

Comparative Study of Serum Vitamin D and Calcium in Patients with and without Temporomandibular Joint Disorder

Anuja Panthee,¹ Asmita Panthee,² Anju Khapung¹

¹Nepal Medical College and Teaching Hospital, Attarkhel, Jorpati, Kathmandu, Nepal, ²Nepal Health Research Council, Ramsahapath, Kathmandu, Nepal.

ABSTRACT

Introduction

Calcium homeostasis, an essential component of musculoskeletal system requires Vitamin D as its integral element. Many studies have demonstrated the inconclusive association between serum calcium and some factors involved in calcium metabolism such as vitamin D. The aim of this present study is to evaluate the serum level of vitamin D and calcium in patient with and without Temporo-mandibular Joint disorder (TMDs) and to determine the association of same with age and gender.

Methods

A comparative study was done over a period of 6 months. Serum analysis of vitamin D and calcium was done for patients, with and without TMDs, visiting Oral and Maxillofacial Surgery (OMFS) Out Patient Department (OPD) from May to October 2022. Data analysis was done using chi square and independent t test in SPSS.

Results

A total of 200 study participants were included in the study of which 100 (50.00%) had TMDs and 100 (50.00%) did not have those problems. The difference in Vitamin D level were found statistically significant in those with and without TMJ problems.

Conclusions

There was statistically significant association between serum Vitamin D and TMDs whereas there was no association between serum calcium and TMDs.

Keywords: Calcium; serum; temporomandibular joint disorders; vitamin D.

Correspondence: Dr. Anuja Panthee, Oral and Maxillofacial Surgery, Nepal Medical College and Teaching Hospital, Jorpati, Kathmandu, Nepal. Email: itsanuja08@yahoo.com. Phone: +977-9841339326.

INTRODUCTION

Temporomandibular joint disorders (TMDs) are a group of disorders overwhelming inside the musculoskeletal framework of the temporomandibular joint which is characterized by tenderness and dysfunction within the joint. The American Academy of Orofacial Pain broadly classifies TMDs into myogenous or muscle-related TMD, and arthrogenous or joint-related TMD.¹ It comprises muscle weakness and tenderness, diminished mouth opening, disturbances in jaw movement, and articular sound amid jaw movement.² Vitamin D is an important component in calcium homeostasis which has a crucial role in maintaining musculoskeletal health. With its key role in articular and muscular well-being, literature has shown an affiliation between low vitamin D levels and musculoskeletal disorders including TMDs.³⁻⁵ There are numerous factors associated with TMDs which is classified as predisposing, initiating and perpetuating factors. Vitamin and mineral deficiency is under the perpetuating factors which has been associated with poor muscle strength and poor physical performance, which is linked with TMDs.⁶

With numerous benefits of vitamin D and calcium in musculoskeletal health, its deficiency is often under diagnosed. The aim of this study is to assess the serum Vitamin D and calcium level in patient with and without TMDs and to find out relation of same according to gender and age.

METHODS

An observational, "quantitative cross-sectional" study was undertaken to evaluate the serum level of vitamin D and calcium in patient with and without TMDs. This study was conducted in the Department of Oral and Maxillofacial Surgery (OMFS), Lumbini Medical College and Teaching Hospital (LMCTH) over a period

of 6 months from May to October 2022 after ethical clearance. A total of 200 patients, 100 with TMDs and 100 without TMDs were taken. Ethical approval was sought from Institutional Review Committee, LMCTH, prior to the study (Ref no.02/S-022). Data was collected using a proforma that included patients' demographic details, subjective symptoms related to TMDs and clinical examination of TMJ was done. Patients were asked to fill the questionnaire to assess subjective symptoms like reduced mouth opening, clicking over the joints, pain over TMJ region radiating to neck, deviation of jaw on opening, difficulty in eating, headache, teeth grinding and was answered as yes or no. Examination included tenderness, TMJ movements, occlusion and mouth opening. Inter-incisal distance was measured by metallic scale. Diagnosis of TMD was done on the basis of patients' responses of the subjective symptoms and clinical examination.

Patients with TMDs such as intraarticular clicking, crepitus, preauricular tenderness while at rest or chewing food, diminished mouth opening, deviation or deflection of jaw while opening and closing etc., no any other orofacial pain complaints except symptoms related to TMDs is included in this study. While patients who already been medication that could interfere with calcium and vitamin D metabolism, history of trauma to the chin or temporomandibular joint, recent Surgery of wisdom teeth, Conditions that could cause TMD or inflammation of the TMJ (including rheumatoid arthritis, lupus, viral infections, and mumps), Presence of malocclusion, and Presence of removable prostheses were excluded from this study.

Exclusion criteria were assessed in each subject by taking a medical history and additional laboratory tests, if needed

Informed and written consent was taken. Both groups of patients were referred to the laboratory for calcium and vitamin D analysis test. In the laboratory, under aseptic condition 5ml blood was withdrawn via venipuncture from patients arm i.e cephalic vein and subjected to biochemistry for analysis of serum level of Vitamin D and calcium. Serum vitamin D and calcium levels of all patients were checked as per Biological Reference Ranges (Deficiency of Vitamin D 25 hydroxy as ≤ 10 ng/ml, Insufficiency of Vitamin D 25 hydroxy as 29-11 ng/ml and normal level as ≥ 30 ng/ml and normal Calcium level as 8.5-10.5 mg/dl). Data was collected and entered in Microsoft excel sheet and exported to Statistical Packages for the Social Sciences (SPSS) version 20 for analysis. Independent t-test and chi-square test were used to compare the measurement. Level of significance was set at P value < 0.05 .

RESULTS

A total of 200 study participants from Lumbini Medical College and Teaching Hospital, Palpa

were included in the study from May to October 2022 of which 100 (50%) had TMD and 100 (50%) did not have TMD. Patients were divided into group A and Group B with and without TMDs respectively. Patients were selected according to inclusion criteria. Majority were female in both the groups, 63 (63.0%) in those with TMD and 57 (57.0%) in those without TMD. An average age of the study participants was 38.64 ± 12.52 years (Table 1).

On an average, in patients with TMD, the serum calcium level in mg/dl was 9.15 ± 0.99 and serum vitamin D level per ng/dl was 30.65 ± 7.19 . Similarly that for those patients without TMD was 9.23 ± 1.11 and 32.38 ± 7.42 respectively (Table 2).

More than half of patients with TMD had hypoglycemia whereas in those without TMD, slightly more than 50% had normal/hyperglycemia (Figure 1).

Table 1. Socio-demographic characteristics of the study participants.

Variables	Groups		Total
	With TMD	Without TMD	
Gender	n (%)	n (%)	n (%)
Male	37 (37.0)	43 (43.0)	80 (40.0)
Female	63 (63.0)	57 (57.0)	120 (60.0)
Total	100 (100.0)	100 (100.0)	200 (100.0)
Age	Mean \pm SD	Mean \pm SD	Mean \pm SD
(in years)	38.93 ± 12.62	38.36 ± 12.47	38.64 ± 12.52

Table 2. Descriptive statistics of the study parameters among the study participants.

Group	Serum calcium level (mg/dl)			Serum Vitamin D level (ng/ml)		
	Minimum	Maximum	Mean \pm SD	Minimum	Maximum	Mean \pm SD
With TMD	6.5	12	9.15 ± 0.99	17	50.2	30.65 ± 7.19
Without TMD	5.9	13	9.23 ± 1.11	11	55	32.38 ± 7.42
Total	5.9	13	9.19 ± 1.05	11	55	31.52 ± 7.34

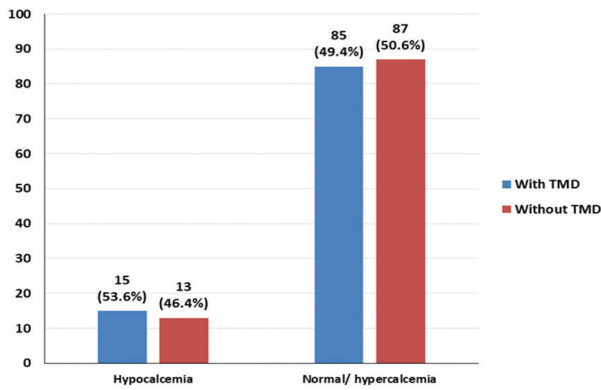


Figure 1. Distribution of patients with and without TMD on the basis of serum calcium level.

Among the study participants with TMD, 15 (15.0%) had hypocalcemia and of those without TMD, 13 (13.0%) had hypocalcemia (Figure 1). It was demonstrated that majority of patients (61.1%) with TMDs had vitamin D insufficiency as compared to those without TMDs. (Figure 2)

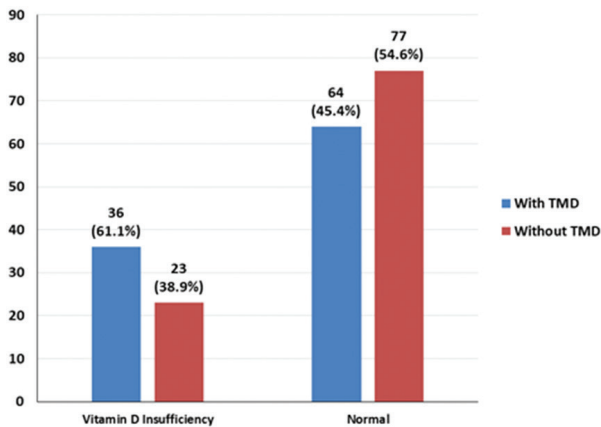


Figure 2. Distribution of patients with and without TMD on the basis of serum Vitamin D level.

Among the study participants with TMD, 36 (36.0%) had Vitamin D insufficiency and of those without TMD, 23 (23.0%) had Vitamin D insufficiency (Figure 2).

There was no statistically significant difference in mean age between the two study groups (p-value) (Table 3).

Table 3. Comparison of mean age between the two study groups.

Group	Mean±SD	t value	p-value
With TMJ problem	38.93±12.62	-0.321	0.748
Without TMJ problem	38.36±12.47		

No statistically significant association was found between presence and absence of TMD with serum calcium level among the study participant (p-value 0.68, t value = - 0.321). There was a statistically significant association between presence and absence of TMD with serum vitamin D level (p-value 0.04). The patients with Vitamin D insufficiency were 1.88 times more likely to develop TMD than the patients with normal Vitamin D level (Odds Ratio 0.53) (Table 4).

DISCUSSION

Temporomandibular disorders (TMD) are conditions that affect more than 10% of the population.⁷ Pain in the preauricular site, articular sound, deviation or deflection of the jaw while opening or closing etc. are the major symptoms of TMDs. Among all the symptoms of

Table 4. Association of TMD with serum calcium and serum Vitamin D level.

Biochemical parameter		With TMD	Without TMD	Total	p-value	Odds Ratio
Serum Calcium level	Hypocalcemia	15 (53.6)	13 (46.4)	28 (100.0)	0.68	NA
	Normal/hypercalcemia	85 (49.4)	87 (50.6)	172 (100.0)		
Serum Vitamin D level	Insufficiency	36 (61.1)	23 (38.9)	59 (100.0)	0.04*	0.53
	Normal	64 (45.4)	77 (54.6)	141 (100.0)		

Chi square test, P-value<0.05 statistically significant*

TMDs, pain is more bothersome to the patient. There could be numerous reasons of pain in the joint including inflammation of the synovial membrane and the growth of sensory nerves through the sub-chondral bone into the articular cartilage.⁸ Studies have shown conflicting results of levels of serum vitamin D, calcium and other minerals that are associated with TMDs. Musculoskeletal disease is one of the major causes of disability in elderly, in which TMDs is one of them. There are multiple etiological factors that trigger TMDs i.e., local and systemic. As vitamin D is an essential element in calcium metabolism, studies have shown that decreased vitamin D level is associated with musculoskeletal disorders.^{9,10} Dietary Calcium absorption is essential for calcium availability for bone mineralization and vitamin D status is a significant parameter influencing intestinal Calcium absorption. Calcium and vitamin D are required to improve and conserve healthy bones and muscles. TMDs is one of the musculoskeletal disorders. Sign and symptoms of TMDs include stiff jaw, preauricular pain radiating to temple region, or referred to neck and shoulder, difficulty in mouth opening, tender muscles of mastication, clicking or articular pain, deviation while opening and closing mouth, headache, earache etc. TMDs affect patient's quality of life as it is tedious to find and treat its etiological factors. According to the intensity and etiology, different protocols are available for management of TMDs, such as conservative or pharmacotherapy or minimal invasive as well as surgical procedures.¹¹ The current study was conducted to investigate and compare the serum level of calcium and vitamin D in patient with and without TMDs.

The results of our study reveals that there was a statistically significant difference in serum vitamin D in patient with and without TMDs. Of the total patients, majority were female in both the groups which is similar to a study by Al-Jundi et al.⁵ Furthermore, another study done by Bueno et al. to evaluate gender differences

in TMDs in adult population showed that the prevalence of TMDs was two times higher in female compared to male¹² and the intensity of pain was also greater in female than male.¹³ The reason could be due to biological, anatomical, psychological or hormonal factors acting alone or in combination in female patients.¹⁴ Another reason could be because the main source of vitamin D is exposure of skin to the sunlight. Females compared to males were found to be affected more by vitamin D deficiency and insufficiency and the cause can be traced back to a lot of social customs that restrict the exposure of "bare skin" to sunlight.

In our study, there was no association between serum level of calcium and TMDs which is similar to the study done by Madani et al. in Iran.¹⁵ The reason could be well explained that normalized levels and intake of calcium may suppress the increase secretion of PTH, when vitamin D is low. However, there are also studies which shows significant lower Calcium level in TMD Patient.¹⁶

In the present study, there was a statistically significant association between presence and absence of TMD with serum vitamin D level. The patients with Vitamin D insufficiency were 1.88 times more likely to develop TMD than the patients with normal Vitamin D level. This finding is similar to a review done by Ferrillo et al. in 2022 to assess the prevalence of Vitamin D deficiency in TMD patients, which showed that the serum level of vitamin D was lower in TMD patients compared to the normal healthy patients.¹⁷ Similarly, a study done by Nemati et al.¹⁸ showed a significant difference in the serum levels of vitamin D between patients with TMDs and the control groups ($p = 0.001$), reporting a higher prevalence of vitamin D deficiency in patients with a TMD. In contrary, Demir et al.¹⁹ and Madani et al.¹⁵ did not report significant differences in the vitamin D serum levels between the TMD patients and the healthy subjects. Furthermore, Staniszewski et al.²⁰ also showed TMD patients had significantly higher

serum levels of vitamin D ($p = 0.005$) compared to the controls. The possible reason of TMDs in vitamin D deficiency could be due to the several genes that have been associated with TMDs, the one is vitamin D receptor (VDR) gene which is regarded as one of the most important genes for investigating the genetic factors that contribute to the pathophysiology of TMDs.¹⁷ Other possible reason for Vitamin D deficiency in TMDs could be due to insufficient exposure to sun as the main source of vitamin D is sunlight. Not only TMDs, there are several studies which shows the deficiency of Vitamin D causing different degenerative bone diseases like osteoarthritis, articular cartilage degeneration etc.²¹

Vitamin D is a steroidal hormone that has many diverse biological actions in a number of target tissues. Vitamin D principally maintains calcium homeostasis and metabolism of bone by acting through vitamin D receptor circulating calcium and phosphate and altering kidney reabsorption and intestinal absorption. Parathyroid hormone (PTH) and fibroblast growth factor- (FGF-) 23, a bone-derived phosphaturic hormone produced in the presence of active vitamin D are also major players involved in the maintenance of these circulating ion levels. PTH secreted by the parathyroid glands in response to low calcium levels acts to stimulate active vitamin D synthesis. This is achieved by inducing the release of

calcium into the circulation via increased bone turnover to prevent hypocalcaemia.

Limitations

One of the limitations of our study could be small sample size and single institutional based study, because of which the result cannot be generalized. However, further studies need to be done to clarify the role of Vitamin D and Calcium in TMDs. Also bone mineral density evaluation could have added information about bone health status in the patients. Moreover, the effects of a decrease in Vitamin D levels, in response to normal calcium level, on symptoms of TMDs would be needed to be studied to determine the exact role of Vitamin D and calcium in TMDs.

CONCLUSIONS

Since TMDs negatively affects patient's quality of life, identifying etiological factors is extremely important to treat these disorders. The result of this study shows that there is a role of Vitamin D in TMDs. So apart from correcting the etiologic factors like malocclusion, emotional psychological factors, osteoporosis, rheumatoid arthritis etc. it can be concluded that low level of Vitamin D should be investigated and corrected.

Conflict of interest: None

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