International Journal of Community Medicine and Public Health
Bhatia R et al. Int J Community Med Public Health. 2021 Jul;8(7):3371-3378
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20212590

Original Research Article

A hospital based case control study to explore the association between Bruxism and Cardiovascular diseases in Kangra region of Himachal Pradesh

Ragini Bhatia[1], Divya Nair H.[1], Mukul Kumar Bhatnagar[2], Saloni Sood[3], Praveen Kumar[4], Rajesh Chaudhary[5]*

[1]Department of Public Health, IIPH, Gandhinagar, Gujarat, India
[2]Department of Cardiology, Dr. RPGMC, Tanda, Himachal Pradesh
[3]Department of Anaesthesia, Pt. JLNGMC, Chamba, Himachal Pradesh
[4]Department of Dentistry, [5]Department of Surgery, Civil Hospital Nagrota Bagwan, Himachal Pradesh

Received: 23 April 2021
Revised: 30 May 2021
Accepted: 31 May 2021

***Correspondence:**
Dr. Rajesh Chaudhary,
E-mail: topgun.chaudhary@gmail.com

ABSTRACT

Background: Cardiovascular diseases (CVDs) have a huge social and economic impact all over the world. Therefore research needs to analyse emerging risk factors for CVDs. Bruxism is a health problem that has low prevalence in the community but may be associated with CVDs. It leads to poor oral health and significantly impacts the quality of life. Studies showing association of CVDs and Bruxism are sparse and, none in Indian context.
Methods: This study was conducted in two hospitals of Kangra region of Himachal Pradesh between the months of April 2020 to June 2020. Due to rising infection rates of COVID-19 cases, 160 patients were enrolled in the study and divided into two groups. 80 patients with a positive history for CVD were included as cases while another 80 patients without any known history for CVD were included in the control group. Self-reporting questionnaire and tooth wear index (TWI) were used as research instruments.
Results: An unadjusted odd's ratio of 2.43 (95% CI, 1.28-4.68) and p value of 0.0069, was found when only self-reported bruxism was taken into account. But when self-reporting of bruxism was combined with TWI, an unadjusted odd's ratio (logit OR) of 3.16 (95% CI, 1.66-6.21) and p value of 0.000529 was found, explaining that the odds of having CVD are 3.16 times higher in patients with bruxism than in those without bruxism.
Conclusions: Bruxism is significantly associated with cardiovascular diseases. More studies, with larger sample size are required to firmly establish the causative relationship between bruxism and CVDs.

Keywords: Bruxism, Cardiovascular diseases, Dental hygiene, Tooth wear index

INTRODUCTION

Bruxism is characterized by grinding of the teeth and is accompanied by clenching of the jaw. In 2018, a consensus statement was issued by Lobbezzo et al in which they included "Bracing" and "Thrusting" to the definition of bruxism and, also showed that bruxism is a centrally controlled phenomenon.[1] Sleep Bruxism (SB) is a masticatory muscle activity during sleep that is characterized as rhythmic (phasic) or non-rhythmic (tonic) and is not just a "movement" or "sleep" disorder in otherwise healthy individuals. Awake Bruxism (AB) is a masticatory muscle activity during wakefulness that is characterized by repetitive or sustained tooth contact.[2] A systematic review by Manfredini et al described the epidemiology of bruxism and, reported the prevalence of

AB to be 21-31.4%, whereas in the same review SB was noted to have a prevalence of 12.8±3.1%.[3]

According to International Classification of Sleep Disorders (ICSD), the clinical criteria for the classification of SB includes the presence of regular or frequent tooth-grinding sounds occurring during sleep; abnormal tooth wear consistent with the above reports of tooth grinding during sleep; transient morning jaw muscle pain or fatigue, temporal headache, and/or jaw locking upon awakening consistent with the above reports of tooth grinding during sleep.[2,4]

Tooth wear index (TWI) and patient's self-reported bruxism episodes are the most commonly used methods for assessment of bruxism clinically.[5] Self- reporting can include questionnaires regarding pain or soreness of the jaw muscles, headaches, lock jaw or his/her observation of grinding sounds at night/day. Definitive diagnosis of SB can only be achieved using electrophysiological tools. Laboratory-based polysomnography (PSG) allows for the detection of SB by recording the muscle activity of masticatory muscles. The exact aetiology of SB is ambiguous and, can be multifactorial in nature. In the past it was attributed to peripheral (morphological) factors including malocclusion and, occlusal interferences. Crowded teeth or high edge fillings etc. could be the reason for same.[6,7]

Eventually it was found that there was no correlation between anatomical/structural factors and bruxism events in SB patients.

Current literature suggests that SB is regulated centrally and, not peripherally.[1] Central factors could be grouped into pathophysiological and psychosocial factors. The link between SB and psychosocial factors such as chronic stress, was supported by the studies reporting elevated levels of urinary catecholamines in patients with SB.[8] Also, SB activity had been related to higher levels of perceived psychological stress and salivary cortisol.[9] A study found that people with higher body mass index (BMI) have higher chances of SB. Smoking, caffeine, alcohol, use of certain medications and, breathing problems could be considered as risk factors for SB. Obstructive sleep apnoea (OSA) syndrome is considered a risk factor for SB. People with type A personalities, reflux oesophagitis, depression or nocturnal frontal lobe epilepsy have higher odds of developing SB.[10]

According to WHO (World Health Organisation), cardiovascular diseases (CVDs) are a group of disorders of heart and blood vessels that could be caused by high blood pressure, smoking, diabetes mellitus, lack of exercise, high blood cholesterol, poor diet, obesity and excessive alcohol consumption.[11] Around 17.9 million people died from CVDs in 2016, which constituted a big chunk of nearly 31% of all global deaths. In 2016, the estimated prevalence of CVDs in India was 54.5 million. These diseases result in increased social and economic burden.[12] After many studies, it has now been proved that poor oral health is an established independent risk factor for CVD.[13] Therefore, bruxism can also be an emerging risk factor for CVD and, research is important to curb the mortality and morbidity due to this disease. The objective of this study was to explore possible association between bruxism and CVD and, to document other factors associated with CVD and bruxism.

METHODS

This hospital based study was conducted in two government hospitals of district Kangra namely, Dr. Rajendra Prasad Government Medical College, Tanda and Civil Hospital Nagrota Bagwan, after ethical clearance from institutional ethical committee.

Case-control study design was employed for this study. Through literature search, prevalence of bruxism was obtained and, formula was employed to calculate the sample size of 196, which included 98 cases and 98 controls in the study group. 1:1 ratio for cases and controls was taken. It was also checked through Epi info software (version 7.2.4.0). The sample size was restricted to 160 due to rising COVID-19 infections. 80 cases and 80 controls were included in this study.

Formula for case control studies is given in the equation.[14]

$$\text{Sample size} = \frac{[(r+1)\,(p^*)(1-p^*)(Z_\beta + Z\alpha_{/2})^2}{r\,(p_1-p_2)^2}$$

In the above equation, r=ratio of control to cases; p*=average proportion exposed=proportion of exposed cases and proportion of control exposed divided by 2; Z_β=standard normal variate for power=for 80% power it is 0.84 and for 90% value is 1.28; $Z_{\alpha/2}$=level of significance, p_1=proportion of cases, p_2=proportion of controls according to previous studies.

Inclusion criteria

Patients aged between 35-70 years attending cardiology or medicine outpatient department (OPD) of the hospital who had a history of cardiovascular disease were included once they signed the informed consent for participation in the study.

Exclusion criteria

Patients who were pregnant, had a history of orthodontic therapy, other systemic pathologies except CVD, severe psychiatric disorders, conditions requiring antibiotic therapy, severe physical disabilities, diagnosed cases of malignancy, radiation therapy within last 12 months, patients on immunosuppressants, and who refused to give consent to participate in the study were excluded from the study.

Cases

All patients referred to the cardiology unit with previously diagnosed case for cardiovascular disease like, myocardial infarction, angina pectoris, stroke, heart failure, hypertensive heart disease, abnormal heart rhythms, congenital heart disease, valvular heart disease, carditis, rheumatic heart disease, cardiomyopathy, aortic aneurysms, peripheral artery disease, thromboembolic disease, and venous thrombosis were considered in the case group.

Controls

Controls were taken from the medicine OPD of the same hospital and, comprised of the patients without positive anamnesis for CVDs who had come for treatment of other ailments.

After explaining the details of the study through participant information sheet, a signed informed consent was taken. The basic information and health status form was used to record the variables such as gender, age, weight, height, marital status, educational background, occupation, hypertension, tobacco consumption, smoking status, alcohol consumption, any heart disease and tooth wear index (TWI). Self-reporting questionnaire was given to the participant to know the awareness of the participant on bruxism episodes. All the patients included in this study received a complete dental check-up and they were clinically examined for Bruxism by means of TWI. TWI given by Smith and Knight given in (Table 1) is a generic index to measure the tooth wear and it ranges from 0 to 4 depending on the extension and depth of lost substance on different tooth surfaces.[15] A mean TWI value higher than 2, for 50% of the teeth especially the anterior teeth, defined the diagnosis of bruxism for a single patient. Self-reported bruxism that was reported by patients themselves or by their partners, was also taken into account. But in most of the cases the participants were unaware of grinding of teeth, even though their dentition showed signs of bruxism. Therefore results were shown for self-reporting bruxism, as well as combined with TWI scores.

For analysing the results for blood pressure, American Heart Association (AHA) guidelines for blood pressure were followed: normal- less than 120/80 mm Hg; elevated-systolic between 120-129 and diastolic less than 80; stage 1- systolic between 130-139 or diastolic between 80-89; stage 2- systolic at least 140 or diastolic at least 90 mmHg; and hypertensive crisis- systolic over 180 and/or diastolic over 120 mmHg.[16]

Poor oral health was assessed using decayed, missing and filled teeth criteria (DMFT), i.e. how many teeth were decayed, how many missing due to caries and, how many filled/restored due to caries.[18] All these numbers were added and a score was given. If 50% or more teeth were decayed, missing or filled, that participant was considered to have poor oral health.

Table 1: Smith and Knight tooth wear index.[15]

Score	Surface	Criterion
0	BLOI	No loss of enamel surface characteristics
	C	No change of color
1	BLOI	Loss of enamel surface characteristics
	C	Minimal loss of contour
2	BLO	Enamel loss just exposing dentine <1/3 of the surface
	I	Enamel loss just exposing dentine
	C	Defect less than 1 mm deep
3	BLO	Enamel loss just exposing dentine >1/3 of the surface
	I	Enamel loss and substantial dentine loss
	C	Defect less than 1-2 mm deep
4	BLO	Complete enamel loss, or pulp exposure or 2° dentine exposure
	I	Pulp exposure or 2° dentine exposure
	C	Defect more than 2 mm deep, or pulp exposure

Surface: B-buccal; L-lingual; O-occlusal; I-incisal; C-cervical

Table 2: BMI classification.[17]

Classification	BMI (kg/metre^2)
Underweight	Below 18.5
Normal	18.5 to 24.9
Overweight	25.0 to 29.9
Obesity	30.0 and above

Data analysis

Data was collected from April 2020 to June 2020. Results were separately analysed for self-reported bruxism and, bruxism combined with TWI. Pearson's Chi-square-test was performed to compare the proportion of bruxism between the CVD patients (cases) and non-CVD patients (controls). Logistic regression was performed to find out the association between CVDs and bruxism as well as other factors such as gender, age, alcohol consumption, tobacco consumption, BMI and, hypertension. The level of statistical significance was set at 0.05 for all analysis. Data analysis was done using R commander (version 4.0.0).

RESULTS

The population was normally distributed for cases and controls. The mean age of CVD patients was 62±11.8 years and the mean age of non-CVD patients was 58.9±11.15 years. Statistics for other variables are given in (Table 3). It shows that a larger number of CVD patients (81.5%) had a TWI score of 3 or more as compared to non CVD patients (56%). About 43% CVD patients were either overweight

or obese as compared to non CVD patients (30%). About 65% CVD patients had poor oral health as compared to non CVD patients (28%).

Table 3: Statistical values of other variables in CVD and non-CVD patients.

Variables	CVD patients N (%)	Non-CVD patients N (%)
Gender		
Males	42 (53)	44 (55)
Females	38 (47)	36 (45)
TWI score		
Score 0	2 (2.5)	5 (6.2)
Score 1	5 (6.2)	8 (10)
Score 2	8 (10)	22 (27.5)
Score 3	30 (37.5)	33 (41.25)
Score 4	35 (43.75)	12 (15)
Poor oral health	52 (65)	22 (28)
BMI status		
Normal	46 (57.5)	56 (70)
Obese	14 (18)	5 (6.2)
Overweight	20 (25)	19 (23.7)

Table 4 shows that out of 160 patients 57.5% patients had bruxism, which was more common among the male patients (54.3%). Bruxism was seen in about 34.5% overweight or obese patients as compared to non bruxists (41.5%). Hypertension was seen in 72.7% patients having bruxism as compared to non- bruxists (52.8%). Poor oral health was seen in 54.3% bruxists as compared to 33.8% non-bruxists. 89.1% bruxists had non office jobs. 41.3% smokers showed bruxism as compared to non bruxists (29.4%). Tobacco chewing was also slightly more common among bruxists (30.4%) as compared to non bruxists (29.4%).

Pearson's Chi square test was performed to see the association of bruxism (self-reported and, when combined with TWI score) and CVDs. Table 5 shows results for combined form of assessment of bruxism, when self-reported bruxism was combined with TWI; the p value is 0.00043, which shows that there is an association between bruxism and CVD.

Table 6 shows the results for self-reported bruxism with a p value of 0.0064, again proving that bruxism has an association with CVD.

Figure 1 shows that 52.5% of the test group (42 out of 80 cardiopathic patients) were diagnosed with bruxism that was self-reported. On the contrary, only 31.25% of the control group (25 out of 80 non-cardiopathic patients) presented self-reporting bruxism.

Figure 2 shows that when TWI was also combined to self-reported bruxism, 71.25% of CVD patients had positive history for bruxism and, 43.75% had bruxism in non-CVD patients.

Table 4: Descriptive statistical values with respect to bruxism.

Numerical summary	Bruxist N (%)	Non-bruxist N (%)
Total no. (160)	92 (57.5)	68 (42.5)
Gender		
Males (n=86)	50 (54.3)	36 (52.9)
Females (n=74)	43 (46.7)	31 (45.5)
BMI status		
Normal	60 (65.2)	39 (57.3)
Overweight	21 (22.8)	08 (11.7)
Obese	11 (11.9)	21 (30.8)
BP		
Normal	25 (27.1)	32 (47.0)
Stage 1 hypertension	32 (34.7)	22 (32.3)
Stage 2 hypertension	35 (38.0)	14 (20.5)
Poor oral health	50 (54.3)	23 (33.8)
Occupation		
Non-office	82 (89.1)	52 (76.4)
Office	10 (10.8)	16 (23.5)
Smoking status		
Smokers	38 (41.3)	20 (29.4)
Non-smokers	54 (58.6)	48 (70.5)
Tobacco		
Tobacco chewing	28 (30.4)	20 (29.4)
Not chewing tobacco	64 (69.5)	48 (70.5)

Table 5: Pearson's Chi square test for bruxism (combining TWI and self-reporting).

Exposure	With CVD	Without CVD	P value	X^2
Having bruxism	57 (71.25%)	45 (57.25%)	0.00043, df=1 $X^2_{(1)}$=12.37	12.37
Not having bruxism	23 (29.75%)	35 (43.75%)		

Table 6: Pearson's Chi square test for self-reported bruxism.

Exposure	With CVD	Without CVD	P value	X^2
Having self-reported bruxism	42 (52.5%)	25 (31.2%)	0.0064, df=1 $X^2_{(1)}$=7.42	7.42
Not having self-reported bruxism	38 (47.5%)	55 (68.8%)		

Logistic regression to see the association of CVD with bruxism and various variables is given by the following.

$$Code = GLM\ (formula = GLM\ (formula = D{\sim}bruxism\ status + gender + BP + poor\ oral\ health + BMI.status, family = binomial\ (logit))$$

Here the dependent variable is CVD.

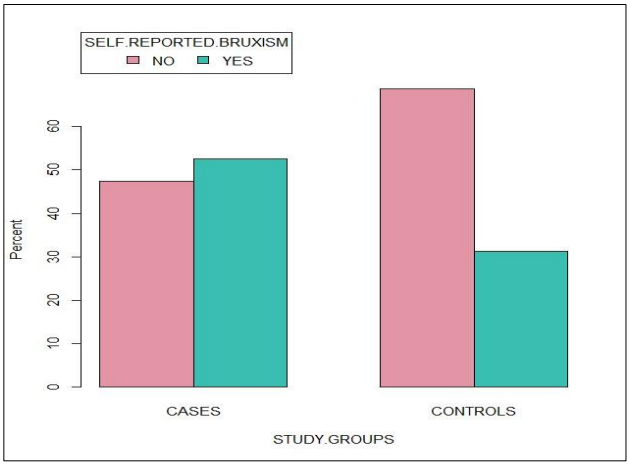

Figure 1: Self-reported bruxism in cases and controls.

After reordering the variables correctly and performing generalized linear regression model, it was found that bruxism, obesity, poor oral health and, BP were significant variables ($p<0.05$). Table 7 shows an un-adjusted odds ratio of 3.16 when self-reported bruxism was combined with TWI. An unadjusted odds ratio of 2.43 for self-reported bruxism was found. This means that the odds of having CVD are 2.43-3.16 times higher for patients having bruxism than those without bruxism.

After adjusting for gender, blood pressure, poor oral health and BMI, Table 8 concludes: an odds ratio of 2.60 was obtained, which means odds of having CVD are 2.60 times higher in patients with bruxism than patients without bruxism keeping other variables constant; as compared to normal BP patients, patients with stage 1 hypertension have 5.22 times higher odds of having CVD, keeping other variables constant; as compared to normal BP participants, patients with stage 2 hypertension have 7.85 times higher odds of having CVD, keeping other variables constant; as compared to good oral health, patients with poor oral health have 3.4 times higher odds for having CVD, keeping other variables constant; and the obese patients have 4.5 times higher odds of having CVD as compared to normal blood pressure patients, keeping other variables constant.

$$Odds\ of\ having\ CVD = 0.081 + 2.607\ bruxism\ status + 5.22\ BP(stage\ 1) + 7.85\ BBP(stage\ 2) + 3.4\ poor\ oral\ health(yes) + 4.5\ BMI(obese)$$

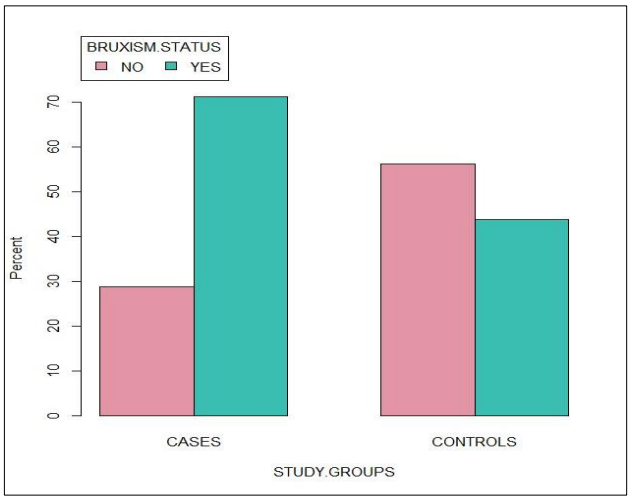

Figure 2: Bruxism status (TWI combined with self-reported) in cases and controls.

The variables of age, gender, occupation, educational status, overweight and, smoking status were found to be insignificant ($p>0.05$) showing no association with the disease.

Table 7: Table for logistic regression for unadjusted odds ratio.

Independent variables	Unadjusted odds ratio	P value	95% CI
Bruxism status (1=yes, 0=no)	3.16	0.000529	1.66 to 6.21
Bruxism status (self-reported) (1=yes, 0=no)	2.43	0.0069	1.28 to 4.68
Gender (1=male, 0=female)	00.90	0.751	0.55 to 1.98
Blood pressure (1=stage 1, 0=normal)	6.023	0.000023	2.66 to 14.38
Blood pressure (1=stage 2, 0=normal)	10.32	0.00000036	4.33 to 26.26
Poor oral health (1=yes, 0=no)	5.07	0.0000024	2.38 to 9.41
BMI (1=overweight, 0=normal)	1.3	0.46	0.51 to 3.40
BMI (1=obese, 0=normal)	4.37	0.0142	1.40 to 19.53

Table 8: Table for logistic regression for adjusted odds ratio.

Independent variables	Adjusted odds ratio	P value	95% CI
Bruxism status (1=yes, 0=no)	2.607	0.016	1.20 to 5.80
Gender (1=male, 0=female)	0.790	.5564	0.35 to 1.72
Blood pressure (1=stage 1, 0=normal)	5.22	0.00053	2.10 to 13.80
Blood pressure (1=stage 2, 0=normal)	7.85	0.000054	2.97 to 22.26
Poor oral health (1=yes, 0=no)	3.41	0.00171	1.59 to 7.45
BMI (1=overweight, 0=normal)	1.47	0.38989	0.61 to 3.60
BMI (1=obese, 0=normal)	4.52	0.02485	1.30 to 19.23

Continued.

DISCUSSION

This observational study was done to find an association between Bruxism and CVDs. Atilgan and co-workers reported an association between bruxism and intima media thickness of the bilateral carotid arteries.[19] They included 120 patients with a male: female ration of 1.2:1. Our study included 160 patients with a male: female ratio of 1.1-1.2:1. They used the carotid B-mode ultrasonography to measure the thickness of intima media and found that it is increased due to atherosclerosis and hence poses a risk for heart failure. It was found to be proportional to bruxism status. Our study agrees with the results of Atilgan et al reporting a greater prevalence of bruxism among patients with a positive history for cardiovascular disease. Nashed and co-workers studied the association between SB and high blood pressure.[20] They found that there was a significant rise in blood pressure during repeated masticatory muscle activity (RMMA) in bruxism patients at night. Bruxism resulted in increased systolic and diastolic blood pressures. However, the sample size of study was small and they couldn't say if this BP rise was due to RMMA/SB, associated arousal, body movements, a combination of these events or, an unidentified factor. A similar study was conducted by Martinowicsz et al to assess the severity of SB in patients with hypertension.[2] They enrolled 70 patients, 35 cases and 35 controls. They used home portable cardiorespiratory ploysomnography for data collection. They found that the Bruxism Episode Index (BEI) was higher in the study group (hypertensives) than the control group (without hypertension). This might be due to the increased sympathetic activity in hypertension and SB. Thus the hypertension present in CVD patients may be the result of bruxism activity or vice-versa. Hypertension (both systolic and diastolic) was found more prominent in patients having bruxism. This shows that bruxism, CVDs and hypertension, all are co-related. These findings were confirmed in present study which showed that, As compared to normal BP patients, patients with stage 1 hypertension have 5.22 times higher odds of having CVD and, patients with stage 2 hypertension have 7.85 times higher odds of having CVD. The patients who had bruxism also showed more prevalence of smoking and tobacco chewing. This is in congruence to studies from past, which gave the similar results and stated that, stress lead to adopting harmful habits and thus, leading to bruxism.[10] Another study that agrees with the results of the present study was done by Marthol et al, which stated that autonomic cardiovascular control is impaired in hypertension, that leads to a reduction in the parasympathetic tone and, an increase in the sympathetic tone.[21] To assess sympathetic cardiac activity in bruxism patients, they monitored cardiac autonomic modulation using spectral analysis of heart rate variability and compared results to those of age-matched healthy participants. In bruxism patients, sympathetic cardiac activity was found to be higher than in volunteers. The higher sympathetic tone means a higher stress which may be related to bruxism. There is a study by Marconcini et al which was similar to the current study, where they compared the prevalence of bruxism among patients having cardiac disease and patients without cardiac disease. They enrolled 120 patients and divided them into cardiopathic and non-cardiopathic groups of 60 each. They concluded that cardiopathic patients were 3.24 times more likely to be suffering more from bruxism as compared to non-cardiopathic patients.[5] Similarly our study found out that odds of having CVD were 2.6 times higher in people with Bruxism as compared to people without bruxism. Another finding was that patients having positive history for bruxism had poor oral health. Similar findings are confirmed in present study which showed that, as compared to patients having good oral health, patients with poor oral health have 3.4 times higher odds for having CVD. Few studies are reported to prove this association but studies by Nakayama et al, Hanamura and Souza et al showed correlation between bruxism with poor oral health and, poor oral health related quality of life.[22-24] Batty et al conducted a review of 975,685 patients from the Korean cancer prevention study.[25] They found out smoking to be linked to poor oral health and an increased risk of coronary heart disease. A statement by AHA suggested that poor oral health whether assessed clinically or self-reported is related to an elevated risk of coronary heart disease.[26] A study found that people with higher BMI have increased amount of circulating catecholamines, hypertension and increased sympathetic over activity thus having a predilection for SB.[27]

In the present study bruxism was more common in overweight patients as compared to obese patients but both CVD and Bruxism were higher in patients with higher BMI. We found that obese patients have 4.5 times higher odds of having CVD as compared to normal BMI patients. Therefore this study is in congruence with the previous studies on association of bruxism and CVD.

This study has some limitations. This study was based on self-reporting of bruxism by the patients which can be faulty and under-reported usually due to sheer neglect, stigma, lack of knowledge and awareness about bruxism. In this study, polysomnography was not used for the assessment of bruxism which is a gold standard for the diagnosis of sleep bruxism. It is an observational study conducted in hospital settings with a small sample size which may affect the power of study.

CONCLUSION

This study showed that the prevalence of bruxism is significantly greater in CVD patients as compared to non CVD patients. Association was more profound in relation to TWI as compared to self-reporting of bruxism, which is reported by a limited number of participants. This may be due to the fact that patients have negligible knowledge/information on bruxism and its signs and symptoms. People consider it a social stigma, an embarrassment and, dental health means only being free of toothache/ dental caries. Co-morbidities, old age or living alone, unawareness and, self-neglect may also be reasons for poor self-reporting of bruxism. Larger population based studies like cohort studies, involving polysomnographic studies are required to prove a causative relationship between bruxism and CVDs.

ACKNOWLEDGEMENTS

We would like to convey our heartfelt gratitude to Dr. Lokesh Chaudhary, Dr. Sanjay Kashyap, Dr. Ranjot Kaur, Dr. Gagandeep Acharya, Dr. Vysnavi Variyal and Dr. Vikrant Saini.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Lobbezoo F, Naeije M. Bruxism is mainly regulated centrally, not peripherally. J Oral Rehab. 2001;1085-91.
2. Martynowicz H, Dymczyk P, Dominiak M, Kazubowska K, Skomro R, Poreba R, Gac P, Wojakowska A, Mazur G, Wieckiewicz M. Evaluation of Intensity of Sleep Bruxism in Arterial Hypertension. J Clin Med. 2018;327.
3. Manfredini D, Winocur E, Guarda-Nardini L, Paesani D, Lobbezoo F. Epidemiology of Bruxism in Adults: A Systematic Review of the Literature. J Orofacial Pain. 2013;99-110.
4. Thorpy MJ. Classification of Sleep Disorders. Neurotherapeutics. 2012;687-701.
5. Marconcini S, Giammarinaro E, Cosola S, Giampietro C, Genovasi AM, Covani U, Giampietro O. Bruxism and Cardio Vascular Diseases: A Cross-Sectional Study. J Cardiol Ther. 2018;734-7.
6. Clark GT, Adler RC. A critical evaluation of occlusal therapy: occlusal adjustment procedures. J Am Dent Assoc. 1939;743-50.
7. Kato T, Thie NMR, Huynh N, Miyawaki S, Lavigne GJ. Topical review: Sleep Bruxism and the role of peripheral sensory influences. J Orofacial Pain. 2003;191-213.
8. Clark GT, Rugh JD, Handelman SL. Nocturnal Masseter Muscle Activity and Urinary Catecholamine Levels in Bruxers. J Dent Res. 1980;1571-6.
9. Karakoulaki S, Tortopidis D, Andreadis D, Koidis P. Relationship Between Sleep Bruxism and Stress Determined by Saliva Biomarkers. Int J Prosthodontics. 2015;467-74.
10. Lavigne GJ, Huynh N, Kato T. Genesis of sleep bruxism: Motor and autonomic-cardiac interactions. Arch Oral Biol. 2007;11:017.
11. World Health Organization. Cardiovascular diseases (CVDs). Available at: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds). Accessed on 27 April 2020.
12. Prabhakaran D, Jeemon P, Sharma M, Roth GA, Johnson C, Harikrishnan S, et al. The changing patterns of cardiovascular diseases and their risk factors in the states of India: the Global Burden of Disease Study 1990–2016. The Lancet Global Health. 2018;e1339-51.
13. Najafipour H, Mohammadi MT, Rahim F, Haghdoost AA, Shadkam M, Afshari M Association of Oral Health and Cardiovascular Disease Risk Factors "Results from a Community Based Study on 5900 Adult Subjects." ISRN Cardiol. 2013;1-6.
14. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med. 2013;121.
15. Smith BG, Knight JK. An index for measuring the wear of teeth. Br Dent J. 1984;156(12):435-8.
16. Whelton PK, Carey RM, Aronow WS. Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Hypertension. 2018;71:1269-324.
17. Dwyer JT, Melanson KJ, Sriprachy AU. Dietary Treatment of Obesity. In: Feingold KR, Anawalt B, Boyce A, editors. Endotext. South Dartmouth (MA): MDText.com, Inc. 2000.
18. Castro ALS, Vianna MIP, Mendes CMC. Comparison of caries lesion detection methods in epidemiological surveys: CAST, ICDAS and DMF. BMC Oral Health. 2018;18:122.
19. Atilgan Z, Buyukkaya R, Yaman F, Tekbas G, Atilgan S, Gunay A, Palanci Y, Guven S. Bruxism: is it a new sign of the cardiovascular diseases? Eur Rev Med Pharmacol Sci. 2011;1369-74.
20. Nashed A, Lanfranchi P, Rompré P, Carra MC, Mayer P, Colombo R, Huynh N, Lavigne G. Sleep

Bruxism Is Associated with a Rise in Arterial Blood Pressure. Sleep. 2012;529-36.
21. Marthol H, Reich S, Jacke J, Lechner KH, Wichmann M, Hilz MJ. Enhanced sympathetic cardiac modulation in bruxism patients. Clin Autonom Res. 2006;276-80.
22. Hanamura H, Houston F, Rylander H, Carlsson GE, Haraldson T, Nyman S. Periodontal Status and Bruxism. J Periodontol. 1987;173-6.
23. Nakayama R, Nishiyama A, Shimada M. Bruxism-Related Signs and Periodontal Disease: A Preliminary Study. Open Dentist J. 2018;400-5.
24. Camara-Souza MB, De Figueredo OMC, Rodrigues Garcia RCM. Association of sleep bruxism with oral health-related quality of life and sleep quality. Clin Oral Investig. 2019;245-51.
25. Batty GD, Jung KJ, Mok Y. Oral health and later coronary heart disease: A study of one million people. Eur J Prev Cardiol. 2018;25(6):598-605.
26. Lockhart PB, Bolger AF, Papapanou PN. Periodontal disease and atherosclerotic vascular disease: does the evidence support an independent association? A scientific statement from the American Heart Association. Circulation. 2012;125:2520-44.
27. Alvarez GE, Beske SD, Ballard TP, Davy KP. Sympathetic neural activation in visceral obesity. Circulation. 2002;2533-6.

Cite this article as: Bhatia R, Divya NH, Bhatnagar MK, Sood S, Kumar P, Chaudhary R. A hospital based case control study to explore the association between Bruxism and Cardiovascular diseases in Kangra region of Himachal Pradesh. Int J Community Med Public Health 2021;8:3371-8.