Global Self-Rating of Oral Health, Concerns About Oral Health, and History of Jaw Injury Related to Temporomandibular Joint Symptoms in Korean Adults

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Aims: *To examine the association between temporomandibular joint (TMJ) symptoms and the global self-rating of oral health, concerns about oral health, and a history of jaw injury or third molar extraction in a representative Korean population.* ***Methods:*** *From the Korean National Oral Health Survey 2006, 4,546 adults aged 18 years and older were included in the analysis. The dependent variable was TMJ symptoms. The independent variables were the global self-rating of oral health, concerns about oral health, and a history of jaw injury or third molar extraction. The demographic information (age and gender), socioeconomic status (education level, monthly household income, vocation, and residence), and behavioral factors (recent dental visit and smoking) were evaluated as confounders. Multivariate linear and logistic regression analyses were applied.* ***Results:*** *The overall prevalence of TMJ symptoms in Koreans was 15.3%. The younger, more educated, middle class, those employed in office and sales, and those who resided in city areas had more TMJ symptoms. The TMJ symptoms were significantly associated with the global self-rating of oral health, concerns about oral health, and history of jaw injury. No significant association was found between the TMJ symptoms and a history of a third molar extraction. The global self-rating of oral health, concerns about oral health, and history of jaw injury had a dose-effect relationship with the severity of TMJ symptoms. Age and gender modified the effect of the global self-rating of oral health, concerns about oral health, and the history of jaw injury on TMJ symptoms.* ***Conclusion:*** *The global self-rating of oral health, concerns about oral health, and a history of jaw injury might be associated with TMJ symptoms.* J OROFAC PAIN 2011;25:308–316

Key words: jaw injury, self-rated oral health, temporomandibular joint disorders, third molar removal

Temporomandibular disorders (TMD) is an all-inclusive term referring to clusters of related disorders in the masticatory system with the common characteristics of temporomandibular joint (TMJ) sounds and pain in the TMJ, preauricular area, or muscles of mastication, and deviations or restrictions in the mandibular range of motion.[1] Although the Research Diagnostic Criteria for Temporomandibular Disoders (RDC/TMD)[2] is a well-established, universally accepted and validated diagnostic system, the use of the RDC/TMD in population epidemiological studies is not feasible because in-person interviews and examinations are needed in such studies. Therefore, epidemiologic studies have reported signs and symptoms of TMD, such as pain and tenderness in the TMJ and masticatory muscles, sounds in the joints, and limitations of mandibular movement, through questionnaires.[2–6] These studies have reported a prevalence ranging from 20% to 40%, which reflect the differences in samples, criteria, and the

methods used to collect information. However, most of these studies are unlikely to be representative of the population, and issues of representativeness and generality arise.

The etiology of TMJ symptoms is not well-known but is considered complex.[1,7] Since TMJ symptoms comprise a number of disorders and conditions in the orofacial region, many etiological factors may be involved. Several studies have addressed factors related to TMJ symptoms.[7–13] The most common factors associated with TMJ symptoms are demographic variables, such as age and gender. Some studies reported that a history of jaw injury and third molar extraction are associated with TMJ symptoms[13–15]; however, there is little data available on the relationship among the perception of oral health, the experience of jaw injury/extracted third molars, and TMJ symptoms.

In addition, the information available on the prevalence of TMD is partly contradictory, and most previous surveys were performed in western countries. One study on Koreans only recorded the data of 19-year-old men.[16] Therefore, the aim of this study was to examine the association between TMJ symptoms and the global self-rating of oral health, concerns about oral health, and a history of jaw injury or third molar extraction in a representative Korean population.

Materials and Methods

Study Population

The Korean National Oral Health Survey 2006,[17] the fifth national oral health survey conducted by the Ministry of Health and Welfare, was performed from September to December 2006 using a stratified cluster sampling procedure. The sampling frame was from the stratified 150 enumeration districts maintained by the departments of statistics in Korea. It was stratified according to the size of the region, such as a metropolitan city, provincial city, or rural area. Sixty households from each enumeration district were telephoned by a female survey interviewer to explain the survey procedure. Households refusing the survey were excluded. The subjects were 15,777 Koreans including oversampling children. The final study data set included all records of Korean adults aged 18 years or older (n = 4,546).

Data Collection

The survey was carried out by eight survey teams using a questionnaire and a dental examination in Korean households. Each team was composed of a dentist and an interviewer, trained on a standard dental examination and interview procedure, and subsequently calibrated for various parameters of oral health status. The demographic information (age and gender), socioeconomic status (education level, monthly household income, vocation, and residence), oral and general health behaviors (recent dental visit and smoking), global self-rating of oral health, concern about oral health, a history of jaw injury, and TMJ symptoms were obtained from the questionnaire. Any history of third molar extraction was determined by dentists.

Questions about the TMJ symptoms included "At present, *(1)* Do you have any sounds around your ears while opening and/or closing your mouth? (clicking), *(2)* Do you have pain around your ears on voluntary and/or self palpation? (pain in the TMJ), and *(3)* Do you have any difficulty in opening your mouth? (difficulty in mouth opening)." All the findings were recorded as either present (1) or absent (0). The global self-rating of the oral health status was obtained using a five-point rating scale (5 = very good, 4 = good, 3 = fair, 2 = poor, and 1 = very poor). The concerns about oral health (1 = none to 3 = always) were also assessed. Information on the self-report of facial trauma or jaw injury ("Have you ever fractured or had teeth removed due to a car accident, sports injury, hit, fall down, or other accident?") was obtained (0 = no, 1 = yes). If the third molar was not found during a dental examination, subjects were asked whether they had ever had their third molar teeth extracted. An answer of "no" was regarded as unerupted teeth. If they answered "yes," the number of third molars extracted was collected (0 to 4).

It was not necessary to obtain permission from the ethics commission because the examinations in this study were based on the Oral Health Act in Korea established in 2000. Informed consent was not obtained because the amount of examinations did not exceed the usual amount of biyearly examinations by the National Health Insurance.

Definition of TMJ Symptoms

TMJ symptoms were defined as present if the subject reported having at least one of the following: clicking (group 1); TMJ pain (group 2); difficulty in mouth opening (group 3); clicking and TMJ pain (group 4); clicking and difficulty in mouth opening (group 5); TMJ pain and difficulty in mouth opening (group 6); clicking, TMJ pain, and difficulty in mouth opening (group 7). Therefore, the individuals who answered "yes" to at least one of the three questions were classified as presenting with possible TMJ symptoms. Group 0 comprised subjects with no such symptoms.

Table 1 Frequencies of TMJ Symptoms

TMJ symptoms	Frequency	%
No TMJ symptoms (group 0)	3,852	84.7
Subjects with clicking (group 1)	504	11.1
Subjects with TMJ pain (group 2)	16	0.4
Subjects with difficulty in mouth opening (group 3)	30	0.7
Subjects with clicking and TMJ pain (group 4)	56	1.2
Subjects with clicking and difficulty in mouth opening (group 5)	37	0.8
Subjects with TMJ pain and difficulty in mouth opening (group 6)	5	0.1
Subjects with clicking, TMJ pain, and difficulty in mouth opening (group 7)	46	1.0
Total	4,546	100.0

Statistical Analyses

The dependent variable was TMJ symptoms. The independent variables included global self-rating of oral health, concern about oral health, history of jaw injury, and history of third molar extraction. The confounders were sociodemographic and oral/general health behavior factors, such as age, gender, education level, monthly household income, vocation, area of residence, recent dental visits, and smoking.

The independent variables were divided for the application of logistic regression into two categories. The global self-rating of oral health was classified into two groups with approximately equal numbers, which represented "good (fair, good, or very good)" or "poor (poor or very poor)" self-rated oral health. The concern about oral health was subdivided into two categories of "no" versus "yes (sometimes and frequent)." History of jaw injury and history of third molar extraction were also categorized into "no" or "yes."

The characteristic variables of the subjects were described using the frequency distributions for the categorical variables. A chi-square test was used to assess the differences in the categorical variables.

Multivariate logistic regression analysis was used to evaluate the adjusted odds ratio (AOR) estimates between the TMJ symptoms (category: no versus yes) and bivariate independent variables to test the association adjusting for sociodemographic and oral/general health behavior factors, including age, gender, education level, monthly household income, vocation, residence, recent dental visit, and smoking (model A). Because age and gender were closely related to the TMJ symptoms,[18–21] the interaction with age/gender should be tested when evaluating the modifying effect of age/gender. Therefore, an interaction term between the independent variables and age was added to the model (model B). An interaction term between the independent variables and gender was also added to the model (model C). In addition to the interaction terms between the independent variables and age/gender in the multivariate logistic models, the changes among AOR of models A, B, and C were evaluated. To determine the strength of the association and the "dose-effect" relationship between the severity of TMJ symptoms (subjects with no symptom [0], subjects with clicking [1], subjects with TMJ pain [2], subjects with difficulty in mouth opening [3], subjects with clicking and TMJ pain [4], subjects with clicking and difficulty in mouth opening [5], subjects with TMJ pain and difficulty in mouth opening [6], and subjects with clicking, TMJ pain, and difficulty in mouth opening [7]) and the independent variables, a multivariate linear regression analysis was performed to evaluate the adjusted and standardized correlation coefficients (partial *r*) estimates between the TMJ symptoms and independent variables. Finally, subsequent subgroup analyses according to age and gender were performed to identify the effect modification on the association between the dependent and independent variables. To determine the cutoff of the age subgroup, the tertile, quartile, and quintile subgroups were compared by the magnitude of the odds ratio (OR). In this study, the quintile subgroup was used to perform subgroup analysis according to age groups. A database was constructed using SPSS version 14.0 (SPSS, IBM). A P value < .05 was considered significant.

Results

Table 1 lists the number of subjects according to TMJ symptoms. The TMJ symptoms were significantly higher in the 18- to 34-year-old group, highly educated, middle group of monthly household income, office/service/sales workers, and city residents. However, the prevalence of TMJ symptoms in this study was similar between both genders (P = .350) (Table 2).

In a crude association, those who perceived their oral health as being poor and worried about their oral health and those who experienced a jaw injury had more TMJ symptoms (Table 3).

In the adjusted association (model A), age and gender showed no association with the TMJ symptoms (Table 4). The self-rated oral health (OR = 1.44), concerns about oral health (OR = 1.66), and history of jaw injury (OR = 1.39) were significantly associated with TMJ symptoms after controlling for

Table 2 Sociodemographic and Behavioral Factors Across the TMJ Symptoms in Koreans (n = 4,546)

Variables	Total n	TMJ symptoms		*P**
		No (n = 3,852), n (%)	Yes (n = 694), n (%)	
Age (y)				
18–34	1,004	744 (74.1)	260 (25.9)	< .001
35–44	926	766 (82.7)	160 (17.3)	
45–54	697	607 (87.1)	90 (12.9)	
55–64	726	642 (88.4)	84 (11.6)	
Over 65	1,193	1,093 (91.6)	100 (8.4)	
Gender				
Male	1,677	1,429 (85.2)	248 (14.8)	NS
Female	2,869	2,423 (84.5)	446 (15.5)	
Education (y)				
< 10	2,037	1,813 (89.0)	224 (11.0)	< .001
10–12	1,358	1,136 (83.7)	222 (16.3)	
≥ 12	1,151	903 (78.5)	248 (21.5)	
Monthly household income (USD)				
< 2,000	2,111	1,838 (87.1)	273 (12.9)	< .001
2,000–4,000	1,629	1,324 (81.3)	305 (18.7)	
> 4000	806	690 (85.6)	116 (14.4)	
Vocation				
Office work	505	412 (81.6)	93 (18.4)	.040
Service and sales	449	366 (81.5)	83 (18.5)	
Laborer	812	698 (86.0)	114 (14.0)	
Others	324	281 (86.7)	43 (13.3)	
Nonworking	2,456	2,095 (85.3)	361 (14.7)	
Area of residence				
Metropolitan	1,732	1,489 (86.0)	243 (14.0)	.023
City	2,188	1,821 (83.2)	367 (16.8)	
Rural	626	542 (86.6)	84 (13.4)	
Recent dental visit				
< 1 year	1,681	1,400 (83.3)	281 (16.7)	.037
≥ 1 year	2,865	2,452 (85.6)	413 (14.4)	
Smoking				
No	3,659	3,109 (85.0)	550 (15.0)	NS
Yes	887	743 (83.8)	144 (16.2)	

*Obtained from chi-square test. NS = not significant.

Table 3 Crude Association Between TMJ Symptoms and Related Factors Among Koreans (n = 4,546)

Variables	Total n	TMJ symptoms		*P**
		No (n = 3,852), n (%)	Yes (n = 694), n (%)	
Global self-rating of oral health				
Good	2,334	2,016 (86.4)	318 (13.6)	.002
Poor	2,212	1,836 (83.0)	376 (17.0)	
Concern about oral health				
No	1,401	1,256 (89.7)	145 (10.3)	< .001
Yes	3,145	2,596 (82.5)	549 (17.5)	
History of jaw injury				
No	3,843	3,282 (85.4)	561 (14.6)	.003
Yes	703	570 (81.1)	133 (18.9)	
History of extracted third molar				
No	2,607	2,213 (84.9)	394 (15.1)	NS
Yes	1,939	1,639 (84.5)	300 (15.5)	

*Obtained from chi-square test.

Table 4 Adjusted Associations Between the TMJ Symptoms and Related Factors (n = 4,546)

	Model A*		Model B†		Model C‡	
Variables	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Age (y)						
Over 65	1					
55–64	1.15 (0.77–1.73)	NS				
45–54	1.14 (0.65–2.01)	NS				
35–44	1.35 (0.64–2.81)	NS				
18–34	1.93 (0.76–4.92)	NS				
	Trend P = .150					
Gender						
Male	1					
Female	1.07 (0.86–1.35)	NS				
Global self-rating of oral health						
Good	1		1		1	
Poor	**1.44 (1.21–1.70)**	**< .001**	1.09 (0.67–1.78)	NS	0.74 (0.41–1.34)	NS
Age	**0.97 (0.96–0.98)**	**< .001**	**0.97 (0.96–0.98)**	**< .001**		
Gender	1.07 (0.85–1.34)	NS			0.87 (0.65–1.15)	NS
Interaction with age			1.01 (1.00–1.02)	NS		
Interaction with gender					**1.50 (1.06–2.11)**	**.022**
Concern about oral health						
No	1		1		1	
Yes	**1.66 (1.36–2.03)**	**< .001**	0.88 (0.50–1.55)	NS	0.78 (0.40–1.49)	NS
Age	**0.97 (0.97–0.98)**	**< .001**	**0.96 (0.95–0.97)**	**< .001**		
Gender	1.05 (0.83–1.31)	NS			0.72 (0.50–1.06)	NS
Interaction with age			**1.01 (1.00–1.03)**	**.021**		
Interaction with gender					**1.62 (1.09–2.43)**	**.018**
History of jaw injury						
No	1		1		1	
Yes	**1.39 (1.12–1.73)**	**.003**	1.83 (0.93–3.58)	NS	1.75 (0.88–3.45)	NS
Age	**0.97 (0.97–0.98)**	**< .001**	**0.97 (0.97–0.98)**	**< .001**		
Gender	1.13 (0.90–1.42)	NS			1.17 (0.91–1.49)	NS
Interaction with age			0.99 (0.98–1.01)	NS		
Interaction with gender					0.86 (0.55–1.33)	NS
History of extracted third molar						
No	1		1		1	
Yes	1.04 (0.88–1.22)	NS	**1.80 (1.09–2.97)**	**.022**	1.13 (0.62–2.05)	NS
Age	**0.97 (0.96–0.98)**	**< .001**	**0.98 (0.97–0.98)**	**< .001**		
Gender	1.09 (0.87–1.37)	NS			1.11 (0.85–1.46)	NS
Interaction with age			**0.99 (0.98–1.00)**	**.023**		
Interaction with gender					0.95 (0.67–1.34)	NS

*Model A adjusted for sociodemographic and behavioral factors, such as age (continuous), gender, education, monthly household income, vocation, residence, recent dental visit, and smoking.
†Model B adjusted for all confounders in model A and the interaction between variable and age (continuous).
‡Model C adjusted for all confounders in model A and the interaction between variable and gender.
Numbers in bold denote statistical significance. CI = confidence intervals.

various confounders. Considering the interaction between each independent variable and age (model B), the interaction with concerns about oral health and a history of extracted third molar were significant (OR = 1.01 and 0.99, respectively). In the gender interaction model (model C), the interaction with self-rated oral health and concerns about oral health were significant (OR = 1.50 and 1.62, respectively). Most of the significant associations became insignificant when the interaction terms with age and gender were included in the model. However, a history of extracted third molars became significant in model B (OR = 1.80) (Table 4).

In the linear regression models, the self-rated oral health, concerns about oral health, and history of jaw injury showed significant associations with the severity of TMJ symptoms after controlling for various confounders, highlighting the dose-effect relationship between the above-mentioned variables and TMJ symptoms (Table 5).

Table 5 Linear Relationship Between the Severity of TMJ Symptoms* and the Related Factors (n = 4,546)

Models	β	SE	*P*	Adjusted R^2	Partial *r*
Global self-rating of oral health (1 = very good, 5 = very poor)	**0.093**	0.015	**< .001**	0.021	**0.092**
Concern about oral health (1 = always, 3 = never)	**–0.122**	0.019	**< .001**	0.022	**–0.094**
History of jaw injury (0 = no, 1 = yes)	**0.146**	0.042	**.001**	0.016	**0.051**
Number of extracted third molars (0 to 4)	–0.001	0.009	NS	0.013	–0.001

*The severity of TMJ symptoms: none (0); those with only clicking (1); only pain in the TMJ (2); only difficulty in mouth opening (3); clicking and pain (4); clicking and difficulty in mouth opening (5); difficulty in mouth opening and pain (6); and all three symptoms (7).
Models are adjusted for sociodemographic and behavioral factors, such as age (continuous), gender, education, monthly household income, vocation, residence, recent dental visit, and smoking.
Bold denotes statistical significance.

Table 6 Adjusted Associations Between the TMJ Symptoms and Related Factors According to the Age Subgroup (n = 4,546)

	Age groups									
	18–34 years		35–44 years		45–54 years		55–64 years		Over 65 years	
Variables	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Global self-rating of oral health (reference = good)	1.26 (0.94–1.68)	NS	**1.41 (1.00–1.99)**	**.050**	**2.20 (1.34–3.64)**	**.002**	1.40 (0.87–2.26)	NS	**1.53 (1.00–2.35)**	**.050**
Concern about oral health (reference = no)	**1.50 (1.07–2.11)**	**.020**	1.32 (0.88–1.96)	NS	1.39 (0.76–2.55)	NS	**3.01 (1.55–5.84)**	**.001**	**2.53 (1.53–4.17)**	**< .001**
History of jaw injury (reference = no)	1.48 (0.99–2.21)	NS	**1.58 (1.01–2.47)**	**.044**	1.13 (0.64–1.98)	NS	1.60 (0.91–2.82)	NS	1.27 (0.69–2.35)	NS
History of extracted third molar (reference = no)	1.15 (0.85–1.56)	NS	1.26 (0.89–1.79)	NS	0.99 (0.63–1.55)	NS	1.03 (0.65–1.63)	NS	**0.61 (0.39–0.97)**	**.034**

Adjusted for sociodemographic and behavioral factors such as age (continuous), gender, education, monthly household income, vocation, residence, recent dental visit, and smoking.
Bold denotes statistical significance.

Table 7 Adjusted Associations Between the TMJ Symptoms and Related Factors According to Gender (n = 4,546)

	Male		Female	
Variables	OR* (95% CI)	*P*	OR (95% CI)	*P*
Global self-rating of oral health (reference = good)	1.15 (0.86–1.52)	NS	**1.62 (1.32–2.00)**	**< .001**
Concern about oral health (reference = no)	1.21 (0.89–1.64)	NS	**2.09 (1.59–2.74)**	**< .001**
History of jaw injury (reference = no)	**1.53 (1.13–2.08)**	**.007**	1.27 (0.93–1.75)	NS
History of extracted third molar (reference = no)	1.10 (0.82–1.46)	NS	1.02 (0.82–1.25)	NS

*Adjusted for sociodemographic and behavioral factors, such as age (continuous), gender, education, monthly household income, vocation, residence, recent dental visit, and smoking.
Bold denotes statistical significance.

When considering the results of separate subgroup analyses according to the age groups, self-rated oral health, concerns about oral health, and history of extracted third molar were significantly associated with the TMJ symptoms in the over 65-year-old group. However, history of jaw injury was associated with TMJ symptoms only in the younger age group. Self-rated oral health was associated with TMJ symptoms in the oldest and middle-aged groups. Concern about oral health was associated with TMJ symptoms in the older and youngest age groups (Table 6). Regarding the results of gender subgroup analyses, the self-rated oral health (OR for males = 1.15, OR for females = 1.62) and concerns about oral health (OR for males = 1.21, OR for females = 2.09) showed significantly higher associations with the TMJ symptoms in females than in males. However, history of a jaw injury (OR for males = 1.53, OR for females = 1.27) had a significantly higher OR for TMJ symptoms in males than females (Table 7).

Discussion

To the authors' knowledge, this is the first study in Korea of the association among the self-perception of oral health, trauma, and TMJ symptoms after adjusting for potentially confounding variables. In this study, a number of extrinsic and intrinsic factors were associated with TMJ symptoms.

These findings suggest that the TMJ symptoms were more prevalent in the young adult group aged 18 to 34 years than in the older age groups. However, the association between TMJ signs and age disappeared in the adjusted logistic model. Epidemiologic studies showed that TMD is common in adolescents.[18,19] Between 31% and 40% of Japanese adolescents present with one or multiple signs of TMD[18] and 25% of children showed one or more clinical signs of TMD.[19] However, the prevalence of self-reported TMD sounds and pain is relatively low (4% to 7%) in Swedish children and adolescents,[20,21] young adults in Israel[22] and Brazil,[6] and 19-year-old Korean men.[16] This shows that the samples, criteria, and methods used to collect the information may result in important differences.

The prevalence of TMJ symptoms in this study was similar between both genders, which is not in agreement with earlier studies.[19–21] However, another study found no gender differences.[22] Although there is some controversy regarding gender differences in TMD, Rieder et al reported that women are more health conscious and seek medical and dental attention more readily than men.[23] These findings can explain the present results from the subgroup analyses according to gender. The OR of the concerns about oral health was higher in females (OR for males = 1.21, OR for females = 2.09). Other sociodemographic factors were not associated with the TMJ symptoms in the adjusted logistic model (data not shown).

Among the variables analyzed in this study, the perceived oral health was significantly associated with TMJ symptoms. Although several studies reported that impaired self-perceived general health was a significant risk factor for reporting TMJ symptoms,[24,25] there are few reports of the relationship between the perceived oral health and TMJ symptoms. In a German study, TMD patients demonstrated higher Oral Health Impact Profile (OHIP) scores than the general population, particularly in the functional and pain-related oral health–related quality of life domains.[26] Although the "trouble pronouncing words" item showed nonsignificant impairment in TMD patients compared to the general population, the "uncomfortable to eat" and "painful aching" items showed significantly more impairment in TMD patients than in the general population.[26] The mechanism for this association is unclear, but it has been suggested that orofacial pain and TMD pain might share the major characteristics of other chronic conditions in the oral cavity and other areas of the body. Segu et al demonstrated that the scores of all OHIP subscales increased with the amount of pain in TMD patients.[11] The strongest correlation reported by these authors occurred within the domains of functional limitation and psychological discomfort, as well as physical and psychological disability. In this study, statistical differences were detected in TMJ symptoms according to the degree of perceived oral health, supporting previous results.

These results showed a positive association between a maxillofacial injury and TMJ symptoms. It has also been shown that patients suffering from TMJ symptoms have a positive history of head/cervical trauma related to the onset of TMJ symptoms.[8,13] However, these studies were carried out in patient groups or university students, not in the general population. Another epidemiologic study carried out on the general population showed no association between a history of trauma to the jaw and symptoms of TMD.[27] This study showed that external trauma to the jaw region is an important predisposing factor in the etiology of TMD. An association between extrinsic trauma and the TMJ symptoms was also noted, in which subjects with a history of extrinsic trauma showed an increased risk of limited mouth opening.[28] Huang et al identified trauma as a risk factor for diagnostic subgroups of painful TMD[8]; however, the conflicting results suggest that the precise role of jaw injury in the etiology of TMD is not completely understood. In the present study, a significant correlation between the TMJ symptoms and history of jaw trauma was found, particularly in the case of a fall (data not shown). The prevalence of TMJ symptoms might be decreased if there was an effective measure to prevent jaw trauma.

An extracted third molar was suggested to be a predisposing factor for the development of TMJ symptoms.[13,14] An extracted third molar might involve prolonged wide opening of the jaw and the application of considerable forces to the mandible that may eventually result in trauma to the TMJ and associated structures.[8] However, these results did not find significant elevated risks for TMJ symptoms subsequent to an extracted third molar. The possible association of TMJ symptoms with an extracted third molar merit further studies because this procedure is commonly performed in Korea. Although dentists examine the patient's history of extracted third molars, it depends on the subjects'

memory as to whether their third molar had been extracted. This is the same situation with a jaw injury. Recall bias could affect the result. Information on the difficulty during extracted third molar surgery could not be collected. Despite the efforts to assess the temporal relationship between trauma and TMD, recall bias hindered the full assessment of the impact of jaw injury or extracted third molar.

The limitations in this study were as follows:

1. The status of TMJ symptoms was assessed by a self-reported questionnaire and not by a clinical examination. The American Academy of Orofacial Pain (AAOP) has proposed 10 questionnaires for a survey of TMJ symptoms and the identification of possible TMD.[1] In the present study, three questions adapted from the anamnesis by AAOP were used.[1] A precise diagnosis of TMD comes from the history, examination, and psychological evaluation of the individual. This approach is expensive and often impracticable for population surveys. On the other hand, questionnaire-based assessments of the TMJ symptoms may be inaccurate, and the number of symptoms required to define a disease has not been established. Moreover, the inclusion criteria of TMJ symptoms in this study were TMJ sounds, TMJ pain, and mouth-opening limitations. Myofacial pain was not included in the definition of TMJ symptoms. There could be a classification bias.
2. Besides the possible misclassification of TMJ symptoms, caution is needed when interpreting the linear relationship (Table 5). Although the definition of the severity of TMJ symptoms was based on the assumption that the severity increased in the order of clicking, TMJ pain, and mouth-opening limitation, it showed little association with the observations. There could be a classification bias.
3. Information on other predisposing factors for TMJ symptoms, such as orthodontic treatment, bruxism, or occlusal status, was not collected.
4. Moreover, an interpretation of the causal pathway of some of the associations described in the cross-sectional study is not obvious because the temporal sequence of the appearance of TMD is unclear. Only a well-designed prospective cohort study can disentangle these complex relations.
5. Pain of the masticatory system is often related to pain conditions elsewhere in the body, eg, lower back pain or pain of the cervical spine and the surrounding musculature.[29] TMD and benign back pain share some features, such as psychological distress, somatization, and depression found in chronic pain illness.[29,30] It is possible that both types of pain coexist independently because of the common origin. On the other hand, one disorder might have causal significance for the other, and TMD pain is a symptom of the general condition. The lack of objective data on the general medical history and oral parafunctions might hinder the association.
6. To evaluate the selection bias, it is important to compare a population that agreed to participate with those who did not. Although the number of subjects who refused to participate in the survey was very small, information on the nonrespondents could not be collected. Therefore, some caution should be taken when interpreting the data.

This study had considerable strengths:

1. The subjects were drawn at random from official inhabitant data files and stratified according to age, gender, and area. Therefore, these results could represent Koreans and can minimize selection bias.
2. Various independent variables allowed complex analyses in terms of comorbidity and risk factor combinations for TMJ symptoms.[31]

Conclusions

TMJ symptoms were frequently reported by young adults aged 18 to 34. The study provides complementary epidemiological information on the TMJ symptoms and supports a multifactorial etiology involving factors from many domains, including the self-rating of oral health, concerns about oral health, and trauma. A more detailed understanding of these factors may be helpful for the development of targeted approaches to TMD therapy and prevention.

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