

Symptoms of Temporomandibular Disorders in the Korean Children and Adolescents

Ah-Hyeon Kim¹, Hyun-Dae Lim^{2,3}, So-Youn An^{1,3}, Je-Woo Lee¹, Ji-Young Ra^{1,3}

¹Department of Pediatric Dentistry, College of Dentistry, Wonkwang University, Iksan, Korea

²Department of Oral Medicine, College of Dentistry, Wonkwang University, Iksan, Korea

³Wonkwang Dental Research Institute, Wonkwang University, Iksan, Korea

Received February 24, 2016

Revised May 11, 2016

Accepted May 26, 2016

Purpose: This study aimed to investigate the characteristics of the symptoms of temporomandibular disorders (TMD) in Korean children and adolescents using representative samples and questionnaires.

Methods: A survey involving the interview of 10-, 12-, and 15-year-old children and adolescents regarding the symptoms of TMD was conducted as a part of the 2010 National Oral Health Surveys. The study population included 18,112 subjects (male, 9,734; female, 8,378). The interview involved three questions related to the symptoms of TMD. The prevalence of symptoms of TMD, correlation of the symptoms with sex and age, and the difference in the number of symptoms according to sex and age were analyzed.

Results: Among the symptoms of TMD in children and adolescents, the prevalence of temporomandibular joint (TMJ) sounds during mouth opening was 13.0%, while those of TMJ pain and limitation were 3.1% and 4.3%, respectively. While the prevalence of TMJ sounds during mouth opening did not show any statistically significant difference between the sexes, the rates of prevalence of TMJ pain and limitation of mouth opening in were higher in the female subjects than the male ($p < 0.05$). It was also observed that the older the subjects, the higher the prevalence of TMJ sounds, TMJ pain, and limitation of mouth opening ($p < 0.05$). The number of symptoms of TMD was found to be increased among female subjects as well as the older ones ($p < 0.05$).

Conclusions: There are variations in the prevalence of symptoms of TMD among Korean children and adolescents according to sex and age, which is consistent with the results of previous studies. It is necessary to conduct a national cohort study to evaluate the risk factors for TMD in children and adolescents.

Key Words: Adolescent; Child; Interview survey; Korean; Symptoms; Temporomandibular joint disorders

Correspondence to:

Ji-Young Ra

Department of Pediatric Dentistry,
College of Dentistry, Wonkwang
University, 460 Iksan-daero,
Iksan 54538, Korea

Tel: +82-63-850-6633

Fax: +82-63-851-5324

E-mail: pedojoy@wku.ac.kr

INTRODUCTION

“Temporomandibular disorders” (TMD) is an umbrella term encompassing a number of clinical problems that involve temporomandibular joint (TMJ) pain and problems of the masticatory muscles.¹⁾ TMD are one of the most common causes for non-odontogenic pain caused by typical musculoskeletal disorders occurring in the oro-facial

region.²⁾ Simply interpreted, TMD is a term that collectively refers to the problems in the positional relationship between the cranium and the mandible. Although the skull and the mandible form a joint, because of their complex structure involving the distribution of various muscles and nerves adjacent to the joint, disorders in these areas exhibit various symptoms, the most important among which are sound during mouth opening, pain, and limitation of mouth

Copyright © 2016 Korean Academy of Orofacial Pain and Oral Medicine. All rights reserved.

© This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

opening.

Earlier studies have reported varying proportions of patients, ranging from 1% to 75% of the entire population, with at least one of the objective signs of TMD; the proportion of patients with subjective symptoms of TMD was reported to range from 5% to 33%.³⁾ In order to increase the reliability of the results of studies on temporomandibular muscles and joints by means of accurate diagnosis of TMD and identification of its symptoms, Dworkin and LeResche⁴⁾ developed the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) in 1992. These diagnostic criteria aid the diagnosis and classification of patients with TMD based on their clinical state (axis I) as well as their pain and psychological states (axis II).⁵⁾

Symptoms of TMD are often observed in children and adolescents, and most adult patients report the appearance of symptoms in their adolescence.^{6,7)} The symptoms of TMD might persist in adulthood because of various anatomical, pathological, and psychosocial factors.⁸⁾ Symptoms associated with TMD very rarely appear in children of ages ≤ 5 years, and some of the symptoms have been reported to increase with age.⁹⁾

Since children and adolescents have a greater ability to adapt than adults, it is hard to diagnose TMD in the former even in the presence of symptoms of the disease. However, if left untreated, TMD might affect the occlusion and the height of the face, and might also result in a specific growth pattern.¹⁰⁻¹²⁾

Various epidemiological studies on TMD have reported inconsistent results in terms of prevalence of the condition by nation, ranging from 11% to 50%; these discrepancies appear to have been caused by differences in the sample size, inclusion criteria, or data collection methods among the studies.¹³⁻¹⁵⁾

In order to resolve this issue, we conducted a survey based on the American Academy of Oro-facial Pain (AAOP) questionnaire as well as the national survey data. The

AAOP survey questionnaire comprises survey questions related to ten of the symptoms of TMD; based on the result of analysis of validity and reliability of the questionnaire, subjects responding in the affirmative to at least one of the questions are diagnosed as having TMD at the time of survey.¹⁶⁾ Although a number of epidemiological studies on TMD have been conducted in Korea, most have been cross-sectional studies, and none have evaluated the patterns of TMD in children and adolescents.¹⁷⁻²²⁾

Therefore, this study aims to investigate the characteristics of the symptoms of TMD in Korean children and adolescents by means of representative samples and questionnaires.

MATERIALS AND METHODS

1. Subjects

This study involved the evaluation of the raw data of children and adolescents of ages of 10, 12, and 15 years, included in the National Oral Health Survey, 2010. A total of 18,112 subjects (9,734 males, 8,378 females) were included in this study.

2. Data Collection

The survey was conducted by face-to-face interviews by examiners visiting the schools where the subjects were enrolled. A small examination table was installed at a specific location at each institution, where the subjects were examined and interviewed.

The interview questionnaire of the National Oral Health Survey, 2010, included the following three questions related to the symptoms of TMD.

- a) Did you experience TMJ sounds in both or either of your ears when opening your mouth now?
- b) Do you have pain in both or either one of your ears?
- c) Do you have pain, discomfort, or difficulty in opening your mouth?

Table 1. Wording of the adopted questionnaire

Question	Wording of the questions
1	Do you have 'TMJ sound' by both ears or one ear when opening your mouth now? (TMJ sound)
2	Do you have pain by both ears or one ear? (TMJ pain)
3	Do you have pain, discomfort, or difficulty in opening your mouth? (TMJ limitation)

TMJ, temporomandibular joint.

Table 2. Demographic features of subjects

		Age (y)			Total
		10	12	15	
Sex	Male	2,968 (51.5)	3,309 (52.9)	3,457 (56.7)	9,734 (53.7)
	Female	2,792 (48.5)	2,944 (47.1)	2,642 (43.3)	8,378 (46.3)
Total		5,760 (31.8)	6,253 (34.5)	6,099 (33.7)	18,112 (100.0)

Values are presented as number (%) of subjects.

Table 3. Prevalence of symptoms of TMD

TMD symptom	No. (%) of subjects
TMJ sound during mouth opening (TMJ sound)	2,332 (13.0)
TMJ pain	556 (3.1)
Difficulty or limitation of mouth opening (TMJ limitation)	745 (4.3)

TMD, temporomandibular disorders; TMJ, temporomandibular joint.

No respondent was excluded.

Each symptom has different number of total respondents.

Table 4. Comparison of TMD prevalence between male and female in Korean children and adolescents

Symptom	Male	Female	p-value
TMJ sound	1,252 (12.9)	1,080 (12.9)	0.728
TMJ pain	271 (2.8)	285 (3.4)	0.004
TMJ limitation	362 (3.7)	383 (4.6)	0.015

TMD, temporomandibular disorders; TMJ, temporomandibular joint.

Values are presented as number (%) of subjects.

No respondent was excluded.

Each symptom has different number of total respondents.

The subjects could respond to each of the questions with 'Yes', 'No', or 'Don't know' (Table 1).

3. Statistical Analysis

Statistical analysis was performed using the IBM SPSS Statistics version 19.0 (IBM Co., Armonk, NY, USA). Evaluations of the sex, age, and prevalence of symptoms of TMD were performed by descriptive statistical analysis. The correlation of the number of symptoms of TMD with sex and age was evaluated using the chi-square test. The significance level was determined to be 0.05.

RESULTS

1. Demographic Features

A total of 18,112 subjects of ages 10 years (5,760 subjects; 31.8%), 12 years (6,253 subjects; 34.5%), and 15 years (6,099 subjects; 33.7%) were included in this study. The

Table 5. Prevalence of TMD symptoms in Korean children and adolescents by age

Symptom	Age (y)			p-value
	10	12	15	
TMJ sound	296 (5.2)	732 (11.7)	1,304 (21.4)	0.000
TMJ pain	84 (1.5)	193 (3.1)	279 (4.6)	0.000
TMJ limitation	86 (1.5)	218 (3.5)	441 (7.2)	0.000

TMD, temporomandibular disorders; TMJ, temporomandibular joint.

Values are presented as number (%) of subjects.

No respondent was excluded.

Each symptom has different number of total respondents.

distribution of subjects according to sex was even in each group. Since the subjects included in this study were part of the National Oral Health Survey, 2010, there were no statistically significant differences in the number of subjects according to sex or age (Table 2).

2. Prevalence of Symptoms of TMD

Among the children and adolescents, the prevalence of symptoms of TMJ sounds during mouth opening was 13.0%, with no statistically significant difference ($p > 0.05$) in prevalence between the male (12.9%) and female (12.9%) subjects. However, the prevalence was observed to increase with an increase in age ($p < 0.05$; Tables 3-5).

TMJ pain was reported in 3.1% of the children and adolescents, with a statistically significant difference in prevalence ($p < 0.05$) between the male (2.8%) and female (3.4%) subjects. The prevalence of TMJ pain was also observed to

Table 6. Comparison of frequency of TMD symptoms between male and female

Symptom No.	Male	Female	p-value
0	8,231 (84.6)	7,072 (84.4)	0.001
1	1,198 (12.3)	977 (11.7)	
2	228 (2.3)	216 (2.6)	
3	77 (0.8)	113 (1.3)	

TMD, temporomandibular disorders.
Values are presented as number (%) of subjects.
No respondent was excluded.

increase with an increase in age ($p < 0.05$).

The prevalence of TMD limitation was 4.3%, and there were significant differences in prevalence between the sexes as well as among the age-groups ($p < 0.05$).

The correlation of the number of symptoms of TMD with sex and age was also evaluated. In particular, the number of symptoms of TMD was higher in female subjects than in male subjects, and it was found to increase with an increase in age ($p < 0.05$; Tables 6, 7).

DISCUSSION

TMD are characterized by TMJ pain and sounds as well as inhibition of jaw movement.²³⁾ The prevalence of TMD has been extensively assessed using the RDC/TMD questionnaire.²⁴⁾ However, since this method involves clinical assessment and interview, its application is not practical in epidemiological studies involving entire populations.²⁵⁾ Epidemiological studies typically involve the evaluation of the condition of a population by means of surveys whose validity has been verified.²⁶⁾ However, the major problem with surveys is that it is impossible to recognize whether or not the subjects have understood the contents of the questionnaires accurately, even after each item has been explained in detail by the investigators. Therefore, in the present survey, we took steps to ensure easier understanding of the questions by the subjects, by means of face-to-face interviews.

Regarding the variations in the symptoms of TMD according to sex, previous studies reported greater prevalence of pain and symptoms associated with TMD in female subjects than in male subjects.^{7,27)} In the present study too, we observed higher prevalence of pain and symptoms

Table 7. Frequency of TMD symptoms by age

Symptom No.	Age (y)			p-value
	10	12	15	
0	5,360 (93.1)	5,347 (85.5)	4,596 (75.4)	0.000
1	344 (6.0)	727 (11.6)	1,104 (18.1)	
2	46 (0.8)	121 (1.9)	277 (4.5)	
3	10 (0.2)	58 (0.9)	122 (2.0)	

TMD, temporomandibular disorders.
Values are presented as number (%) of subjects.
No respondent was excluded.

of limitation of the TMJ in the female subjects than in the male subjects. This difference might be associated with neurological and physical characteristics, because women tend to have a lower threshold for pain and greater vulnerability to stress than men.²⁸⁾ A previous cross-sectional study also reported an increase in pain as well as TMD in female subjects in adolescence, which indicates that changes in hormones play a major role in the physiology of TMD.²⁹⁻³¹⁾ In addition, an epidemiological study involving children and adolescents reported 2.0 to 3.5 times higher prevalence of TMD-associated symptoms in female subjects than in male subjects; according to the results of this study, the greater the proportion of female subjects in the population, the greater was the number of symptoms of TMD.³²⁻³⁴⁾ Therefore, the influence of onset of menstruation-related hormonal changes on the symptoms of TMD needs to be evaluated in future studies.

Jo et al.³⁵⁾ reported that TMD were more common in female subjects, regardless of age, which is consistent with the results of many of the previous studies. However, in a previous study involving subjects between the ages of 10 years and 16 years, similar prevalence rates of TMD were observed among the male and female subjects.⁷⁾ Additionally, Nilsson et al.²⁷⁾ also reported no significant difference in the intensity of pain associated with TMD between the sexes. These discrepancies in results among different studies indicate that the possibility that the type and severity of TMD are influenced by both age and sex, and it is necessary to evaluate the independent impact of sex on the factors associated with the condition.

In the present study, we found that the prevalence rates of TMJ sounds during mouth opening and TMJ pain and limitation increased with age. Similarly, Ko et al.³⁶⁾ reported

that the prevalence of TMJ noise, joint pain upon chewing solid food, and discomfort of jaw muscles increased continuously with age. According to List et al.⁷⁾ the prevalence of clicking noise of the TMJ in adolescents between the ages of 12 years and 18 years was 11%, in 3% of these subjects, the TMJ sounds were accompanied by fatigue and stiffness of the lower jaw. In contrast, Schmitter et al.³⁷⁾ reported that the prevalence rates of joint sounds and muscle pain in older subjects were 38% and 12%, respectively, while, in younger subjects, the prevalence rates of clicking and orofacial pain were 7% each and that of muscle pain was 25%. These results indicate the symptoms of TMD vary according to age.

TMD are caused by various factors, including occlusal interference, hypermobility of the temporal and masseter muscles, teeth grinding and stress, although it is not clear which one of these factors plays the primary role in the occurrence of TMD. Additionally, the frequencies of neck problems and improper posture are high in patients with TMD; the prevalence of symptoms of TMD has been found to be increased in patients with neck problems. The mechanisms by which factors cause TMD and whether they aggravate the symptoms of TMD should be evaluated by further studies.

The present study utilized the data of the National Oral Health Survey, 2010, in Korea. Korea has conducted a nation-wide survey every three years from the year 2000. Therefore, the sampling procedure is reliable, and the study population is representative of the Korean population. Additionally, the results are applicable for the entire population. Each of the national surveys has had high intra and interclass correlation coefficients of agreement among the examiners. Therefore, the questionnaire used in this survey is a simple and practical tool for conducting chair-side screening tests.

In conclusion, the results of our study indicate variations in the symptoms of TMD among Korean children and adolescents according to sex and age, and these results are consistent with those of previous studies. It is necessary to conduct a national cohort study to evaluate the risk factors for TMD and perform multiple analyses involving a variety of variables in further studies on the symptoms of TMD.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. McNeill C. Temporomandibular disorders. Guidelines for classification, assessment and management. London: The Academy of Orofacial Pain, Quintessence; 1993.
2. Ok SM, Kim CY, Jeong SH, Ahn YW, Ko MY. Comparative analysis: the patterns of temporomandibular disorder among adolescents. *J Oral Med Pain* 2012;37:47-59.
3. De Kanter RJ, Truin GJ, Burgersdijk RC, et al. Prevalence in the Dutch adult population and a meta-analysis of signs and symptoms of temporomandibular disorder. *J Dent Res* 1993;72:1509-1518.
4. Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. *J Craniomandib Disord* 1992;6:301-355.
5. Manfredini D, Guarda-Nardini L, Winocur E, Piccotti F, Ahlberg J, Lobbezoo F. Research diagnostic criteria for temporomandibular disorders: a systematic review of axis I epidemiologic findings. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2011;112:453-462.
6. Jedel E, Carlsson J, Stener-Victorin E. Health-related quality of life in child patients with temporomandibular disorder pain. *Eur J Pain* 2007;11:557-563.
7. List T, Wahlund K, Wenneberg B, Dworkin SF. TMD in children and adolescents: prevalence of pain, gender differences, and perceived treatment need. *J Orofac Pain* 1999;13:9-20.
8. Von Korff M, Dworkin SF, Le Resche L, Kruger A. An epidemiologic comparison of pain complaints. *Pain* 1988;32:173-183.
9. Köhler AA, Helkimo AN, Magnusson T, Hugoson A. Prevalence of symptoms and signs indicative of temporomandibular disorders in children and adolescents. A cross-sectional epidemiological investigation covering two decades. *Eur Arch Paediatr Dent* 2009;10(Suppl 1):16-25.
10. Kirveskari P, Alanen P, Jämsä T. Functional state of the stomatognathic system in 5, 10 and 15 year old children in southwestern Finland. *Proc Finn Dent Soc* 1986;82:3-8.
11. Dibbets JM, van der Weele LT, Uildriks AK. Symptoms of TMJ dysfunction: indicators of growth patterns? *J Pedod* 1985;9:265-284.
12. Carlsson GE, Ingervall B, Lewin T, Molin C. Relation between functional disturbances of the masticatory system and some anthropometric, physiological and psychological variables in young Swedish men. *J Oral Rehabil* 1976;3:305-310.
13. Locker D, Slade G. Prevalence of symptoms associated with temporomandibular disorders in a Canadian population. *Community Dent Oral Epidemiol* 1988;16:310-313.
14. Duckro PN, Tait RC, Margolis RB, Deshields TL. Prevalence of temporomandibular symptoms in a large United States metro-

- politan area. *Cranio* 1990;8:131-138.
15. Glass EG, McGlynn FD, Glaros AG, Melton K, Romans K. Prevalence of temporomandibular disorder symptoms in a major metropolitan area. *Cranio* 1993;11:217-220.
 16. De Leeuw R. *Orofacial pain: guidelines for assessment, diagnosis, and management*. Chicago: Quintessence; 2008.
 17. Chung SC, Lee SW, Hyun KY. Clinical symptoms and patterns of mandibular movement in the patients with TMJ dysfunction. *J Korean Acad Oral Med* 1985;10:5-16.
 18. Kim SH. Study of general public's knowledge of TMD: how predominantly is TMD understood by people. *Korean J Oral Med* 2000;25:371-382.
 19. Kim SH, Choi JK. Comparison of prevalence of TMD between elderly and young population. *J Korean Acad Oral Med* 1989;14:25-34.
 20. Kim MH, Nahm DS. The prevalence study of TMD and the associated factors in Korean malocclusion patients. *Korean J Orthod* 1997;27:523-538.
 21. Park MH, Ko MY. Screening evaluation and predicting prognosis of craniomandibular disorder patients with the Solberg questionnaire. *J Korean Acad Oral Med* 1994;19:111-123.
 22. Sohn DE, Ahn YW, Park JS, Ko MY. An epidemiological study of temporomandibular disorders patients by screening questionnaire. *Korean J Oral Med* 2004;29:341-351.
 23. Visscher CM, Ligthart L, Schuller AA, et al. Comorbid disorders and sociodemographic variables in temporomandibular pain in the general Dutch population. *J Oral Facial Pain Headache* 2015;29:51-59.
 24. List T, Dworkin SF. Comparing TMD diagnoses and clinical findings at Swedish and US TMD centers using research diagnostic criteria for temporomandibular disorders. *J Orofac Pain* 1996;10:240-253.
 25. Gonçalves DA, Dal Fabbro AL, Campos JA, Bigal ME, Speciali JG. Symptoms of temporomandibular disorders in the population: an epidemiological study. *J Orofac Pain* 2010;24:270-278.
 26. Helkimo M. Studies on function and dysfunction of the masticatory system. 3. Analyses of anamnestic and clinical recordings of dysfunction with the aid of indices. *Swed Dent J* 1974;67:165-181.
 27. Nilsson IM, Drangsholt M, List T. Impact of temporomandibular disorder pain in adolescents: differences by age and gender. *J Orofac Pain* 2009;23:115-122.
 28. Sena MF, Mesquita KS, Santos FR, Silva FW, Serrano KV. Prevalence of temporomandibular dysfunction in children and adolescents. *Rev Paul Pediatr* 2013;31:538-545.
 29. Hirsch C, Hoffmann J, Türp JC. Are temporomandibular disorder symptoms and diagnoses associated with pubertal development in adolescents? An epidemiological study. *J Orofac Orthop* 2012;73:6-8, 10-8.
 30. LeResche L, Mancl LA, Drangsholt MT, Saunders K, Von Korff M. Relationship of pain and symptoms to pubertal development in adolescents. *Pain* 2005;118:201-209.
 31. Warren MP, Fried JL. Temporomandibular disorders and hormones in women. *Cells Tissues Organs* 2001;169:187-192.
 32. Huddleston Slater JJ, Lobbezoo F, Onland-Moret NC, Naeije M. Anterior disc displacement with reduction and symptomatic hypermobility in the human temporomandibular joint: prevalence rates and risk factors in children and teenagers. *J Orofac Pain* 2007;21:55-62.
 33. LeResche L, Mancl LA, Drangsholt MT, Huang G, Von Korff M. Predictors of onset of facial pain and temporomandibular disorders in early adolescence. *Pain* 2007;129:269-278.
 34. Pereira LJ, Pereira-Cenci T, Pereira SM, et al. Psychological factors and the incidence of temporomandibular disorders in early adolescence. *Braz Oral Res* 2009;23:155-160.
 35. Jo JH, Park JW, Kim JR, Seo HD, Jang JH, Chung JW. Age differences in signs and symptoms of patients with temporomandibular disorders. *J Oral Med Pain* 2015;40:55-62.
 36. Ko SJ, Han DS, Han KS. Prevalence of symptoms of craniomandibular disorders in 9-16 year old Korean school children. *J Wonkwang Dent Res Inst* 1994;4:45-60.
 37. Schmitter M, Rammelsberg P, Hassel A. The prevalence of signs and symptoms of temporomandibular disorders in very old subjects. *J Oral Rehabil* 2005;32:467-473.