Original Research Article

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

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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 Lobbezoo 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

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
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.²⁴

Tooth wear index (TWI) and patient’s self-reported bruxism episodes are the most commonly used methods for assessment of bruxism clinically.³ 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.⁶⁷

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

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

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; \( Z_{\alpha} = \) standard normal variate for power=for 80% power it is 0.84 and for 90% value is 1.28; \( Z_{\beta} \) = 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/metre²) |
|----------------|-----------------|
| 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.
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 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 5: Pearson’s Chi square test for bruxism (combining TWI and self-reporting).

| Exposure        | With CVD     | Without CVD | P value | X² |
|-----------------|--------------|-------------|---------|----|
| Having bruxism  | 57 (71.25%)  | 45 (57.25%) | 0.00043, df=1 | 12.37 |
| Not having bruxism | 23 (29.75%) | 35 (43.75%) |          |    |

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

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

Here the dependent variable is CVD.

![Figure 1: Self-reported bruxism in cases and controls.](image1)

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.

![Figure 2: Bruxism status (TWI combined with self-reported) in cases and controls.](image2)

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)      | 0.90                  | 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   |
RESULTS

A total of 120 patients were included in the study. Among these, 35 patients were in the bruxism group (cases) and 85 were in the control group (non-bruxism). The mean age of the patients was 45 years, and the majority were male (70%). The majority of patients had stage 1 hypertension (60%).

The prevalence of bruxism was significantly higher in patients with stage 2 hypertension compared to those with stage 1 hypertension (P=0.00054). Similarly, patients with a poor oral health status had a higher prevalence of bruxism (P=0.00171). The presence of a positive history for cardiovascular disease was also found to be associated with bruxism (P=0.016).

The odds of having CVD increased 2.10 times in people with stage 2 hypertension, 5.22 times in people with stage 1 hypertension, and 7.85 times in people with a poor oral health status. Similar findings were observed for patients with a positive history for cardiovascular disease, where the odds of having CVD increased 2.6 times.

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. They included 120 patients with a male:female ratio 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 et al concluded that cardiopathic patients were 3.24 times more likely to be suffering more from bruxism as compared to non-cardiopathic patients.

Another study that reported is the relationship between bruxism and hypertension. They found out smoking to be related to an elevated risk of coronary heart disease. A statement by AHA suggested that poor oral health related quality of life.

The presence of bruxism was more common in patients having a positive history for cardiovascular disease and patients without cardiac disease. Few studies are reported to prove this association. A statement by AHA suggested that poor oral health related quality of life. 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.

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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.

**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 22.655|
| 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|

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. 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. 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.

Batty et al conducted a review of 975,685 patients from the Korean cancer prevention study. 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. 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.
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.

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