1)	
upper	1365	(89.1)	167	(10.9)	
<i>Education</i>					
\leq elementary	1292	(81.2)	299	(18.8)	<0.001
middle school	561	(83.1)	114	(16.9)	
high school	1822	(88.2)	244	(11.8)	
college or higher	1737	(91.3)	165	(8.7)	
<i>Stress</i>					
low	4226	(93.0)	319	(7.0)	<0.001
high	1203	(70.4)	507	(29.6)	
<i>Occupation</i>					
white collar	1192	(91.9)	105	(8.1)	<0.001
blue collar	2115	(88.1)	286	(11.9)	
unemployed	2076	(82.9)	428	(17.1)	

Table 2. Odds ratios and confidence intervals for depressive symptoms according to chewing ability

Chewing ability	Depressive symptoms		Crude odds ratio		Adjusted odds ratio	
	No, n (%)	Yes, n (%)	OR	95%CI	OR*	95%CI
Very good	1,675 (90.2)	182 (9.8)	1		1	
Good	1,625 (88.3)	215 (11.7)	1.22	0.99–1.50	1.05	0.84–1.32
Moderate	692 (85.3)	119 (14.7)	1.58	1.24–2.03	1.31	1.00–1.73
Poor	1,183 (82.4)	252 (17.6)	1.96	1.60–2.41	1.41	1.12–1.78
Very poor	146 (77.7)	42 (22.3)	2.65	1.82–3.86	1.76	1.16–2.76

* Adjusted by age, gender, marital status, income, education, stress, and occupation.

Smith and Woods, 2012). Although a direct relationship cannot be explained, the underlying mechanisms allow us to hypothesise reasons for a relationship between chewing ability and depression. In animal studies, biting while being restrained suppresses stress-induced blood catecholamine levels (Hori *et al.*, 2004). Electroencephalography (EEG) studies have provided evidence that chewing gum produces brain wave patterns that are very similar to the brain state of people who are relaxed (Smith and Woods, 2012). Hollingworth suggested that chewing relieves stress by reducing excessive muscular tension and energy via masticatory movements (Hollingworth, 2004). Chewing ability is also believed to affect people's food selection, which can in turn influence their nutrition (Kimura *et al.*, 2009; Sheiham *et al.*, 1999). Nutrition can play a key role in the onset as well as the severity and duration of depression. Many of the easily noticeable food patterns that precede depression are identical to those that occur during depression. These may include poor appetite, skipping meals and a dominant desire for sweet foods (Rao *et al.*, 2008). Symptoms of temporomandibular disorders as a risk factor for chewing ability are associated with depressive symptoms (Sipilä *et al.*, 2001). Therefore, further studies should be performed to confirm and generalise the results of our study.

This study has some limitations. Being a cross-sectional study, causal effect relationships cannot be identified. Chewing ability was evaluated by a self-rated questionnaire rather than an objective test and as such could be affected by mood so it is conceivable that depressed participants may have rated their chewing ability negatively on the basis of their mood rather than providing true data regarding their chewing ability (Kimura *et al.*, 2013). However, Gordon and colleagues (1985) suggested that subjective chewing ability is a more reliable indicator than the quality of dentition itself.

Conclusion

The investigation found an association between chewing ability and depressive symptoms in Korean adults. Subjects with reduced chewing ability were more susceptible to having depressive symptoms.

Acknowledgement

This work was supported by an Inha Research Grant.

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