Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 8
Open Access

Level of Vitamin D Associated with Temporomandibular Disorder Patients in Dhaka, Bangladesh

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Cite this paper as: Ruman Banik, Md. Asaduzzaman, Md. Wares Uddin, Wahidujjaman, Ashik Abdullah Imon, Mahmudul Hasan, Md. Faridul Islam, Rubina Shrestha (2024). Level of Vitamin D Associated with Temporomandibular Disorder Patients in Dhaka, Bangladesh. *Frontiers in Health Informatics*, *13 (8) 6292-6301*

Abstract:

Background: Temporomandibular disorders (TMD) are a group of conditions affecting the temporomandibular joint (TMJ) and associated structures, often resulting in pain and dysfunction. Vitamin D deficiency has been implicated in various musculoskeletal disorders, yet its role in TMD remains unclear. ***Aim of the study:*** This study investigates the association between vitamin D levels and the presence of TMD. ***Methods:*** This cross-sectional study included 157 patients diagnosed with TMD. Demographic data, personal habits, comorbidities, and clinical symptoms were recorded. Serum vitamin D levels were measured, and OPG (orthopantomogram) imaging was performed. Statistical analysis was conducted to evaluate the relationship between vitamin D levels and TMD symptoms. ***Result:*** The majority of participants (69.42%) exhibited vitamin D deficiency (<20.00 ng/ml). TMD symptoms such as jaw mobility problems (72.61%), clicking sounds (70.70%), and pain (77.70%) were commonly reported. Abnormal OPG findings were observed in 95.54% of the subjects. Additionally, comorbid conditions like diabetes mellitus (19.74%) and smoking (25.48%) were prevalent in the study population. A significant association between low vitamin D levels and the presence of TMD symptoms was found. ***Conclusion:*** Our study suggests a significant association between low serum vitamin D

levels and temporomandibular disorder symptoms. These findings support the potential role of vitamin D in TMD pathophysiology, highlighting the need for further research to explore therapeutic interventions involving vitamin D supplementation for TMD patients.
Keywords: Vitamin D, Temporomandibular Disorder, Serum Levels, TMD Symptoms, Comorbidities, Jaw Pain, Orthopantomogram.

Introduction

Temporomandibular disorders (TMDs) are a diverse group of conditions affecting the TMJs, surrounding soft tissues, and supporting bones. These disorders can manifest in various ways, impacting one or more components, leading to a broad range of clinical presentations and varying degrees of severity [1, 2]. Elderly individuals are particularly susceptible to TMDs, which are often linked to age-related musculoskeletal conditions [3]. Chronic musculoskeletal pain, defined as pain lasting more than three months, is common in individuals aged 18 and older and significantly affects their quality of life, as noted by the World Health Organization's Bone & Joint Decade program [4]. Epidemiological studies have shown that about 5% of the general population is affected by clinically diagnosed TMDs, but estimates suggest that as many as 60% may experience one or more symptoms associated with TMDs, indicating potential underreporting and underdiagnosis [1, 5]. There is a clear gender disparity in the prevalence of TMDs, with women being twice as likely as men to develop these disorders. Women also tend to report higher pain intensities compared to men, suggesting differences in pain perception, processing, and hormonal influences [6, 7]. Alarmingly, studies have indicated that approximately 30% of adolescents aged 14-18 years' experience TMDs, which underscores the importance of early detection and intervention in this vulnerable age group [8, 9]. In 2014, the International Research Diagnostic Criteria for Temporomandibular Disorder Consortium Network revised the classification of TMDs into four main categories: temporomandibular joint disorders, mastication muscle disorders, headaches attributed to TMDs, and disorders affecting related structures such as the temporomandibular joint and masticatory muscles [10]. The development of TMDs is influenced by a complex interplay of biological, environmental, emotional, and cognitive factors, in addition to local and systemic conditions. Systemic diseases, such as rheumatoid arthritis, ankylosing spondylitis, and lupus, are known contributors to TMDs [8]. The clinical presentation of TMDs includes muscle and joint discomfort, headaches, limitations in jaw mobility, joint inflammation, and audible joint sounds, such as clicking or popping. These symptoms can significantly impact daily activities such as eating, speaking, and sleeping. Treatment strategies for TMDs often overlap with those used for other musculoskeletal and repetitive motion disorders. Self-management strategies, including avoiding hard foods, addressing teeth-clenching behaviors associated with stress, and reducing habits like chewing gum or wide mouth opening, play a crucial role in alleviating symptoms. In addition, nonsteroidal anti-inflammatory drugs (NSAIDs) are frequently used to provide pain relief [11, 12]. Vitamin D is vital for musculoskeletal health, influencing calcium and phosphate metabolism, cell differentiation, and immune function. It is primarily obtained through sunlight exposure but can also be sourced from dietary intake, including fatty fish and fish oils [13]. Vitamin D deficiency has been linked to chronic pain and various comorbidities. Although some studies have examined the relationship between vitamin D and TMDs, findings have been inconsistent, highlighting the need for further research to clarify the connection between vitamin D levels and TMD development [14]. Understanding this relationship is essential for developing more effective prevention and treatment strategies for TMDs. This study aims to investigate the relationship between vitamin D deficiency and Temporomandibular Joint Disorder, along with associated clinical signs, symptoms, and sociodemographic factors among patients in Dhaka, Bangladesh.

METHODOLOGY & MATERIALS

This cross-sectional study was conducted at the Department of Oral and Maxillofacial Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, over a 12-month period. The study was approved by the Oral

and Maxillofacial Surgery Department at BSMMU, and ethical clearance was obtained from the BSMMU Institutional Review Board (IRB). A total of 157 participants diagnosed with Temporomandibular Disorder (TMD) were enrolled in the study using purposive sampling. The inclusion and exclusion criteria for participant selection were as follows:

Inclusion Criteria

- Patients, both male and female, with clinically apparent TMD presenting at the Department of Oral & Maxillofacial Surgery, BSMMU.
- Age range: 10–60 years.

Exclusion Criteria

- Patients with renal or hepatic failure or other chronic conditions.
- Women who were pregnant or lactating.
- Patients using medications or supplements that affect bone metabolism, including hormone replacement therapy, glucocorticoids, bisphosphonates, teriparatide, and antiepileptic drugs.

Data Collection

Demographic data (age, gender, and medical history) were collected through structured interviews. Participants were asked to complete a simple yes/no questionnaire to assess subjective symptoms such as limited mouth opening, joint clicking, TMJ discomfort radiating to the neck, jaw deviation, difficulty eating, headaches, and tooth grinding. Clinical evaluations were performed, which included assessments of tenderness, TMJ motion, occlusion, and mouth opening. The interincisal distance was measured using a caliper. Joint abnormalities were examined using orthopantomograms (OPGs) and TMJ radiographs (both open and closed mouth), with MRI used to confirm the diagnosis. TMD diagnosis was based on clinical and radiological findings. Serum vitamin D levels were assessed for all patients using enzyme-linked immunosorbent assay (ELISA) with OCTEIA kits. Vitamin D deficiency was defined as serum 25-hydroxyvitamin D [25(OH)D] levels <25 nmol/l, with secondary hyperparathyroidism indicated by serum intact parathyroid hormone (iPTH) levels >65 ng/l. Vitamin D levels were categorized as deficient (<10 ng/ml), insufficient (10–30 ng/ml), or adequate (30–100 ng/ml).

Statistical Analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 24 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to summarize demographic data, with frequencies and percentages reported. For continuous data, appropriate univariate and bivariate analyses were conducted using the student's t-test. Categorical variables were analyzed using the Chi-square test or the two-tailed Fisher exact test, as appropriate. The sensitivity, specificity, positive and negative predictive values, and accuracy of the vitamin D assessment in relation to TMD were also calculated. A p-value of <0.05 was considered statistically significant.

RESULT

A total of 157 participants were included in this study. The age distribution showed that 12.73% of participants were aged 10-20 years, 56.05% were aged 21-40 years, and 31.21% were aged 41-60 years. (Table 1). In terms of gender, 56.68% were male, and 43.31% were female (Figure 1). Regarding personal habits, 31.84% of participants had no personal habits, 24.84% engaged in betel quid chewing, 25.48% were smokers, and 17.19% reported both betel quid chewing and smoking. A small proportion (0.63%) of participants consumed alcohol (Figure 2). The distribution of respondents based on co-morbidity showed that the majority, 66.24%, had no co-morbidities. Diabetes Mellitus was the most common co-morbidity, affecting 19.74% of participants, followed by hypertension at 7%. Kidney disease, liver

disease, and cardiac disease were present in a smaller proportion of the population, with 0.65%, 1.27%, and 1.91% of participants, respectively. Other co-morbidities were reported by 3.18% of respondents (Table 2). Table 3 presented the distribution of respondents based on signs and symptoms. The most commonly reported symptom was pain, experienced by 77.70% of participants. Jaw mobility issues were noted by 72.61%, while 70.70% of respondents reported a clicking sound in the joint. Rheumatoid arthritis was reported by 68.15% of the participants, and 58.60% noted joint inflammation. Ankylosing spondylitis was observed in 57.96% of participants, and 49.04% of respondents experienced headaches. Regarding OPG findings, 95.54% of participants had abnormal results, while only 4.45% had normal OPG findings (Figure 3). Table 4 showed the distribution of serum Vitamin D3 levels among participants. The majority, 69.42%, had Vitamin D3 deficiency, with levels below 20.00 ng/ml. Vitamin D3 insufficiency, with levels between 20-29 ng/ml, was observed in 28.66% of participants. Only 1.91% had sufficient Vitamin D3 levels, ranging from 30-100 ng/ml. No participants had Vitamin D3 toxicity, with levels exceeding 100 ng/ml.

Table 1: Demographic characteristics of the study population (n=157)

Variables	Frequency (n)	Percentage (%)
Age (years)		
10-20	20	12.73
21-40	88	56.05
41-60	49	31.21

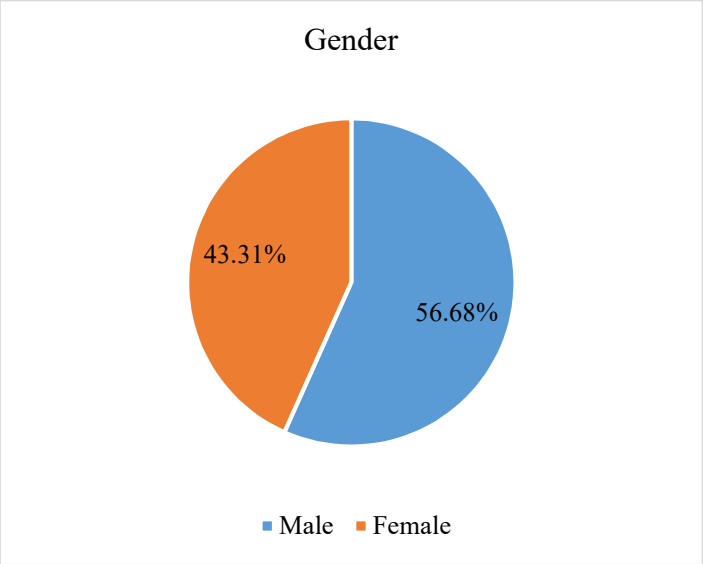

Figure 1: Distribution of gender among participants (n=157)

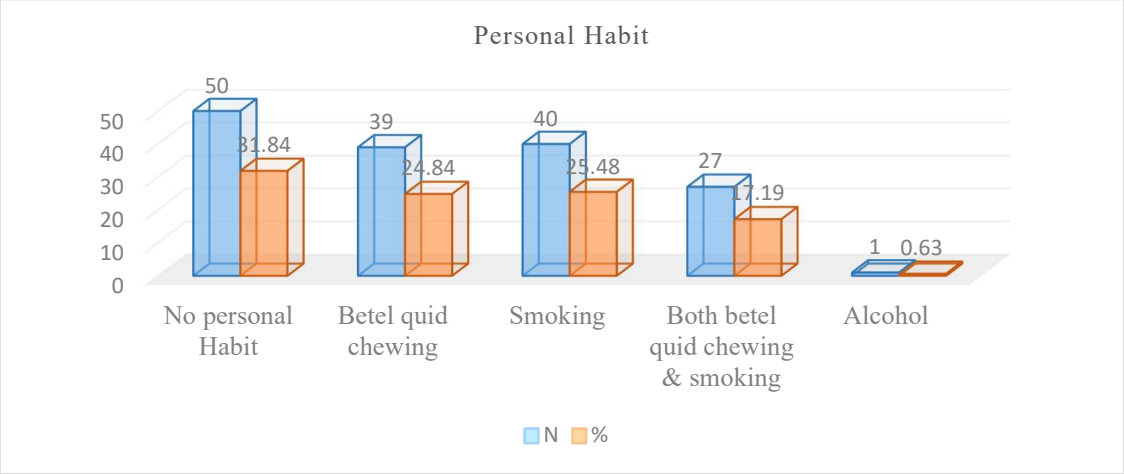

Figure 2: Distribution of Personal habit of participants (n=157)

Table 2: Distribution of the respondents according to Co-morbidity

Co-morbidity	Frequency (n)	Percentage (%)
No-Comorbidity	104	66.24
Diabetes Mellitus	31	19.74
Hypertension	11	7
Kidney Disease	1	0.65
Liver disease	2	1.27
Cardiac Disease	3	1.91
Others	5	3.18

Table 3: Distribution of the respondents according to sign and symptom

Sign & Symptom	Frequency (n)	Percentage (%)
Clicking Sound on joint	111	70.70
Joint inflammation	92	58.60
Headache	77	49.04
Jaw Mobility Problems	114	72.61
Rheumatoid arthritis	107	68.15
Alkalosis spondylitis	91	57.96
Others(pain)	122	77.70

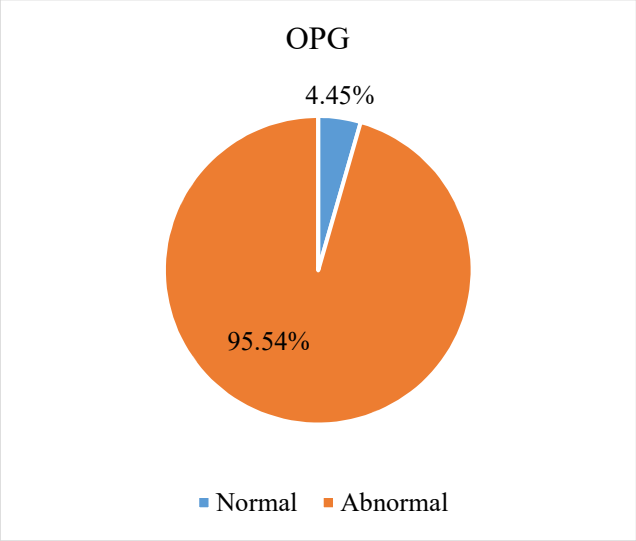

Figure 3: Distribution of the respondents according to OPG findings

Table 4: Distribution of the respondents according to Vit-D3 level.

Serum Vitamin-D3 level	Frequency (n)	Percentage (%)
Deficiency (<20.00 ng/ml)	109	69.42
Insufficiency (20-29 ng/ml)	45	28.66
Sufficiency (30-100 ng/ml)	3	1.91
Toxicity > 100ng/ml	0	0.00

DISCUSSION

Temporomandibular disorder (TMD) encompasses a range of conditions affecting the temporomandibular joint (TMJ), leading to pain, dysfunction, and discomfort. TMD has multifactorial etiologies, including mechanical, inflammatory, and systemic factors. Recent research suggests that vitamin D, a crucial nutrient for bone and joint health, may play a significant role in TMD pathogenesis [15]. Vitamin D deficiency has been linked to musculoskeletal pain and dysfunction, making it an important factor to consider in TMD management [16]. Dhaka, the capital of Bangladesh, experiences limited sunlight exposure for a significant portion of the year, contributing to widespread vitamin D deficiency [17]. Given the global concern regarding vitamin D insufficiency, its prevalence in Dhaka and other regions of Bangladesh may be particularly high [18-19]. Hence, it is crucial to investigate the correlation between vitamin D and temporomandibular disorder (TMD) among this particular demographic. In this study, the majority of the respondents (56.05%) fell between the age range of 21-40 years. Following this group, 31.21% of the respondents were between the ages of 41 and 60 years, while 12.73% were aged 10-20 years. This finding aligns with previous research indicating that TMD is more prevalent in individuals of this age group [20]. In terms of gender, our study showed a higher percentage of male participants (56.68%). This observation contrasts with findings from other studies that report a higher prevalence of TMD in females [21]. Regarding personal habits, a significant proportion of participants reported engaging in smoking or betel quid chewing (43.32%). These habits have been identified as potential risk factors for TMD [22]. Notably, alcohol consumption was minimal in our cohort (0.63%), which may contribute to a reduced risk of TMD, as alcohol consumption has been shown to have mixed effects on TMJ function [23]. In our study, 66.24% of participants had no comorbidity, while the remaining patients reported conditions such as diabetes mellitus, hypertension, and rheumatoid arthritis. This distribution is in line with findings by Qin et al. (2024), who highlighted the potential role of systemic conditions in exacerbating TMD symptoms [20]. Notably, rheumatoid arthritis was observed in 68.15% of participants,

further supporting the association between autoimmune diseases and TMD. In the present study, joint clicking was reported by 70.7% of participants, while 72.61% experienced restricted jaw mobility. Pain was the most prevalent symptom, affecting 77.7% of respondents, and 68.15% were diagnosed with rheumatoid arthritis. Additionally, joint inflammation was observed in 58.6% of participants, ankylosing spondylitis in 57.96%, and headaches in 49.04%. These findings are consistent with those reported by Sadura-Sieklucka et al. (2021), who identified similar symptomatology among individuals with temporomandibular disorders (TMD), particularly pain and impaired jaw function [24]. Research suggests a link between vitamin D insufficiency and increased pain perception, a key characteristic of temporomandibular disorder (TMD). Optimizing vitamin D levels may help manage TMD-related pain [25]. Observational studies indicate an association between chronic pain and low 25-hydroxyvitamin D (25-OHD) levels. Moreover, vitamin D deficiency has been linked to the progression of temporomandibular joint (TMJ) osteoarthritis in both young and postmenopausal women [26]. Another study found that reduced serum vitamin D levels increase susceptibility to osteoporosis, particularly in winter [27]. Our radiographic findings, as assessed by the orthopantomogram (OPG), showed that 95.54% of participants had abnormal findings. This result is consistent with the literature, which suggests that OPG is an effective tool in diagnosing TMJ abnormalities, particularly in patients presenting with symptoms such as jaw pain and clicking sounds [28]. Concerning vitamin D levels, our study revealed that 69.42% of participants had vitamin D deficiency (<20.00 ng/ml), while 28.66% had insufficiency (20-29 ng/ml). These results are concerning, as vitamin D deficiency has been linked to increased risk of musculoskeletal disorders, including TMD. The association between low vitamin D levels and TMD has been highlighted in several studies [29], suggesting that vitamin D plays a critical role in maintaining joint health. However, a small proportion of our participants (1.91%) had sufficient vitamin D levels, which may indicate that vitamin D supplementation could be beneficial in improving the clinical outcomes of TMD patients.A recent study conducted across several healthcare centers in Korea provides valuable evidence suggesting a potential link between vitamin D deficiency and an increased risk of temporomandibular disorders (TMDs). The research indicates that individuals with serum vitamin D levels below 20 ng/mL are 1.5 times more likely to develop TMDs compared to those with levels of 20 ng/mL or higher [30]. Several studies have explored the relationship between vitamin D levels and temporomandibular disorders (TMD), yielding mixed results. Similarly, Yildiz et al. (2021) found notable discrepancies in serum vitamin D concentrations between the patient group and controls, with a higher prevalence of severe deficiency in TMD patients [31]. Hong et al. (2021) observed significant variations in serum 25(OH)D levels across different stages of TMJ osteoarthritis, establishing a correlation with disease progression in both young and postmenopausal women [26]. However, Demir et al. (2019) and Madani et al. (2019) reported no statistically significant differences [32-33], whereas Staniszewski et al. (2019) identified a marked disparity between TMD patients and controls [34].

Limitations of the study

Every hospital-based study has some limitations and the present study undertaken is no exception to this fact. The limitations of the present study are mentioned. One limitation of this study is the cross-sectional design, which prevents the establishment of causal relationships between vitamin D levels and temporomandibular disorders (TMD). Additionally, the study relies on self-reported data for personal habits, such as smoking and betel quid chewing, which may introduce recall bias. Another limitation is the lack of long-term follow-up to assess the potential impact of vitamin D supplementation on TMD symptoms over time. Furthermore, the study does not account for potential confounding variables, such as genetic factors, that may also influence the development of TMD.

CONCLUSION AND RECOMMENDATIONS

Emerging evidence suggests a potential link between vitamin D levels and temporomandibular disorder (TMD); however, this relationship should be interpreted cautiously. The development and severity of TMD symptoms are

multifaceted, influenced by various factors. Effective clinical management of TMD requires a comprehensive approach, with vitamin D status being one of the key considerations. Patients with TMD are encouraged to consult healthcare professionals to assess their vitamin D levels and adopt appropriate interventions, such as dietary modifications or supplementation, to address deficiencies. Vitamin D plays a crucial role in bone health, inflammation regulation, muscle function, and pain perception in TMD. Further research is essential to elucidate the underlying mechanisms and optimize therapeutic strategies for managing vitamin D in TMD patients.

Funding: *Awarded by BSMMU Research Grand*
Conflict of interest: *None declared*
Ethical approval: *The study was approved by the Institutional Review Board (IRB)*

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