

Prevalence of temporomandibular disorders in Korean high school students

Jong-Wook Ju¹, Tae-Yoon Hwang^{2*}

¹Dept. of Dental Hygiene, Jinju Health College, Assistant professor

²Dept. of Preventive Medicine & Public Health, College of Medicine, Yeungnam University, Professor

Objectives: The objective and subjective prevalence of temporomandibular joint disorder (TMD) in Korean adolescents has not been reported. This study aims to investigate the prevalence of TMD in Korean high school students objectively, through oral examination, and subjectively, via questionnaire, to identify the factors associated with this disorder.

Methods: Oral examination and a structured self-reporting questionnaire survey, as recommended by the American Academy of Orofacial Pain (AAOP), were conducted on 643 high school students (318 males and 325 females) in Gyeongsangnam-do, Korea.

Results: The oral examination revealed that 29.5% of students (21.4% male and 37.5% female) had TMD. Included in the diagnostic criteria for TMD, temporomandibular joint (TMJ) sound was present in 21.9% of the students, followed by mouth-opening deviation, TMJ pain, and restricted mouth opening, which were present in 14.3%, 10.1%, and 0.3% of the students, respectively. The subjective symptoms included TMD sound (46.8%), headache or neck pain (25.5%), and pain in or around the ears, temples, or cheeks (16.5%). Logistic regression analysis showed that TMD was associated with sex, malocclusion, and symptom severity ($p < 0.001$).

Conclusions: This study revealed a high prevalence of TMD in adolescents in Korea. There was a significant correlation between oral examination findings and screening questionnaire results. The use of these tests to identify individuals who should be closely monitored clinically may reduce costs and lead to early treatment.

Keywords adolescent, facial pain, prevalence, temporomandibular joint disorders, oral examination

Received on Aug 17, 2020. Revised on Sep 07, 2020. Accepted on Sep 14, 2020.

* Corresponding Author (E-mail: luke@ynu.ac.kr)

I. Introduction

Temporomandibular disorder (TMD) is a collective term that includes various clinical symptoms characterized by pain in the masticatory musculature and/or temporomandibular joint (TMJ) and associated structures; TMJ sounds; and a limitation or deviation in mandibular range of motion[1].

The causes of TMD include malocclusion, trauma, emotional stress, deep pain input, and parafunction[2]. Symptoms associated with TMD include restricted mouth opening, masticatory muscle stiffness, joint sound, headache, muscle ache, neuralgia, and facial pain[3]. These symptoms eventually affect the oral health-related quality of life[4][5].

Although TMD may appear at any age, it most frequently affects those between 15 and 45 years of age; the prevalence increases from the age of 15 years and peaks in those in their late 20s[6]. TMD during adolescence should be considered

of greater importance because it can cause learning and/or sleep impairments, and has an impact on school life and/or activities of daily living[7].

According to the 2010 Korea National Oral Health Survey, the prevalence of TMJ sounds in children aged 10, 12, and 15 years is 5.18%, 11.45%, and 21.84%, respectively. TMJ pain was present in 1.36%, 3.14%, and 4.81%; and trismus or restricted mouth opening was present in 1.47%, 3.41%, and 7.91%, respectively; thus, these symptoms tended to increase with age[8].

Studies outside of Korea have reported that the prevalence of TMD is 10-70% of the total population[9] and 16-68% among children and adolescents[10]. The symptoms and signs of TMD rarely appear during childhood[11]; however, they are found in 4.9-60% of adolescents and adults[12][13]. Furthermore, most adults with TMD state that their symptoms first appeared during adolescence[14].

Han and Yu[15] have reported that TMJ pain is the most common sign of TMD in patients who visited dentists. Factors associated with the condition include trauma, teeth grinding, and teeth clenching. Seo et al.[16], Park and Yoon[17], and Lee et al.[18] surveyed high school and college students and adults and reported that a TMJ sound was the most common symptom, while associated factors included trauma, teeth grinding, teeth clenching, and stress. Feteih[19] conducted an oral examination and survey of adolescents, and found that the objective evaluation (oral examination) indicated TMJ sound is the most common sign. Interestingly, the subjective evaluation (questionnaire) revealed that headache is the most common symptom. The habit of lip or cheek biting was also identified as an associated factor.

To date, no study has compared the prevalence of TMD in Korean adolescents using objective and subjective assessments. Thus, the objective of the present study was to investigate the prevalence of TMD in Korean high school students by using an oral examination and questionnaire to identify the factors associated with TMD.

II. Methods

1. Participants and study design

This present study was approved by the institution's Institutional Review Board of Y University (IRB No. YUHS-10-14-002). The study used a cross-sectional survey design, in which the oral examination and questionnaire were conducted between April 1 and 18, 2014. We recruited through convenience sampling 686 students (aged 15-17 years) from two high schools in South Gyeongsang Province. Among a total of 686 candidates, 643 participants were included in the final study population. We excluded 24 students who refused to undergo an oral examination and 19 students whose responses to the questions were inadequate for use as study data.

2. Data collection

1) Oral examinations

Oral examinations were performed by a single dentist, using a pen light in addition to natural light. Occlusion status was recorded on the oral examination form as normal, crowding, maxillary protrusion, mandibular protrusion, or other. The major signs of TMD were recorded on the oral examination form as TMJ sound, TMJ pain, mouth-opening deviation, and restricted mouth opening, based on clinical examination. If the results were positive for any of these signs, TMD was considered present.

Positivity for TMJ sound was determined based on palpation[20] or auscultation[21] while the students opened or closed their mouths; auscultation was performed within 5 cm from the TMJ. Positivity for TMJ pain was determined on the basis of palpation of the TMJ during mandibular movement[22]. Positivity for mouth opening deviation was based on a deviation of ≥ 2 mm to the right or left of the mandibular central line during maximum mouth opening[21]. Positivity for restricted mouth opening was determined based on a distance of ≤ 4 cm between the maxillary and mandibular incisal edge during maximum mouth opening[23].

2) Questionnaire design

A structured self-reporting questionnaire was used to identify the sex, subjective oral health status, and subjective TMD symptom severity.

For comprehensive and standardized assessment of TMD symptoms, the screening questionnaire for TMD recommended by the American Academy of Orofacial Pain (AAOP) was used to determine the presence and severity of subjective TMD symptoms, on the basis of assessment of restricted mandibular movement, TMJ sound, orofacial pain, and masticatory muscle pain[6].

The short-form questionnaire for TMD contained 10 questions about symptoms. Positive responses to any of the questions indicated that the respondent had TMD and the severity of TMD was determined on the basis of the number of positive responses[6]. Positive responses were tallied and quartiles calculated. The severity of TMD was categorized according to the method used by Seo et al.[16]: normal (0 positive response), mild (1 positive response), moderate (2-3 positive

responses), and severe (≥ 4 positive responses). A reliability analysis revealed a Cronbach's α of 0.705.

3. Statistical analysis

Data analysis was performed using SPSS(21.0 ver for windows, IBM SPSS Statistics). Cross-sectional analysis was performed to compare the prevalence of TMD according to sex, subjective oral health status, occlusion status, and subjective TMD symptom severity in the participants. Binary logistic regression analysis was performed to identify the factors influencing TMD.

III. Results

1. Prevalence of temporomandibular disorders by characteristics

The number of students with TMD was 190 (29.5%). There

was a significant difference in TMD prevalence between sexes: 68 (21.4%) and 122 (37.5%) male and female students, respectively, were diagnosed with TMD ($p < 0.001$).

The percentage of students with TMD who responded that their subjective oral health status was very good, good, fair, bad, and very bad was 13.3%, 25.2%, 25.3%, 41.1%, and 55.6%, respectively. There were significant differences in the prevalence of TMD according to subjective oral health status ($p = 0.001$). There were significant differences in occlusion status; the percentages of students with TMD were 15.2%, 75.6%, 52.3%, and 40.0% in normal status, crowding, maxillary protrusion, and mandibular protrusion, respectively ($p < 0.001$). In addition, there were significant differences in subjective TMD symptom severity: 231 students (35.9%) considered themselves normal or asymptomatic; however, clinical examination revealed that 38 of these students (16.5%) had TMD. The percentage of students with TMD that reported with mild, moderate, and severe symptom severity was 23.5%, 37.3%, and 66.2%, respectively ($p < 0.001$) <Table 1>.

<Table 1> Prevalence of temporomandibular disorders by sex and oral health characteristics

Characteristics	Subject	TMD		p-value
		Yes	No	
Sex				
Male	318 (49.5)	68 (21.4)	250 (78.6)	<0.001
Female	325 (50.5)	122 (37.5)	203 (62.5)	
Subjective oral health status				
Very good	15 (2.3)	2 (13.3)	13 (86.7)	0.001
Good	119 (18.5)	30 (25.2)	89 (74.8)	
Fair	332 (51.6)	84 (25.3)	248 (74.7)	
Bad	168 (26.1)	69 (41.1)	99 (58.9)	
Very bad	9 (1.4)	5 (55.6)	4 (44.4)	
Occlusion status				
Normal	421 (65.5)	64 (15.2)	357 (84.8)	<0.001
Crowding	90 (14.0)	68 (75.6)	22 (24.4)	
Maxillary protrusion	65 (10.1)	34 (52.3)	31 (47.7)	
Mandibular protrusion	60 (9.3)	24 (40.0)	36 (60.0)	
Other	7 (1.1)	0 (0.0)	7 (100.0)	
TMD symptom severity				
Normal	231 (35.9)	38 (16.5)	193 (83.5)	<0.001
Mild	179 (27.8)	42 (23.5)	137 (76.5)	
Moderate	153 (23.8)	57 (37.3)	96 (62.7)	
Severe	80 (12.4)	53 (66.2)	27 (33.8)	
Total	643 (100)	190 (29.5)	453 (70.5)	

TMD: temporomandibular disorders.
Data are given as numbers (percentages).
p-values based on chi-square test.

2. Distribution of signs with temporomandibular disorder

Within the TMD group, 142 students (21.9%) had a TMJ sound, while 92 (14.3%), 65 (10.1%), and 2 (0.3%) students had mouth opening deviation, TMJ pain, and restricted opening, respectively <Table 2>.

3. Frequency of subjective temporomandibular disorders symptoms

Among the 10 questions on subjective TMD symptoms, the item with the highest positive response rate was TMJ sound (46.8%), followed by frequent headache or neck pain (25.5%) and pain in or around the ears, temples, or cheeks (16.5%). Within the TMD group, 72.1% of students responded that they were aware of noises in the jaw joint, while 27.9% responded

that they had frequent headache or neck pain. Moreover, 21.6% responded that they had pain in or around the ears, temples, or cheeks <Table 3>.

4. The influence factors affection temporomandibular disorders

Logistic regression analysis identified sex, malocclusion, and subjective TMD symptom severity as factors significantly influencing TMD. The odds ratio (OR) for TMD was 2.39 for females relative to males, 7.75 for malocclusion relative to normal occlusion, and 2.78 and 7.23 for moderate and severe symptom severity relative to normal <Table 4>.

IV. Discussion

TMD is a collective term for a group of musculoskeletal and neuromuscular conditions that present with several clinical signs and symptoms involving the masticatory musculature, the TMJ, and associated structures[24]. Jeong et al.[25] have defined the criterion for diagnosing TMD as the presence of any one of the following signs: TMJ sound, TMJ pain, and restricted mouth opening; however, Feteih [19] has defined

<Table 2> Distribution of signs in the study subjects with temporomandibular disorder

TMD Signs*	No. (%)
TMJ sounds	141 (21.9)
TMJ pain	65 (10.1)
Opening deviation	92 (14.3)
Restricted opening	2 (0.3)

TMD, temporomandibular disorders; TMJ, temporomandibular joint.
*Multiple response.

<Table 3> Frequency of the subject with subjective TMD symptom

TMD symptom questions*	Subject (N = 643)	TMD	
		Yes (N = 190)	No (N = 453)
1. Do you have difficulty, pain, or both when opening your mouth, for instance when yawning?	84 (13.1)	57 (30.0)	27 (6.0)
2. Does your jaw "get stuck", "lock", or "go out"?	49 (7.6)	31 (16.3)	18 (4.0)
3. Do you have difficulty, pain, or both when chewing, talking, or using your jaws?	61 (9.5)	40 (21.1)	21 (4.6)
4. Are you aware of noises in the jaw joints?	301 (46.8)	137 (72.1)	164 (36.2)
5. Do your jaws regularly feel stiff, tight, or tired?	79 (12.3)	52 (27.4)	27 (6.2)
6. Do you have pain in or about the ears, temples or cheeks?	106 (16.5)	41 (21.6)	65 (14.3)
7. Have you been aware of any recent changes in your bite?	72 (11.2)	34 (17.9)	38 (8.4)
8. Do you have frequent headaches or neck pain?	164 (25.5)	53 (27.9)	111 (24.5)
9. Do you have a recent injury to your head, neck, or jaw?	15 (2.3)	1 (0.5)	14 (3.1)
10. Have you been previously treated for unexplained facial pain or a jaw joint problem?	25 (3.9)	18 (9.5)	7 (1.5)

TMD: temporomandibular disorders.
Data are given as numbers (percentages).
TMD, temporomandibular disorders; TMJ, temporomandibular joint.
*Multiple response.Multiple response.

<Table 4> Risk factors associated with temporomandibular disorders

Variables	B	S.E.	OR	95% CI
Sex(ref: male)				
Female	0.871	0.217	2.390	1.563-3.656
Occlusion status(ref : normal)				
Malocclusion	2.047	0.214	7.748	5.094-11.783
Subjective oral health status(ref: very good)				
Good	0.632	0.899	1.882	0.323-10.950
Fair	0.304	0.880	1.355	0.242-7.601
Bad	0.561	0.889	1.753	0.279-10.127
Very bad	1.203	1.203	3.329	0.315-35.172
TMD symptom severity(ref: normal)				
Mild	0.347	0.279	1.415	0.818-2.447
Moderate	1.023	0.276	2.783	1.621-4.777
Severe	1.978	0.337	7.228	3.736-13.983
Constant	-3.328	0.881	0.036	

TMD, temporomandibular disorders.

Results of binary logistic regression analysis.

TMD according to the presence of one or more of the following signs: TMJ sound, TMJ pain and tenderness, opening deviation, and restricted opening.

In the present study, TMD was identified in 29.5% (n = 190) of the total study population (n = 643), with 21.9%, 14.3%, 10.1%, and 0.3% of the students recording a TMJ sound, opening deviation, TMJ pain, and restricted mouth opening, respectively. Feteih[19] has reported that 21.3% of students aged 12-16 years showed at least one sign of TMD, including 13.5%, 4.7%, 3.9%, 2.6%, and 0.5% with TMJ sound, restricted opening, opening deviation, TMJ pain, and TMJ tenderness, respectively. In line with the present study, they reported that a TMJ sound is the most common sign of TMD, confirming that this is the most typical sign of TMD.

In the present study, there were statistically significant differences in the prevalence of TMD in students with teeth crowding, maxillary protrusion, and mandibular protrusion compared with normal occlusion status. A study by Kim et al.[26] has also revealed significant TMD prevalence among students with teeth crowding, maxillary protrusion, and mandibular protrusion when compared with normal occlusion.

The present study used a screening questionnaire[6] recommended by the AAOP for TMD, which considers a positive response to any one of the questions as indicating possible TMD. The

results showed that the prevalence of subjective TMD symptoms was 64.1%. TMD symptoms have been shown in 49.8% of 221 high school students aged 15-16 years[17] in previous studies. Moreover, the prevalence of TMD symptoms is 34.9% in 934 Brazilian adolescents aged 10-14 years[27]. The increased prevalence of TMD symptoms in adolescents may be explained by an increase in the age of the study population.

Among the 10 questions in the short-form questionnaire for TMD, the question with the highest positive response rate was TMJ sound (46.8%). This was higher than the prevalence obtained through oral examination (21.9%). The subjective prevalence may have been higher because the short-form questionnaire also included previous experiences with TMJ sound as a positive response. Jeong et al.[25] have conducted interviews to investigate TMD status and found that 20.7% of 430 Korean high school students aged 16 years reported having a TMJ sound. Park and Yoon[17] also reported that TMJ sound had the highest positive response rate (32.1%) among the questions in a screening questionnaire for TMDs.

When the participants were divided into normal (asymptomatic), mild, moderate, and severe groups based on subjective TMD symptom severity, as determined by the 10 questions in the short-form questionnaire for TMD, the number of participants in each group was 231 (35.9%), 179 (27.8%), 153 (23.8%),

and 80 (12.4%), respectively. The prevalence of TMD according to subjective TMD symptom severity was 23.5% in the mild group, but this increased significantly with greater severity, to 37.3% and 66.2% in the moderate and severe groups, respectively. The prevalence of TMD in the normal (asymptomatic) group was 16.5%, indicating that many students did not perceive their own TMD symptoms. Therefore, it may be necessary to establish measures for screening these students and providing the necessary follow-up care.

The logistic regression analysis showed that females were 2.65 times more likely to report TMD. This higher risk may be due to female students responding more sensitively to stress[18][28] than male students. With respect to subjective TMD symptom severity, the OR for TMD in the moderate and severe groups was 2.78 and 7.23 times higher than in the normal group, respectively. This indicated that students with more positive responses to questions about subjective TMD symptoms were more likely to have TMD; these students should be monitored closely for TMD.

V. Conclusions

The limitations in the present study included that the study population was limited to high school students from a specific region; therefore, the population may not be representative of all high school students in Korea. Moreover, the study was a cross-sectional study; therefore, it cannot confirm a temporal causal relationship between TMD prevalence and influencing factors. However, this study revealed a high prevalence of TMD in adolescents in Korea. There was a significant correlation between oral examination findings and screening questionnaire results. The use of these tests to identify individuals who should be closely monitored clinically may reduce costs and leads to early treatment.

REFERENCES

1. Laskin DM: The president's conference on the examination, diagnosis and management of temporomandibular disorders. Chicago, American Dental Association, 1983.
2. Okeson JP: Management of temporomandibular disorders and occlusion. 7th ed. St. Louis, Elsevier Health Sciences, 2014.
3. Clark GT, Solberg WK: Perspectives in Temporomandibular Disorders. 1st ed. Chicago, Quintessence Publishing Co., 1987.
4. Schierz O, John MT, Reissmann DR, Mehrstedt M, Szentpetery A: Comparison of perceived oral health in patients with temporomandibular disorders and dental and anxiety using oral health-related quality of life profiles. *Quality of Life Research* 17(6):857-866, 2008.
DOI : 10.1007/s11136-008-9360-3
5. Lemos GA, Paulino MR, Forte FDS, Beltrão RTS, Batista AUD: Influence of temporomandibular disorder presence and severity on oral health-related quality of life. *Revista Dor* 16(1):10-11, 2015.
DOI : 10.5935/1806-0013.20150003
6. McNeill C: Temporomandibular Disorders: Guidelines for Classification, Assessment, and Management. 2nd ed. Chicago, Quintessence Publishing Co., 1993.
7. Nilsson IM, Drangsholt M, List T: Impact of temporomandibular disorder pain in adolescents: differences by age and gender. *Journal of Orofacial Pain* 23(2):115-122, 2009.
8. Ministry of Health and Welfare: 2010 National Oral Health Survey Report [internet]. Ministry of Health and Welfare; 2011. [cited 2013 July 15]. Available from: http://www.mohw.go.kr/react/jb/sjb030301vw.jsp?PAR_MENU_ID=03&MENU_ID=032901&CONT_SEQ=337102.
9. Li C, Su N, Yang X, Yang X, Shi Z, Li L: Ultrasonography for the detection of disc displacement of Temporomandibular Joint: A Systematic Review and Meta-Analysis. *Journal of Oral and Maxillofacial Surgery* 70(6):1300-1309, 2012.
DOI : 10.1016/j.joms.2012.01.003
10. Sena MF, Mesquita KS, Santos FR, Silva FW, Serrano KV: Prevalence of temporomandibular dysfunction in children and adolescents. *Revista Paulista de Pediatria* 31(4):538-545, 2013.
DOI : 10.1590/S0103-05822013000400018
11. Köhler AA, Helkimo AN, Magnusson T, Hugoson A: Prevalence of symptoms and signs indicative of tempor-

- omandibular disorders in children and adolescents: A cross-sectional epidemiological investigation covering two decades. *European Archives Paediatric Dentistry* 10(1 Suppl): 16-25, 2009.
DOI : 10.1007/BF03262695
12. Adèrn B, Stenvinkel C, Sahlqvist L, Tegelberg A: Prevalence of temporomandibular dysfunction and pain in adult general practice patients. *Acta Odontologica Scandinavica* 72(8):585-590, 2014.
DOI : 10.3109/00016357.2013.878390
 13. Campos JA, Carrascosa AC, Bonafe FS, Maroco J: Epidemiology of severity of temporomandibular disorders in Brazilian women. *Journal of Oral & Facial Pain and Headache* 28(2):147-152, 2014.
DOI : 10.11607/ofph.1194
 14. Karibe H, Shimazu K, Okamoto A, Kawakami T, Kato U, Warita-Naoi S: Prevalence and association of self-reported anxiety, pain, and oral parafunctional habits with temporomandibular disorders in Japanese children and adolescents: a cross-sectional survey. *BMC Oral Health* 15:8, 2015.
DOI : 10.1186/1472-6831-15-8
 15. Han SY, Yu JS: A study of temporomandibular disorders and food intake ability among dental clinic outpatients. *Journal of Dental Hygiene Science* 11(3):285-292, 2011.
 16. Seo EG, Kim SD, Lee JY, Rim JS: Temporomandibular disorders and risk factors in office workers, service workers, and teachers. *Journal of Korean Society of Dental Hygiene* 12(3):563-576, 2012.
DOI : 10.13065/jksdh.2012.12.3.563
 17. Park EJ, Yoon YJ: Relationship between the prevalence of temporomandibular joint disorders in some male high school students and computer utilization. *Journal of Korean Society of Dental Hygiene* 13(4):651-657, 2013.
DOI : 10.13065/iksdh.2013.13.4.651
 18. Lee SM, Kim CH, Jun MK: Relationship between occlusion analysis using the T-scan III[®] system and oral behavior checklist according to temporomandibular joint disorder in female college students. *Journal of Korean Society of Dental Hygiene* 19(2):317-327, 2019.
DOI : 10.13065/jksdh.20190016
 19. Feteih RM: Signs and symptoms of temporomandibular disorders and oral parafunctions in urban Saudi arabian adolescents: a research report. *Head & Face Medicine* 2:25, 2006.
DOI : 10.1186/1746-160X-2-25
 20. Goho C, Jones H: Association between primary dentition wear and clinical temporomandibular dysfunction signs. *Pediatric Dentistry* 13:263-266, 1991.
 21. Gross A, Gale EN: A prevalence study of the clinical signs associated with mandibular dysfunction. *The Journal of the American Dental Association* 107(6):932-936, 1983.
DOI : 10.14219/jada.archive.1983.0354
 22. Dworkin SF, Huggins KH, LeReche L, et al: Epidemiology of signs and symptoms in temporomandibular disorders: Clinical signs in cases and control. *The Journal of the American Dental Association* 120(3):273-281, 1990.
DOI : 10.14219/jada.archive.1990.0043
 23. Chung SC, Kim YK, Ko MY, et al: Orofacial pains and temporomandibular disorders. 1st ed. Seoul, Shinhung International, pp.136-151, 2006.
 24. American Academy of Orofacial Pain: Temporomandibular disorder. In Leeuw R and Klasser GD (eds) *Orofacial Pain: Guidelines for assessment, diagnosis, and management*. 5th ed. Chicago, Quintessence Publishing Co., 2013.
 25. Jeong KH, Kwon HK, Kim JB, Choe CH: Prevalence of temporomandibular disorders and its relation with maxillofacial trauma in 6-14 and 16 years old Korean children. *Journal of Korean Academy of Oral Health* 27(2):249-263, 2003.
 26. Kim HS, Park SC, Jung MH: A study on the relationship between malocclusion and the prevalence of temporomandibular disorder. *Journal of Korean Academy of Dental Technology* 35(3):231-242, 2013.
DOI : 10.14347/kadt.2013.35.3.231
 27. Bertoli FMP, Bruzamolín CD, Pizzatto E, Losso EM, Brancher JA, Souza JF: Prevalence of diagnosed temporomandibular disorders: A cross-sectional study in Brazilian adolescents. *PLOS ONE* 13(2): e0192254, 2018.
DOI : 10.1371/journal.pone.0192254
 28. Heo SY, Kim JS: Oral health factors related with the stress of adolescents. *Journal of Korean Society of Oral Health Science* 6(2):1-8, 2018.