

Assessment of Symptoms Associated with Temporomandibular Dysfunction and Bruxism among Elderly Population: An Epidemiological Survey

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ABSTRACT

Aim: The aim of the study was to assess the symptoms associated with temporomandibular disorders (TMD) and bruxism among elderly population in Ranchi, India.

Materials and methods: A cross-sectional study was done on 600 elderly subjects; data regarding the signs and symptoms associated with temporomandibular disorder and bruxism were recorded using both structured questionnaire and clinical examination. Spearman correlation analysis was done to find the association between TMD and bruxism.

Results: Out of 600 subjects, 49% were males and 51% were females. The overall prevalence of TMD-related symptoms like temporomandibular joint (TMJ) pain, difficulty in jaw opening, TMJ sounds, and bruxism were 10.5, 11.2, 14, and 17% among elderly subjects. TMD symptoms and bruxism were relatively more commonly seen among females when compared to males. According to logistic regression (significantly correlated independent variables, i.e., TMD symptoms among analyzed variables), the dependent variable like bruxism had highest odds ratio, i.e., 8 for 60–70 years age-group and 15.1 for 70–80 year age-group.

Conclusion: There was a lesser prevalence of symptoms related to TMD and bruxism among the study population, and bruxism had the highest odds ratio in TMD between the analyzed variables.

Clinical significance: Human aging contributes too many oral problems, while resolving these, the felt needs of the population are sometimes ignored which adds up to the growing list of issues. Studies have shown inconclusive evidence regarding the prevalence of symptoms related to TMD and bruxism as these are known to trouble elderly populations.

Keywords: Bruxism, Elderly population, Symptoms, Temporomandibular disorders.

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INTRODUCTION

Any deleterious oral habits often developed and found in humans are very important. It can have a big influence on both oral health and general health if not detected early in their life. One such deleterious habit seen among the population is bruxism. It was first described in the medical literature by *Marie Pietkiewicz* in 1907¹ and in the year 1931, *Frohman* gave the term “bruxism.”² The name bruxism is derived from the Greek word *brycheinâ*, which means to grind or gnash one’s teeth. Miller proposed a distinction between nocturnal tooth grinding, which he called bruxism, and chronic daily tooth grinding, which he called bruxomania.^{3,4} Ramfjord proposed the notion that occlusal variables caused bruxism in 1960, and he described bruxism as the habitual behavior of grinding teeth, while the individual is either chewing or swallowing. Clenching and grinding were separated in 1983, with clenching being classified as centric bruxism and grinding as eccentric bruxism. In the year 1995, Vanderas described bruxism as the unusable activity of the mandible throughout the day or overnight, with or without an audible sound.⁵ However, according to the most recent classification of sleep disorders, bruxism at night is now categorized as a sleep-related movement disorder.⁶

To date, three definitions of sleep bruxism have been provided by the American Academy of Sleep Medicine (AASM). For the third edition of the ICSD, a new definition of general bruxism was adopted: “a repeated jaw-muscle activity characterized by

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clenching or grinding of the teeth and/or bracing or thrusting of the mandible.” Bruxism is defined as “the para-functional grinding of the teeth; an oral habit consisting of involuntary rhythmic or spasmodic nonfunctional gnashing, grinding, or clenching of teeth, other than chewing movements of the mandible, which

may lead to occlusal damage," according to recent literature. Many neurotransmitters in the central nervous system appeared to influence bruxism, according to Lobbezoo and Naeije in 2001.^{7,8}

Many reports states that bruxism is more common with children, but there are studies which state that it increases during adolescences, more in middle age, and decreases with age progression. But some studies contradict this statement.^{9–12} Dentists are focused about bruxism because it causes a variety of dental problems. Bruxism has direct relation to the changes that occur in the masticatory muscles which often associated with discomfort and pain in the TMJ, along with difficulty in chewing, joint luxation, uncoordinated jaw movements, degenerative alterations in the joint, restricted/deviated mandibular movements and joint sounds and also end up in damage to tooth structure, fracture of restorative materials and other psychosocial issues. In the normal community, the prevalence varies from 8 to 31%.¹³ A review report of Achmud et al. states that the prevalence of bruxism ranges from 3.5 to 40.6% and has no tendency toward sex.^{14–19} The main cause of nondental pain in the orofacial region in population is TMD, which involves masticatory muscles, temporomandibular muscles, and related structures.^{20,21}

There is a general consensus of clicks as a result of the impact between the mandibular condyle and the temporal component of the TMJ after rapid passage through the posterior band of the disc joint.²² Crepitus is found in an advanced stage of TMJ disorders and is associated with degenerative conditions. Several studies have explained that sounds in TMJ often occur in population with TMJ disorders.^{23,24} According to many reports across the globe, the symptoms of TMD are very common, but with aging population, they are confusing as few reports show increasing prevalence among 50–60 years. Also, there is sex predilection with females dominating. The literature's inconclusive results regarding TMD symptoms and bruxism in older adults prompted this research. Therefore, the aim of this study was to evaluate the prevalence of symptoms associated with TMD and bruxism among elderly population.

MATERIALS AND METHODS

Study Design

This was a cross-sectional study design, where it evaluated the symptoms related to TMD and bruxism among elderly population aged 60 years and above residing in Ranchi, eastern India. The scientific and ethical aspects of the protocol were reviewed and approved by the concerned review board, and necessary clearance was obtained. All the participating elderly populations were made aware of the nature and aim of the investigation, and written informed consent was obtained prior to data collection. The survey was carried out over a period of 6 months, starting from June 2019 to November 2019.

Sample Selection

The study areas were geographically divided into six zones, and from each zone, a total of 100 samples were selected. This was a household survey, and only those residents with names enlisted in the electoral list were recruited for the study confirming their residence. Once around 100 subjects from a particular zone were interviewed and examined, the next zone was sought.

A total of 600 subjects constituted the study population. The sample size was estimated to be around 600 using following parameters: precision of 5% and design effect of 1 at alpha error of 5%. For data collection, a convenience sampling technique

was employed. Subjects with debilitating systemic diseases or neurological disorder, physical difficulties, and those who did not consent were excluded from the study.

Data Collection

A pilot survey was undertaken to test the feasibility of the study including the assessment of clarity, validity, and applicability of the questionnaire for recording general information, and evaluation of symptoms associated with TMD symptoms, like TMJ pain, TMJ sounds, and difficulty in opening the mouth, and bruxism was assessed among them. All necessary corrections were made. The examinations were carried out by the principal investigator himself. The investigator was calibrated by the senior expert for assessing the symptoms related to TMD and bruxism. The kappa co-efficient value for intra-examiner reliability for symptoms related to TMD (like TMJ pain, TMJ sounds, and difficulty in opening the mouth) and bruxism was 0.94, 0.97, 0.93, and 0.99, respectively. The values reflect high degree of conformity in observations. A specially prepared and pretested format (questionnaire) with four simple questions was exclusively designed for recording all the required and relevant general information and clinical findings by means of personal interview and examination by the qualified examiner. Symptoms like TMJ pain, difficulty in jaw opening, and TMJ sounds associated with TMD and grinding/clenching of teeth associated with bruxism were evaluated. Four responses, i.e., no problems, some, rather great, and severe, were included.²⁵ Also, clinical examination was also performed to confirm the TMD and bruxism.

Joint Sound Analysis

Unfortunately, joint sounds were analyzed by occurrence of a click/pop and crepitus through lateral and dorsal extra-auricular examination. Digital palpation of both TMJs was performed along with auscultation by stethoscope with diaphragm end-piece. Digital palpation is valuable in detection of irregular TMJ movements due, for instance, to displacement of the disc. The participants were asked to open and close their mouth several times to detect the presence or absence of joint sounds and to classify their type. Each subject performed the different movements at least three times. When signs were detected by auscultation, the subject was classified as positive for joint sounds.

Assessment of Bruxism

Elderly population was assessed for signs and symptoms of bruxism based on the criteria from American Academy of Sleep Medicine and Clinical examination of subjects for incisal and/or occlusal tooth wear. All aseptic precautions were employed prior, during, and postexamination procedure. A total of 25–30 subjects were interviewed and examined on any given scheduled day of survey, and duration of data collection for each subject ranged from 5 to 10 minutes.

Statistical Analysis

The data obtained were coded and entered into the excel sheet. This was later transferred to the Statistical Package for Social Sciences (SPSS) software version 18, which was used for statistical analysis with the significance level set at 5%. Logistic regression was used in conjunction with a Spearman correlation analysis to see whether there was any link between TMD-related symptoms and various background variables.²⁵

RESULTS

The data obtained from the study were subjected to statistically analysis. Demographic characteristics of the study population are shown in Table 1. In the present study, a total of 600 subjects constituted the study population, of which 49% were males and the rest 51% were females. The age of the subjects ranged between 60.2 and 74 years, and the mean age-group was 68.4. A majority of 63.8% belonged to 60–70 years category, and 36.2% belonged to 70–80 years category.

Symptoms related to TMD and bruxism are shown in Table 2. Majority of the responders were not aware of any TMD-related problems, like TMJ pain (89.5%), difficulty in jaw opening (88.8%), and TM joint sounds (86%), and bruxism, i.e., grinding/clenching of teeth (83%). However, there was evident difference between the sex among both 60–70 and 70–80 years categories which showed higher prevalence of TMD-related problems among females. TMJ pain was seen among 10.5% of the total study population. It was more seen among females, 13 and 12% among 60–70 years category and 70–80 years category, respectively. Difficulty in jaw opening was also assessed, which showed an overall 11.2% prevalence. Similarly, to TMJ pain, difficulty in jaw opening was also seen more among females with 15.5 and 11.9% among 60–70 years category and 70–80 years category, respectively. And lastly, regarding TM

joint sounds, an overall 14% of the study subjects were affected. It was seen more among females with 17 and 13% among 60–70 years category and 70–80 years category, respectively. When bruxism was evaluated, i.e., grinding/clenching of teeth, an overall 17% of the study subjects had some form of severity related to the bruxism. Bruxism was more common among women in both age-groups and was more predominant among those aged 70–80.

Table 3 shows the cross-tabulation of difficulty in opening the mouth wide and TMJ pain with TM joint sounds. The percentage of positive answers for pain in the TMJ region and difficulty in opening the jaw wide for both 60–70 and 70–80 years categories who said *yes* (i.e., some, rather many, and greater problems) was greater when compared to those who answered *no*. The results were compared between *yes* and *no* for all four comparisons, i.e., for problems to open the jaw wide and pain in TMJ region for both 60–70 and 70–80 years categories, and were statistically significant with $p < 0.05$.

Table 4 shows the cross-tabulation of symptoms related to TMD and bruxism. The percentage of positive answers for difficulty in opening the mouth broadly, discomfort in the TMJ region, and TMJ noise issues for both 60–70 and 70–80 years categories who said *yes* (i.e., some, rather many, and greater problems) was greater when compared to those who answered *no*. The results were compared between *yes* and *no* for all six comparisons, i.e., for difficulty in opening the mouth broadly, discomfort in the TMJ region, and TMJ noise issues for all 60–70 and 70–80 years categories, and were statistically significant with $p < 0.05$.

According to logistic regression, Table 5 indicates the substantially interrelated explanatory variables. The variable was the following: (a) individuals having occasional or no symptoms of TMD and (b) persons who have a severe or moderate TMD symptom. In both age-groups, bruxism showed highest odds ratio of 8 and 15.1 for 60–70 and 70–80 years categories, respectively. While other variables did not show odds ration above 3 except for dry mouth which was 3.2.

Table 1: The distribution of the study population according to the age and gender

Age	Gender		Total
	Male	Female	
60–70 years	191 (31.8%)	192 (32%)	383 (63.8%)
70–80 years	103 (17.2%)	114 (19%)	217 (36.2%)
Total	294 (49%)	306 (51%)	600 (100%)

Table 2: The distribution of the symptoms associated to temporomandibular disorder with bruxism among the study population

Symptoms related to TMD and bruxism	Category	Age						Total
		60–70 years			70–80 years			
		Male	Female	Total	Male	Female	Total	
TMJ pain	No	90.9%	87%	89%	92%	88%	90%	89.5%
	Yes	9.1%	13%	11%	8%	12%	10%	10.5%
Difficulty in jaw opening	No	90.7%	84.5%	87.6%	92%	88.1%	90%	88.8%
	Yes	9.3%	15.5%	12.4%	8%	11.9%	10%	11.2%
TM joint sounds	No	87.2%	83%	85.1%	87%	87%	87%	86%
	Yes	12.8%	17%	14.9%	13%	13%	13%	14%
Grinding/clenching of teeth (bruxism)	No	83%	77%	80%	87.9%	84%	86%	83%
	Yes	17%	23%	20%	12.1%	16%	14%	17%

Table 3: The descriptive statistic (percentage) of positive responses to two questions about TMD-related symptoms to TMJ noises in two age-groups

Difficulty with TMJ sounds	Difficulty in opening the jaw wide ^a		TMJ-related pain ^a	
	60–70 years age group (n = 375)	70–80 years age group (n = 212)	60–70 years age group (n = 374)	70–80 years age group (n = 210)
Yes ^a	37.8	36.2	42.5	38.8
No ^b	6.6	5.7	5.2	4.3

^aThere are a few, fairly numerous, and significant issues; ^bAll four comparisons between *yes* and *no* are considerably different ($p < 0.05$)

Table 4: The percentage of positive responses to three questions on severe TMD-related symptoms to bruxism in two age-groups

	Difficulty in opening the jaw wide ^a		TMJ-related pain ^a		Difficulty with TMJ sounds ^a	
	60–70 years age-group (n = 374)	70–80 years age-group (n = 212)	60–70 years age-group (n = 373)	70–80 years age-group (n = 210)	60–70 years age-group (n = 372)	70–80 years age-group (n = 210)
Yes ^a	25.2	28.2	29.0	27.1	29.1	33.1
No ^b	7.3	6.8	6.1	5.9	10.3	9.2

^aThere are a few, fairly numerous, and significant issues; ^bAll six comparisons between yes and no are considerably different ($p < 0.05$)

Table 5: Substantially connected independent variables

Age-group	Sig.	OR	95% CI for OR	
			Lower	Upper
60–70 years				
Chewing problems	0.05	1.8	1.3	2.6
Burning mouth	0.001	2.7	1.2	3.1
Altered taste	0.001	1.6	1.4	2.9
Bruxism	0.05	8.0	5.2	11.1
Problems with dental materials	0.05	2.0	1.2	2.6
Sensitivity of teeth	0.05	1.8	1.2	2.3
70–80 years				
Toothache during last 3 months	0.05	2.5	1.1	3.9
Bruxism	0.001	15.1	7.6	20.4
Dry mouth	0.001	3.2	1.6	5.9
Avoid dental treatment because of high expenditure	0.001	2.9	1.3	5.2

The variables used in this study were as follows: 1. People who have TMJ pain, difficulty in mouth opening, or clicking/joint sounds on a regular or infrequent basis ($n_{60-70} = 369$; $n_{70-80} = 217$); 2. People experiencing severe or moderate TMD discomfort, opening difficulty, or clicking/joint sounds ($n_{60-70} = 16$; $n_{70-80} = 7$)

DISCUSSION

Epidemiological literature on oral health in the elderly is not very encouraging, and it indicates profound imbalances among countries and regions and as a function of institutionalization. This disparity is attributed to many causes and in the availability of and access to oral health care services.^{26,27} Geriatric population was the target group in this study, and they carry a lot of oral health burden with age passing by. The disintegration of physiological use of oral structure is quite natural and invites many health issues if not taken care at times. And in a country like India, where general health service availability is not adequate, the state of oral health services is quite debatable. Most of the studies are conducted on children and younger generations as they consider bruxism to be seen more among younger population but this will not eliminate the fact that it will never occur in old age-group.

Understanding temporomandibular complexity is quite challenging for many clinicians. It may be reasoned that structural complexity, complex mechanism involved, known wearing, and tearing with the physiological use and complex pathophysiology makes the matter sensitive. Relatively some of the known signs and symptoms justify the problems associated with this structure. Symptoms like temporomandibular pain, difficulty in jaw opening, and temporomandibular joint sounds were considered for assessment of temporomandibular disorders, but there are many

other signs and symptoms associated with TMD, and all this clearly warrants a differential diagnosis for better understanding of TMD problems.

The present study showed relatively low prevalence of symptoms associated with TMD and bruxism in both 60–70 and 70–80 years categories. Many earlier studies of elderly people conducted all around the world have found similar results of low prevalence of TMD symptoms and bruxism as this one. However, studies done by LeResche,²⁸ Carlsson and LeResche,²⁹ and De Leeuw³⁰ have shown higher prevalence of TMD symptoms and bruxism among younger generations.

Prevalence of symptoms of TMD among 70-year-old Swedish population³¹ and 76- to 86-year-old Finish population³² was 13 and 14%, respectively, while in our study, it varied overall between 10.5 and 14% for symptoms of TMD like TMJ pain, difficulty in jaw opening, and TM joint sounds. It can be justified that reasons like aging, edentulism, trauma, pathological conditions, loss of teeth as a result of dental caries, and periodontal problems all add up to higher prevalence among females. The age-group, i.e., 70–80 years, reported fewer symptoms of TMD than the age-group, i.e., 60–70 years; the differences were minor, particularly among males. The expectation that the older population would have a lower prevalence of TMD symptoms than the younger group was partially confirmed.

Bruxism prevalence or grinding/clenching of teeth was around 17% which was similar to the reports of Unell et al. It included responses like some, rather great, and severe. These finding were commonly found to be more among females when compared to males. It can be justified that in Indian scenario, lower socioeconomic status, stressful lifestyles, dependency, lack of awareness, and poor education in this part of the region all add to the complexity of the problem. Also, differential diagnosis was not made for general wear and tear of the teeth due to physiological chewing phenomenon.

In this study, the association between different symptoms of TMD was assessed and there was significant association existing between problems of TMJ sounds who said yes to when compared to difficulty in opening the jaw wide and pain in the TMJ region who said no problems with TMJ sounds. Many researches among teenagers and young adults have already revealed and explored this type of link between distinct TMD symptoms.³⁷ This being cross-sectional study, it is difficult to assess the association as they may have other problems like osteoarthritis/osteoarthritis

or other bone disorders commonly seen in old age.^{38,39} This helps to explain the data above, as well as the fact that joint clicking rarely leads to locking or other serious difficulties, as evidenced by several longitudinal studies;^{40,41} furthermore, no distinction was made between different forms of internal TMJ derangements that led to this condition. It can also be noted from many recent studies that prognosis of each individual differs and the need for other diagnosis can be warranted amid different forms of internal TMJ derangement.⁴² Because of the study design, no different types of TMJ noises could be elicited. According to the findings, further investigation of other suspected TMD symptoms should be encouraged.

Bruxism patients had a substantially higher prevalence of TMD symptoms than nonbruxism patients (25.2–33.1%). Physiological and habitual grinding of teeth resulting in loss of vertical height, exhaustion of masticatory muscles resulting in pain, degenerative changes in TMJ, and altered sounds because of degenerative changes all adds up to the existing problems.

Individual variables and dependent variables were further evaluated using logistic regression by further dichotomization. Bruxism had much greater odds ratio, i.e., 8 for 60–70 years category and 15.1 for 70–80 years category for symptoms associated with TMD. This conclusion bolsters the evidence for a link between bruxism and TMD symptoms and supports the findings of several research done by Johansson et al.,³³ Johansson et al.,³⁶ Osterberg et al.,³⁸ Carlsson et al.,⁴³ and Ahlberg et al.⁴⁴ However, many other studies have questioned bruxism to be a major risk for TMD and orofacial pain.^{45–48}

Limitation of the study can be further improved by many well-designed longitudinal multicentric studies to further substantiate the association between symptoms of TMD and bruxism, and also, the concept of multifactorial etiology has opened the Pandora box of TMD and bruxism sciences.

CONCLUSION

It can be concluded from present study that symptoms related to TMD and bruxism were seen in less than 17% of the elderly population in both 60–70 and 70–80 years age-group. It was seen affecting more among females when compared to males. Older age-group (70–80 years) reported lesser TMD symptoms and bruxism than younger age-group (60–70 years); however, the differences were very small. In both the age-groups, subjects who reported bruxism had a significantly higher prevalence of TMD symptoms than those who did not report bruxism. Bruxism had the highest odds ratio of 8 and 15.1 among 60–70 and 70–80 years for TMD symptoms among the analyzed variables.

REFERENCES

1. Marie MM, Pietkiewicz M. La Bruxomania [Bruxism]. *Rev Stomatol* 1907;14:107–116.
2. Frohman BS. Application of psychotherapy to dental problems. *Dent Cosmet* 1931;73(11):1117–1122.
3. Kanathila H, Pangi A, Poojary B, et al. Diagnosis and treatment of bruxism: concepts from past and present. *Int J Appl Dent Sci* 2018;4(1):290–295.
4. Varalakshmi Reddy S, Praveen Kumar M, Sravanthi D, et al. Bruxism: a literature review. *J Int Oral Health* 2014;6(6):105–109. PMID: 25628497.

5. Vanderas AP, Manetas KJ. Relationship between malocclusion and bruxism in children and adolescents: a review. *Pediatr Dent* 1995;17(1):7–12. PMID: 7899111.
6. Krishna Prasad D, Swaminathan AA, Anupama Prasad D. A review of current concepts in bruxism—diagnosis and management. *Nitte Univ J Health Sci* 2014;4(4):129–136. DOI: 10.1055/s-0040-1703852.
7. Lobbezoo F, Naeije M. Bruxism is mainly regulated centrally, not peripherally. *J Oral Rehabil* 2001;28(12):1085–1091. DOI: 10.1046/j.1365-2842.2001.00839.x.
8. Mayorquim MV, Filho IJZ, de Araujo TSB, et al. Pediatric bruxism: from etiology to treatment: a review. *Acta Sci Dent Sci* 2018; 2(3):17–20.
9. Achmud H, Wahyuni S, Ramadhany YF. A review the relationship of bruxism with temporo-mandibular disorders in children. *Sys Rev Pharm* 2020;11(6):136–142.
10. Alves CL, Fagundes DM, Soares PBF, et al. Knowledge of parents/ caregivers about bruxism in children treated at the pediatric dentistry clinic. *Sleep Sci* 2019;12(3):185–189. DOI: 10.5935/1984-0063.20190083.
11. Reis LO, Ribeiro RA, Martins CC, et al. Association between bruxism and temporo-mandibular disorders in children: a systematic review and meta-analysis. *Int J Pediatr Dent* 2019;29(5):585–595. DOI: 10.1111/ipd.12496.
12. Lobbezoo F, Ahlberg J, Raphael KG, et al. International consensus on the assessment of bruxism: report of a working progress. *J Oral Rehabil* 2018;45(11):837–844. DOI: 10.1111/joor.12663.
13. Manfredini D, Winocur E, Guarda Nardini L, et al. Epidemiology of bruxism in adults: a systematic review of literature. *J Orofac Pain* 2013; 27(2):99–110. DOI: 10.11607/jop.921.
14. Bader G, Lavigne GJ. Sleep bruxism: an overview of an oromandibular sleep movement disorder. *Sleep Med Rev* 2000;4(1):27–43. DOI: 10.1053/smr.1999.0070.
15. Manfredini D, Restrepo C, Diaz-Serrano K, et al. Prevalence of sleep bruxism in children: a systematic review of the literature. *J Oral Rehabil* 2013;40(8):631–642. DOI: 10.1111/joor.12069.
16. Carra MC, Huynh N, Morton P, et al. Prevalence and risk factors of sleep bruxism and wake-time tooth clenching in a 7- to 17-yr-old population. *Eur J Oral Sci* 2011;119(5):386–394. DOI: 10.1111/j.1600-0722.2011.00846.x.
17. Murray GM, Peck CC. Orofacial pain and jaw muscle activity: a new model. *J Orofac Pain* 2007;21(4):263–278. PMID: 18018989.
18. Carrara SV, Conti PCR, Barbosa JS. Statement of the 1st consensus on temporo-mandibular disorders and orofacial pain. *Dental Press J Orthod* 2010;15(3):114–120. DOI: 10.1590/S2176-94512010000300014.
19. Raphael KG, Santiago V, Lobbezoo F. Is bruxism a disorder or a behavior? Rethinking the international consensus on defining and grading of bruxism. *J Oral Rehabil* 2016;43(10):791–798. DOI: 10.1111/joor.12413.
20. Arafa AF, Mostafa NM, Moussa SA. Assessment of associated with bruxism. *J Dent Oral Disord Ther* 2019;7(1):1–6.
21. Chauhan D, Kaundal J, Karol S, et al. Prevalence of signs and symptoms of temporo-mandibular disorders in urban and rural children of northern hilly state, Himachal Pradesh, India: a cross sectional survey. *J Commun Health* 2013;4(1):21–25. DOI: 10.4103/2155-8213.110182.
22. Farsi NM. Symptoms and signs of temporo-mandibular disorders and oral para functions among Saudi Children. *J Oral Rehabil* 2003;30(12):1200–1208. DOI: 10.1111/j.1365-2842.2003.01187.x.
23. Castelo PM, Gaviao MB, Pereira LJ, et al. Relationship between oral parafunctional/nutritive sucking habits and temporomandibular joint dysfunction in primary dentition. *Int J Paediatr Dent* 2005;15(1):29–36. DOI: 10.1111/j.1365-263X.2005.00608.x.
24. Barbosa Tde S, Miyakoda LS, Pocztaruk Rde L, et al. Temporomandibular disorders and bruxism in childhood and adolescence: review of the literature. *Int J Pediatr Otorhinolaryngol* 2008;72(3):299–314. DOI: 10.1016/j.ijporl.2007.11.006.
25. Unell L, Johansson A, Ekback G, et al. Prevalence of troublesome symptoms related to Temporo-mandibular disorders and awareness

- of bruxism in 65- and 75-year-old subjects. *Gerodontology* 2012;29:e772–e779. DOI: 10.1111/j.1741-2358.2011.00558.x.
26. Patersen PE, Kandelman D, Arpin S, et al. Global oral health of older people—call for public health action. *Community Dent Health* 2010;27(4 Suppl. 2):257–267. PMID: 21313969.
 27. Thompson WM. Epidemiology of oral health conditions in older people. *Gerodontology* 2014;31 Suppl. 1:9–16. DOI: 10.1111/ger.12085.
 28. LeResche L. Epidemiology of temporo-mandibular disorders: implications for the investigation of etiologic factors. *Crit Rev Oral Biol Med* 1997;8(3):291–305. DOI: 10.1177/10454411970080030401.
 29. Carlsson GE, LeResche L. Epidemiology of temporo-mandibular disorders. In: Sessle BJ, Bryant PS, Dionne RA, editors. *Temporo-mandibular disorders and related pain conditions, progress in pain research and management*. vol. 4. Seattle: IASP Press, 1995. p. 211–226.
 30. De Leeuw R, editor. *Orofacial pain. Guidelines for assessment, diagnosis, and management*. Chicago: Quintessence; 2008. p. 132–133.
 31. Osterberg T, Carlsson GE. Relationship between symptoms of temporomandibular disorders and dental status, general health and psychosomatic factors in two cohorts of 70-year-old subjects. *Gerodontology* 2007;24(3):129–135. DOI: 10.1111/j.1741-2358.2007.00162.x.
 32. Schmidt-Kaunisaho K, Hiltunen K, Ainamo A. Prevalence of symptoms of cranio-mandibular disorders in a population of elderly inhabitants in Helsinki, Finland. *Acta Odontol Scand* 1994;52(3):135–139. DOI: 10.3109/00016359409027587.
 33. Johansson A, Unell L, Carlsson GE, et al. Differences in four reported symptoms related to Temporo-mandibular disorders in a cohort of 50-year-old subjects followed up after 10 years. *Acta Odontol Scand* 2008;66(1):50–57. DOI: 10.1080/00016350801922775.
 34. Wänman A. Longitudinal course of symptoms of craniomandibular disorders in men and women. *Acta Odontol Scand* 1996;54(6):337–342. DOI: 10.3109/00016359609003548.
 35. Dao TT, LeResche L. Gender differences in pain. *J Orofac Pain* 2000;14(3):169–195. PMID: 11203754.
 36. Johansson A, Unell L, Carlsson GE, et al. Gender differences in symptoms related to temporo-mandibular disorders in a population of 50-year-old subjects. *J Orofac Pain* 2003;17(1):29–35. PMID: 12756928.
 37. Magnusson T, Egermark I, Carlsson GE. A prospective investigation over two decades on signs and symptoms of Temporo-mandibular disorders and associated variables. A final summary. *Acta Odontol Scand* 2005;63(2):99–109. DOI: 10.1080/00016350510019739.
 38. Osterberg T, Carlsson GE, Wedel A, et al. A cross-sectional and longitudinal study of cranio-mandibular dysfunction in an elderly population. *J Craniomandib Disord* 1992;6(4):237–245. PMID: 1298758.
 39. Schmitter M, Rammelsberg P, Hassel A. The prevalence of signs and symptoms of temporo-mandibular disorders in very old subjects. *J Oral Rehabil* 2005;32(7):467–473. DOI: 10.1111/j.1365-2842.2005.01449.x.
 40. Wänman A, Agerberg G. Temporomandibular joint sounds in adolescents: a longitudinal study. *Oral Surg Oral Med Oral Pathol* 1990;69(1):2–9. DOI: 10.1016/0030-4220(90)90259-u.
 41. Könönen M, Waltimo A, Nyström M. Does clicking in adolescence lead to painful Temporo-mandibular joint locking? *Lancet* 1996;347(9008):1080–1081. DOI: 10.1016/s0140-6736(96)90280-9.
 42. Naeije M, Kalaykova S, Visscher CM, et al. Evaluation of the research diagnostic criteria for temporo-mandibular disorders for the recognition of an anterior disc displacement with reduction. *J Orofac Pain* 2009;23(4):303–311. PMID: 19888478.
 43. Carlsson GE, Egermark I, Magnusson T. Predictors of bruxism/orofacial parafunctions and tooth wear in subjects over a 20-year follow-up. *J Orofac Pain* 2003;17(1):50–57. PMID: 12756931.
 44. Ahlberg J, Savolainen A, Rantala M, et al. Reported bruxism and biopsychosocial symptoms: a longitudinal study. *Community Dent Oral Epidemiol* 2004;32(4):307–311. DOI: 10.1111/j.1600-0528.2004.00163.x.
 45. Lobbezoo F, Lavigne GJ. Do bruxism and temporo-mandibular disorders have a cause-and-effect relationship? *J Orofac Pain* 1997;11(1):15–23 (Review). PMID: 10332307.
 46. Kato T, Thie NM, Huynh N, et al. Topical review: sleep bruxism and the role of peripheral sensory influences. *J Orofac Pain* 2003;17(3):191–213. PMID: 14520766.
 47. Manfredini D, Lobbezoo F. Relationship between bruxism and temporomandibular disorders: a systematic review of literature from 1998 to 2008. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2010;109(6):e26–e50. DOI: 10.1016/j.tripleo.2010.02.013.
 48. De Boever JA, Carlsson GE, Klineberg IJ. Need for occlusal therapy and prosthodontic treatment in the management of Temporomandibular disorders. Part I. Occlusal interferences and occlusal adjustment. *J Oral Rehabil* 2000;27(5):367–379. DOI: 10.1046/j.1365-2842.2000.00574.x.