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Spectrum of Oral Diseases in High Altitude Area & Its Association with Cardiovascular Risk Factors

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Abstract

Objective: *To establish the association between dental diseases in high altitude area and its association with risk factors for cardiovascular diseases.*

Study Population *1032 combatants were screened for their routine medical and dental check up.*

Methods: *All the combatants had undergone general medical examination which include the physical parameters like weight, height and BMI. General examination also included serial blood pressure measurement for six days. For dental examination all the combatants were examined for various dental diseases i.e dental caries, Infected root stumps, periodontal conditions and other oral conditions that will hamper their abilities to perform their duties in high altitude area. For identifying dental caries we use dental explorer, dental mirror and for periodontal conditions we use UNC15 periodontal probe. Individuals with generalised periodontitis were subjected for lab investigations in the form of blood sugar (fasting blood sugar level and post prandial blood sugar levels), HbA1c, lipid profile and sonography for fatty liver.*

Results: *Out of 1032 combatants, 65% had carious tooth,13% had a infected root stumps and 36% had a periodontitis .however some of them had a combination of dental diseases like dental caries and infected root stump/stumps, caries and periodontitis, periodontitis and infected root stumps or all three dental diseases. Out of 130 generalised periodontitis cases, 12.30% (16) had impaired glucose tolerance, 8%(11) were diabetics, 13.84%(18) had dyslipidaemia and 10%(13) had isolated hypertriglyceridemia. Also those patients who had dyslipidemia or isolated hypertriglycerdemia along with periodontitis were subjected for sonological study for fatty liver. 91% of cases had fatty liver. This shows a significant association between periodontal diseases and cardiovascular diseases.*

Conclusion: *Thus our study correlates association between dental diseases and risk factors for cardiovascular diseases like hypertension, Body mass index, Dyslipidemia, Type 2 diabetes mellitus & impaired glucose tolerance in high altitude areas.*

Keywords: *High altitude area, hypertension, BMI, dental caries, infected root stumps, periodontitis, dyslipidemia.*

Introduction

High Altitude is defined as an altitude above 2700m (9000 feet). Ascent to these altitudes is associated with a significant risk of acute and sub-acute/chronic high-altitude illness.[1] Above this altitude there is a definite and significant reduction in peak exercise capacity and submaximal exercise endurance. This is so since at this altitude the low ambient barometric pressure results in an alveolar oxygen partial pressure (PAO2) close to 60mm Hg. At this PAO2, the effects of hypoxia on the human body are obvious and easily recognizable.[2]

Cardiovascular Changes at High Altitude

Cardiac Output- The hypoxic environment of high altitude is a challenge for adequate oxygen delivery to tissues.[3] The cardiovascular system responds to this challenge both by a central activation of the sympathetic nervous system and by compensatory changes in the local tissue blood flow regulatory mechanisms. The cardiac output is seen to increase during acute ascent to high altitude. This increase is principally due to an increase in the heart rate. The magnitude of increase of cardiac output depends on the altitude. With acclimatization, the resting cardiac output approaches near sea-level values but the cardiac output during exercise is lower than that seen at sea-level.[3]

Peripheral vascular resistance (PVR) and blood pressure- During the first few hours of ascent to high altitude, the systemic arterial blood pressure remains unchanged or might be slightly lower than sea level values.[4] It is then often seen to rise over the next few weeks. This alternating trend of systemic arterial blood pressure is thought to be the result of the opposing influences of increased sympathetic activity (leading to increased PVR and raised blood pressure) and hypoxia induced vasodilatation in tissue beds (leading to decreased PVR and lowered blood pressure).

An increase in BP consequent to the stress of high-altitude sojourn i.e. hypobaric hypoxia, cold, apprehension etc may lead to BP values in the hypertensive range especially in those with BP values in the pre-hypertensive range at near sea-level. The elevation in BP seen at high altitude may be due to increased sympathetic discharge and fluid retention in the initial weeks at high altitude reported by some workers.

Altitude Exacerbated Health Problems

A number of illnesses may be exacerbated by sojourn at high altitude. It is clear that diseases such as primary or secondary pulmonary hypertension, cardiac congenital anomalies and valvular disorders that lead to increased pulmonic flow/pulmonary artery pressure, COPD, symptomatic CAD and CCF etc. shall be exacerbated by high altitude exposure and individuals with these disorders should not be allowed to ascend to high altitude.

The two diseases mainly addressed here is risk factor for cardiovascular diseases and common dental diseases like dental caries, infected root stumps & periodontal diseases.

Periodontitis- Periodontitis has been defined as "an infectious disease resulting in inflammation within the supporting tissues of the teeth, progressive attachment loss, and bone loss."[5]

In addition to the local immune response caused by the dental biofilm, periodontitis may also be associated with a number of systemic disorders and defined syndromes. In most cases, patients with systemic diseases that lead to impaired host immunity may also show periodontal destruction. Therefore, periodontitis is a disease that is not only limited to the area of the oral cavity; it is also associated with severe systemic diseases (e.g., cardiovascular disorders, diabetes mellitus).[6]

Clinical Features

General Characteristics

Characteristic clinical findings in patients with untreated chronic periodontitis include the following

- Supragingival and subgingival plaque and calculus

- Gingival swelling, redness, and loss of gingival stippling
- Altered gingival margins (e.g., rolled, flattened, cratered papillae, recessions)
- Pocket formation
- Bleeding on probing
- Attachment loss (angular or horizontally)
- Bone loss
- Root furcation involvement (exposure)
- Increased tooth mobility
- Change in tooth position
- Tooth loss

Periodontitis can be clinically revealed with periodontal screening and recording, which results in a periodontal screening index rating. The condition is diagnosed via the assessment of the clinical attachment level and the detection of inflammatory changes in the marginal gingiva. Measurements of periodontal pocket depth in combination with the location of the marginal gingiva allow for conclusions to be drawn regarding the loss of clinical attachment.

Periodontitis is considered a site-specific disease. Local inflammation, pocket formation, attachment loss, and bone loss are the consequences of direct exposure to the subgingival plaque (biofilm). As a result of this local effect, pocket formation and attachment as well as bone loss may occur on one surface of a tooth, whereas other surfaces maintain normal attachment levels. As a result of the site-specific nature, the number of teeth with clinical attachment loss classifies chronic periodontitis into the following types:

- **Localized chronic periodontitis**: less than 30% of the sites show attachment and bone loss
- **Generalized chronic periodontitis**: 30% or more of the sites show attachment and bone loss during chronic periodontitis, the local inflammatory response may lead to different patterns of bone loss, including vertical (angular) and horizontal bone destruction. Although vertical bone loss is associated with intra-bony pocket formation, horizontal bone loss is usually associated with supra-bony (supra-alveolar) pockets.

Risk Factors for Disease

A number of different factors influence the etiopathology of chronic periodontitis. The composition of the oral microflora is a major etiologic factor that leads to periodontal destruction. In this context, the extent of the periodontal destruction depends on the host's immune competence as well as genetic predispositions that influence individual susceptibility to disease. In addition, both systemic diseases and environmental factors interfere with the development and progression of chronic periodontitis.[7]

Systemic Factors

Periodontitis occurs with severe systemic diseases, such as diabetes mellitus, cardiovascular disorders, stroke, and lung disorders.[8,9,10,11]

For diabetes mellitus and periodontitis, it is known that there is an interaction during which both diseases mutually correlate with each other. Patients with diabetes mellitus exhibit a higher risk for the development of periodontitis, and periodontal infection and inflammation may negatively interfere with the glycemic control of the diabetic patient.[12] A number of studies showed that the prevalence, severity, and prognosis of periodontitis are associated with the incidence of diabetes mellitus. It was found that the average pocket depth as well as the clinical attachment loss was increased in patients with diabetes mellitus (independent of the type of diabetes mellitus).[12,13] Patients with poor glycemic control (i.e., a glycated hemoglobin level of >9%) tend to experience a more severe progression of periodontitis as compared with patients with good glycemic control (i.e., a glycated hemoglobin level of <9%). With regard to the progression of severe periodontitis, no difference was found between patients with good glycemic control and non-diabetic patients.[14] With diabetes mellitus, advanced glycation end products may arise and lead to the release of free oxygen and pro-inflammatory mediators (i.e., cytokines). Advanced glycation end products may also promote chemotaxis and the adhesion of

inflammatory cells to periodontal tissues, and the increased apoptosis of fibroblasts and osteoblasts may occur.[15]Furthermore, patients with diabetes mellitus tend to show a higher body mass index; therefore, increased concentrations of adipokines that directly influence inflammatory responses will likely be found.[16] Hyperglycemia itself leads to the release of proinflammatory mediators in the bloodstream, which in turn promote increased glucose concentration.[12] Periodontal therapy may contribute to the glycemic control of the diabetic patient. It has been shown that systematic periodontal therapy leads a 0.4% reduction of glycated hemoglobin. Each therapy regimen that contributes to achieve a reduction in the glycated hemoglobin level decreases the risk of diabetes-related long-term consequences, such as myocardial infarction, microvascular complications, and many others.[12]

Material & Method

All the individuals had undergone general medical examination which include the physical parameters like weight, height and BMI as shown in figure 1. General examination also included serial blood pressure measurement for six days. For dental examination all the individuals were examined for various dental diseases i.e. dental caries, Infected root stumps, periodontal conditions and other oral conditions that will hamper their abilities to perform their duties in high altitude area. For identifying dental caries we use dental explorer, dental mirror and for periodontal conditions we use UNC15 periodontal probe. Individuals with generalized periodontitis were subjected for lab investigations in the form of blood sugar (fasting blood sugar level and post prandial blood sugar levels), HbA1c, lipid profile and sonography for fatty liver.

Results

In the sample size of 1032 persons who underwent dental inspection, we looked for 3 parameters namely dental caries, infected root stumps & periodontal diseases. In general physical examination, we took an average of six days blood pressure with average BMI of individuals of all age group (20-29 years, 30-39 years, 40-49 years). Out of 1032 individuals 639 individuals belonged to age group of 20-29 years, 289 individuals belonged to age group of 30-39 years & 104 individuals belonged to age group of 40-49.

In the population of 20-29 years age group, 66% (423) of individual had carious tooth and their average blood pressure over 6 days was 126/84 mmHg with average BMI is 23.9. Individuals free from carious tooth i.e. 34% (216) had an average blood pressure of 124/82mmHg over six days with average BMI of 22(figure 2).

In the population of 30-39 years age group 63%(183) of persons had carious tooth and their average blood pressure over 6 days was 134/88mmHg with average BMI of 24.2. Individuals free from carious tooth i.e. 37%(106) had an average blood pressure of 126/84mmHg over six days with average BMI of 22.5(figure 2).

In the population of 40-49 years age group 61% (63) of persons had carious tooth and their average blood pressure over 6 days was 134/90 mmHg with average BMI of 25.8. Individuals free from carious tooth i.e. 39%(41) had an average blood pressure of 130/88mmHg over six days with average BMI of 24.9(figure 2).

In the population of 20-29 years age group, 13%(84) of individuals had infected root stumps and their average blood pressure over 6 days was 128/80 mmHg with average BMI of 24. Individuals who don't have any infected root stumps i.e. 87% (555) had an average blood pressure of 125/80mmHg over six days with average BMI of 22.5(figure 3).

In the population of 30-39years age group, 12%(34) of individuals had infected root stumps, their average blood pressure over 6 days was136/89 mmHg with average BMI of 24.8. Individuals who don't have any infected root stumps i.e. 88%(255) had an average blood pressure of 127/83mmHg over six days with average BMI of 22.8(figure 3).

In the population of 40-49 years age group, 15%(16) of individuals had infected root stumps and their average blood pressure over 6 days was 136/90mmHg. With average BMI of 25.9. Individuals who don't have any infected root stumps i.e. 85% (88) has an average blood pressure of 132/88mmHg over six days with average BMI of 24.9(figure 3).

In the population of 20-29 years age group,13%(83) of individuals has periodontitis, their average blood pressure over 6 days was 130/90 mmHg with average BMI of 24.5. Individuals with healthy gingiva or gingivitis i.e. 87%(556) had an average blood pressure of 125/80mmHg over six days with average BMI of 22.5(figure 4).

In the population of 30-39 years age group,72%(209) of individuals had periodontitis, their average blood pressure over 6 days was136/92 mmHg with average BMI of 25.2. Individuals with healthy gingiva or gingivitis i.e. 27%(80) has an average blood pressure of 126/84mmHg over six days with average BMI of 22.9(figure 4).

In the population of 40-49 years age group, 74%(77) of individuals has periodontitis, their average blood pressure over 6 days was132/92 mmHg with average BMI of 26.6.Individuals with healthy gingiva or gingivitis i.e. 26%(27) has an average blood pressure of 130/86mmHg over six days with average BMI of 25.0(figure 4).

Out of 1032 individuals 36% (369) individuals had localised or generalised periodontitis.

Out of 369 individuals 12.59%(130) individuals had generalised periodontitis.

Patients with generalised periodontitis further subjected for metaboilic profile like blood sugar(fasting and post prandial) HbA1c, lipid profile and USG abdomen for fatty liver.

Out of 130 generalised periodontitis cases 12.30% (16) had impaired glucose tolerance, 8%(11) were diabetics, 13.84%(18) had dyslipidaemia and 10%(13) has isolated hypertriglyceridemia(figure 5 and 6). Also those who have either dyslipidaemia or isolated hypertriglyceridaemia along-with periodontitis, USG shows fatty liver changes in 91%(29) cases. Also those patients who had dyslipidemia or isolated hypertriglycerdemia along with periodontitis were subjected for monological study for fatty liver. 91% of cases had fatty liver.

This shows a significant association between periodontal diseases and cardiovascular diseases in the body.

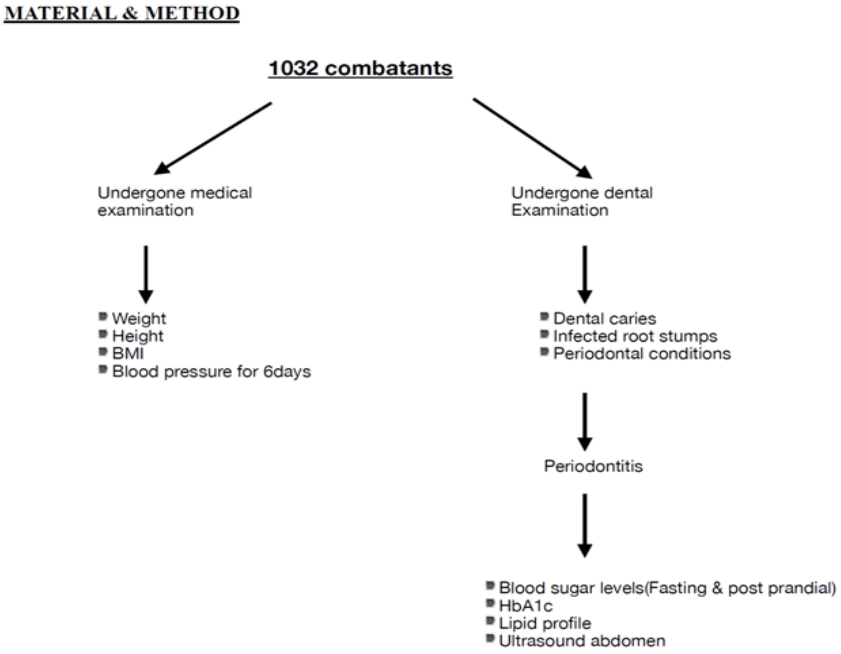


Figure 1

FIGURE 2

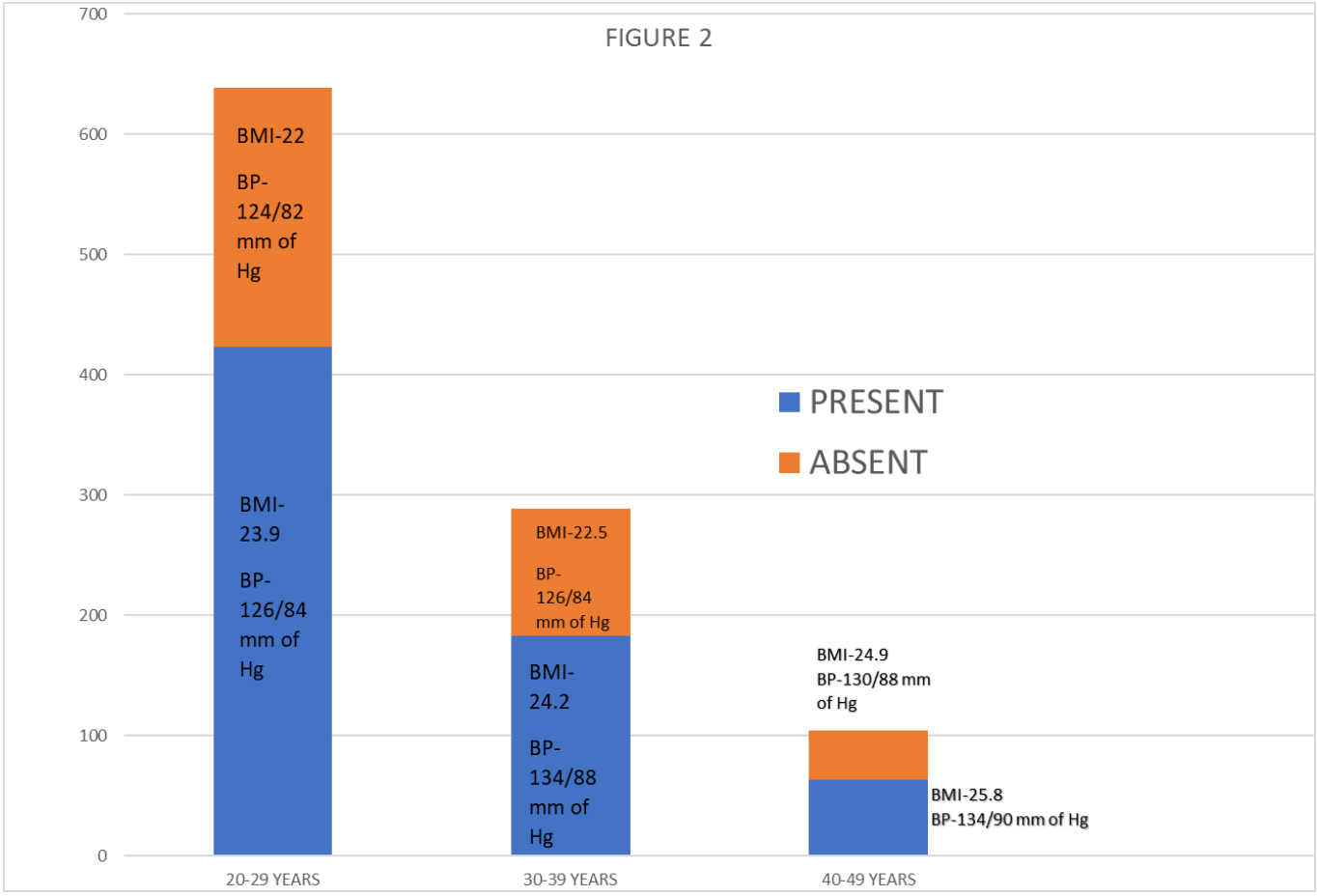
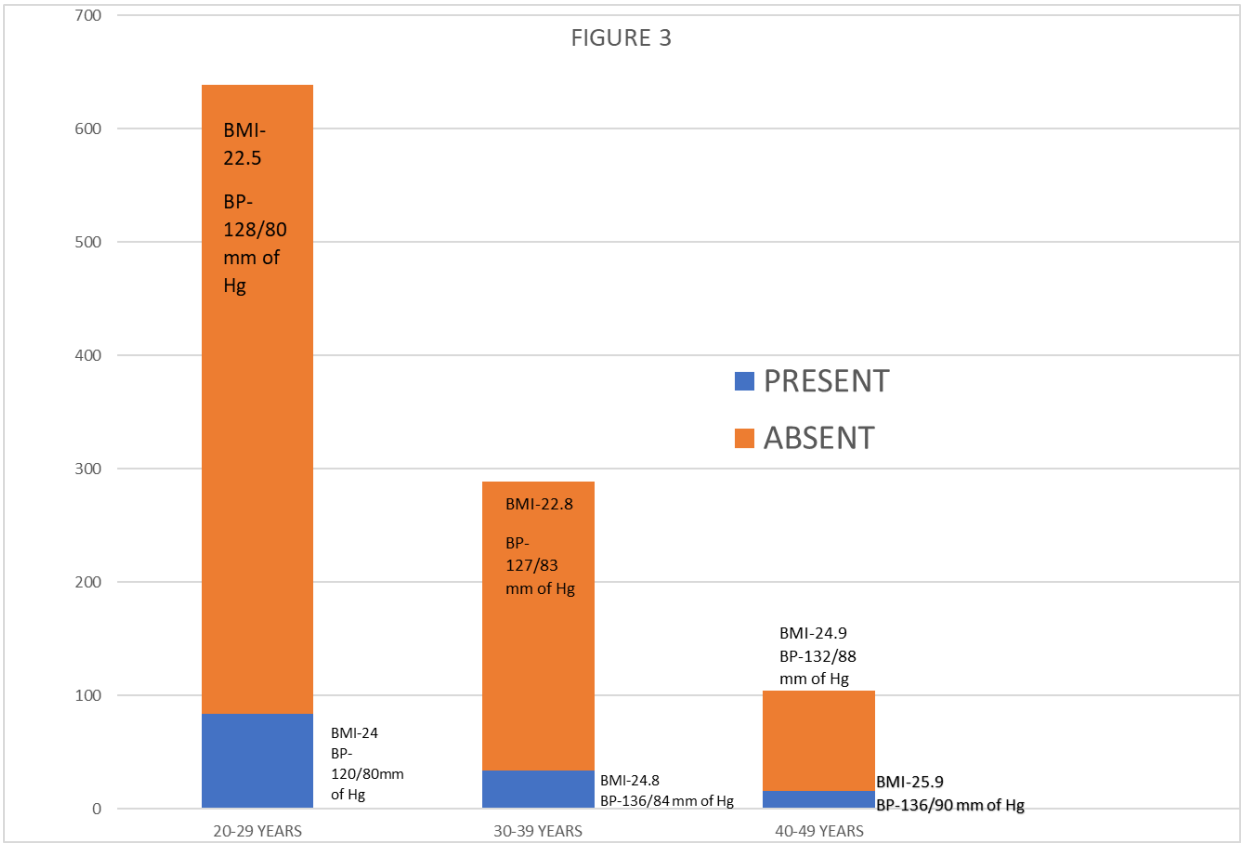
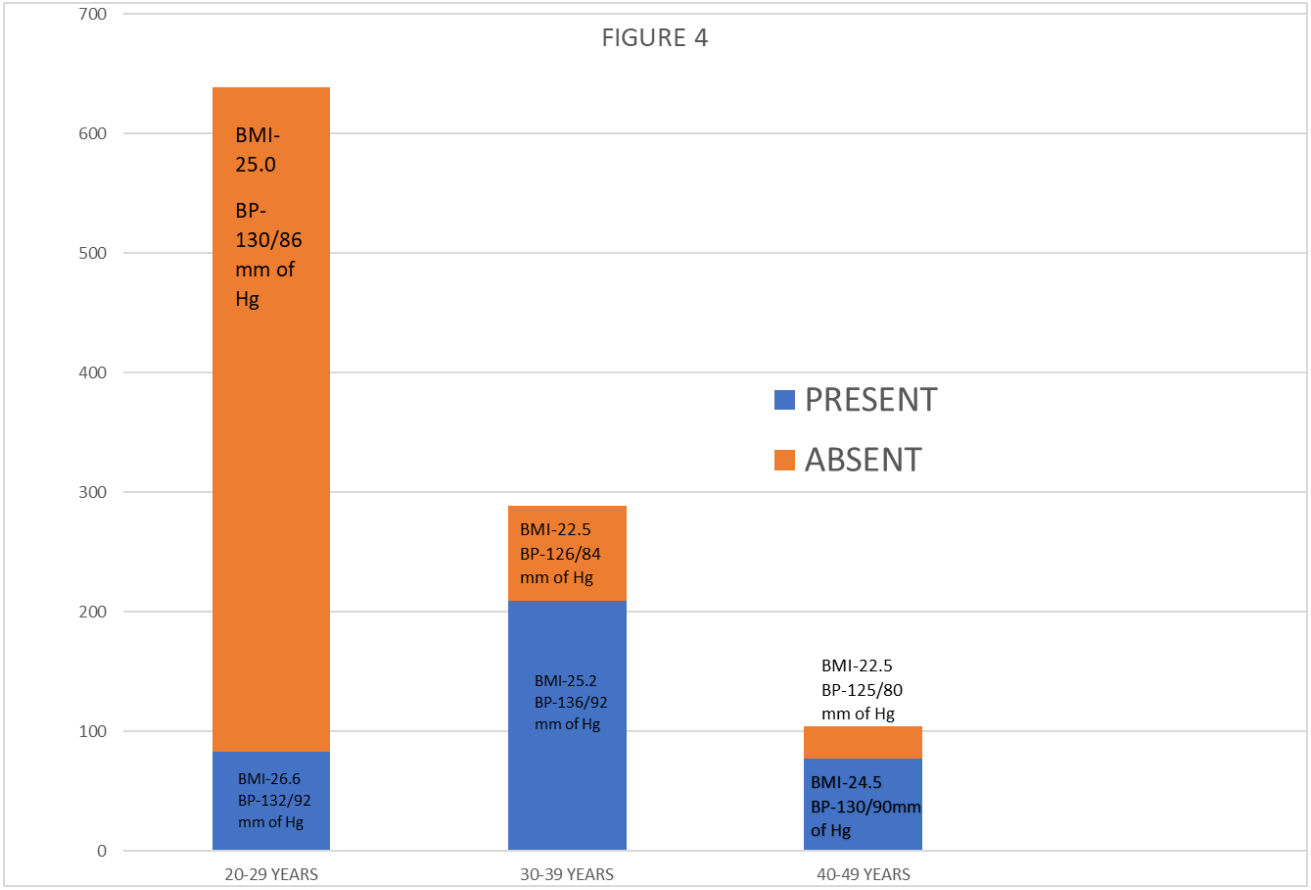


FIGURE 3





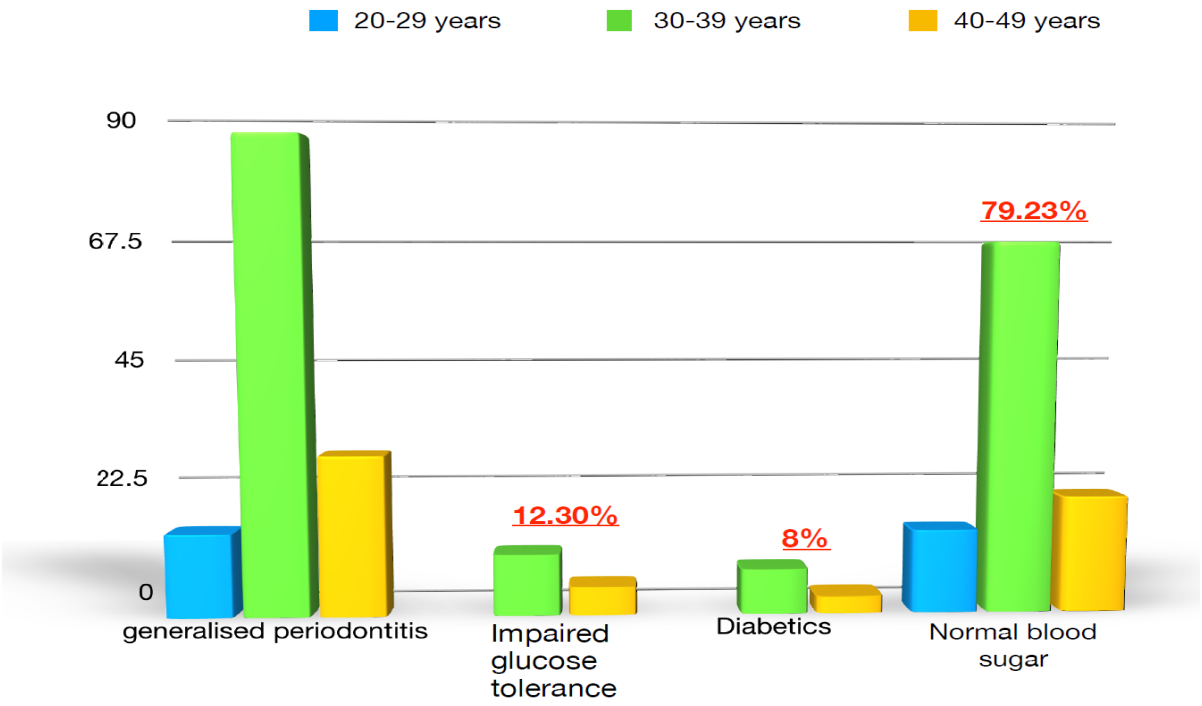


Chart showing incidence of impaired glucose tolerance and diabetes in different age group population suffering from generalised periodontitis.

Figure 5

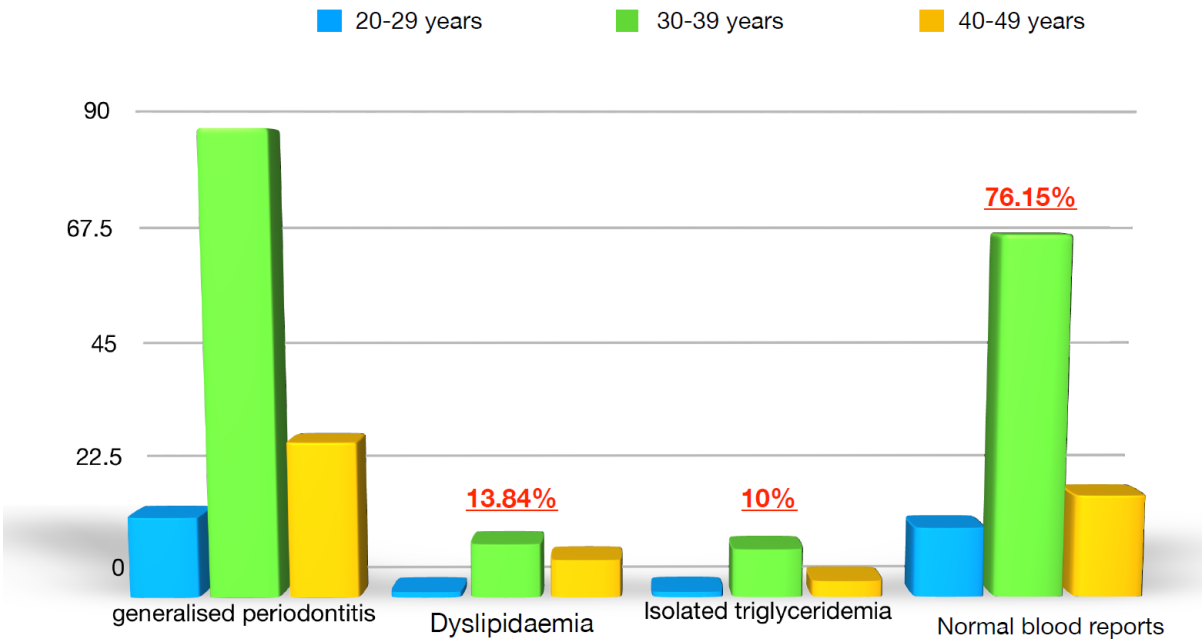


Chart showing incidence of dyslipidaemia and isolated triglyceridemia in different age group population suffering from generalised periodontitis.

Figure 6

Table 1-Salient Findings of our Study Showing Association of oral Diseases in High Altitude with Cardiovascular Risk Factors

AGE	N	CARIES						INFECTED ROOT STUMP						PERIODONTITIS					
		PRESENT			ABSENT			PRESENT			ABSENT			PRESENT			ABSENT		
		N	BP	BMI	N	BP	BMI	N	BP	BMI	N	BP	BMI	N	BP	BMI	N	BP	BMI
20-29	639	423	126/84	23.9	216	124/82	22	84	128/80	24	555	128/80	22.5	83	130/90	24.5	556	125/80	22.5
30-39	289	183	134/88	24.2	106	126/84	22.5	34	136/84	24.8	255	127/83	22.8	209	136/92	25.2	80	126/84	22.5
40-49	104	63	134/90	25.8	41	130/88	24.9	16	136/90	25.9	88	132/88	24.9	77	132/92	26.6	27	130/86	25.0

Table 2-Association of Generalised Periodontitis with Metabolic Profile

	DIABETIC	IGT	DYSLIPIDEMIA	ISOLATED HYPERTRIGLYCERIDEMIA	FATTY LIVER
Present	11	16	18	13	29
Absent	119	114	112	117	101

Discussion

Over the last three decades the investigators are constantly working to study /explore the association between periodontal disease and cardiovascular diseases. Overall it was identified that poor oral hygiene is the main contributory factor for the pathogenesis of significant cardiovascular disease.[17] (Meurman et al. 2004). Further investigation reinforced the role of periodontal infections in the development of cardiovascular diseases.[18] (Mustapha et al 2007). studies in western Himalayas have shown hypertension to be relatively more common at high altitude, particularly in those in the 4th and 5th decade of

life.[19]. This could be due to the increase in plasma norepinephrine levels at high altitude[20]. It has been found that high altitude hypoxia plays a major role in development of impaired glucose tolerance.[21] The relationship between diabetes mellitus and periodontal disease has been extensively studied. Epidemiological research found that diabetes increases the risk for and severity of periodontal diseases.[22] The increased prevalence and severity of periodontitis typically seen in patients with diabetes especially those with poor metabolic controlled, to the designation of periodontal disease as the "sixth complication of diabetes."[22] In addition to the five "classic" complications of diabetes, the American Diabetes Association has officially recognized that periodontal disease is common among patients with diabetes, and the Association's Standards of Care include taking a history of current or past dental infections as part of the physician's examination.[23] In our study also we found that out of 130 patients with chronic periodontitis 16(12.30%) had impaired glucose tolerance and 11 (8%) patients were diabetics.

In a longitudinal study of patients with type 2 diabetes, severe periodontitis was associated with the significant worsening of glycemic control over time.[24] Individuals with severe periodontitis at the baseline examination had a greater incidence of worsening glycemic control over a 2- to 4-year period as compared with those without periodontitis at baseline. In this study, periodontitis is known to have preceded the worsening of glycemic control. Periodontitis has also been associated with the classic complications of diabetes.

To further explore the association between periodontal disease and cardiovascular diseases, investigators have studied specific systemic disorders and medical outcomes to determine their relationship to periodontal status. Cardiovascular diseases related events are a major cause of death. MI has been associated with acute systemic bacterial and viral infections, and MI is sometimes preceded by influenza- like symptoms.[25,26] Localized infection that results in a chronic inflammatory reaction has been suggested as a mechanism of underlying cardiovascular diseases in these individuals.[27]

In cross-sectional studies of patients with acute MI or confirmed cardiovascular diseases who are compared with age- and gender-matched control patients, patients with MI had significantly worse dental health (e.g., periodontitis, periapical lesions, caries, pericoronitis) as compared with controls.[28,29,30] Our study also found cardiovascular risk factors like age, dyslipidemia, impaired glucose tolerance, type II DM, isolated hypertriglyceridemia and fatty liver in association with poor dental hygiene(table 1). In our study periodontitis was found to be more common in the age group 30-49 years and also the individuals were detected to have stage I hypertension and higher BMI.

A systematic review and meta-analysis of data from 15 studies showed a significant 14% to 22% increase in the risk of cardiovascular diseases-related events in patients with periodontal disease as compared with those free from periodontal diseases.[31] Janket and colleagues[32] performed a meta-analysis of periodontal disease as a risk factor for future cardiovascular events and found an overall 19% increased risk of such events among individuals with periodontitis. In our study out of 1032 subjects,369 were detected to have periodontitis, of which 130 had generalized periodontitis. Majority of these 130 subjects were found to have features of metabolic syndrome (table 2).

Conclusion

Thus our study correlates association between dental diseases and risk factors for cardiovascular diseases like hypertension, Body mass index, Dyslipidemia, Type 2 diabetes mellitus & impaired glucose tolerance in high altitude areas.

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