

# Assessment of Fasting Blood Glucose in Chronic Periodontitis Patients Visiting a Tertiary Hospital

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## ABSTRACT

**Introduction:** It is well-established that diabetes unfavourably influences periodontal health and results in periodontitis. However, upcoming evidences also show that periodontitis initiate a chronic state of insulin resistance leading to hyperglycemia.

**Objectives:** We designed this study to assess fasting blood glucose level in chronic periodontitis patients and also explore the relationship between severity of chronic periodontitis and fasting blood glucose level with analysis of their risk factors in adult population of eastern Nepal.

**Methods:** A cross sectional hospital-based study was conducted on a total of 141 chronic periodontitis patients aged 30-55 years which were divided into Group A (Mild periodontitis) and Group B (Moderate/ Severe periodontitis) according to the American Academy of Periodontology / Centres for Disease Control (AAP/ CDC) criteria. Fasting blood glucose level was analyzed as normal (<100 mg/dl), impaired fasting (100-125 mg/dl), and diabetic ( $\geq 126$  mg/dl) based on the American Diabetes Association (ADA) criteria.

**Results:** Among the 141 subjects examined, Group A accounted to be 43.26% and Group B 56.74%. The mean fasting blood glucose level was  $121.51 \pm 53.67$  mg/dl. Chi-square test showed that severity of periodontitis and body mass index were significantly associated with the categories of fasting blood glucose. Multivariate logistic regression analysis showed that age (OR=1.08), gender (OR=3.48) and body mass index (OR=0.38) were significantly associated with impaired fasting glucose. The risk of acquiring diabetes in mild periodontitis was 0.255 times less likely than in severe periodontitis (OR=0.255, CI 0.065-0.997).

**Conclusions:** The severity of chronic periodontitis showed significant association with the categories of fasting blood glucose.

**Keywords:** Body mass index; chronic periodontitis; hyperglycemia.

## INTRODUCTION

The oral cavity is the junction of medicine and dentistry and the window into the general health of a patient. Diabetes and periodontitis are two

such chronic diseases which have for some time been viewed as connected both biologically and physiologically. In 2005, World Health Organization (WHO) published that nearly 10-15 % of the population globally is suffering from a severe form of periodontitis.<sup>1</sup> Investigation of epidemiological studies on oral disease in Nepal has reported that 29 % of Nepalese of 35-44 years are having deep periodontal pockets.<sup>2</sup>

Periodontal infections have been related to increased possibility for prediabetes.<sup>3,4</sup> Clinical

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periodontal parameters have also been reported to be linked with amplified risk for accelerated 5-year progression of hemoglobin A1c.<sup>5</sup> On the contrary, there are also studies which have shown no relationship between periodontitis and elevated blood glucose level.<sup>6-8</sup>

In Nepalese population, there exists meagre information on how periodontal status affects fasting blood glucose level. Thus, this study was conducted with an aim to assess fasting blood glucose level in chronic periodontitis patients and also explore association between severity of chronic periodontitis and fasting blood glucose level with analysis of their risk factors.

## METHODS

Purposive sampling method with definite inclusion and exclusion criteria was used to enroll patients from the Department of Periodontology and Oral Implantology, College of Dental Surgery, B.P. Koirala Institute of Health Sciences (BPKIHS), Dharan from September 2017 to September 2018. Inclusion criteria comprised of diagnosed cases of chronic periodontitis in the array of 30-55 years with at least 20 teeth in both the arches except 3<sup>rd</sup> molars, which were divided into 3 categories mild, moderate and severe as per American Academy of Periodontology / Centers for Disease Control and Prevention (AAP/ CDC) criteria.<sup>9</sup> Group A consisted of mild periodontitis and Group B consisted of moderate and severe periodontitis combined together. Exclusion criteria were diagnosed cases of diabetes, other compromised medical conditions, patients receiving medication known to alter periodontal health, periodontal treatment done within preceding 3 months and aggressive periodontitis. The sample size calculated was 141 based on the formula to ascertain sample size utilizing mean and standard deviation.

It was an instrument-based study. Instruments used were mouth mirror, tweezer, explorer, and University

of North Carolina-15 probe (UNC-15). Periodontitis was diagnosed with the help of clinical parameters probing pocket depth and clinical attachment loss with UNC-15 probe by the principal investigator and was validated by a board-certified periodontist with more than 15 years in the field. Written informed consent was taken from the participants. Ethical clearance was acquired as per the guidelines from the Institutional Review Committee (code no: IRC/1083/017).

AAP/ CDC Classification of chronic periodontitis<sup>9</sup> defined severe periodontitis as “two or more interproximal sites with CAL  $\geq$  6 mm (clinical attachment level), not on the same tooth, and one or more interproximal sites with PPD  $\geq$  5 mm (probing pocket depth)”, moderate periodontitis as “two or more interproximal sites with CAL  $\geq$  4 mm, not on the same tooth, or two or more interproximal sites with PPD  $\geq$  5 mm, not on the same tooth” and mild periodontitis as “having at least two interproximal sites with CAL  $\geq$  3 mm and at least two interproximal sites with PPD  $\geq$  4 mm (not on the same tooth) or one site with PPD  $\geq$  5 mm”. For either case definition, at least two teeth must be present.

Socio-demographic details like age, gender, body mass index, smoking and socioeconomic status were taken. Age and gender were obtained by questionnaires. Body mass index (BMI) was determined by estimating the weight in kg and height in meters and was classified as normal (18.5-24.9), overweight (25-29.9) or obese ( $\geq$ 30). Smoking was evaluated based on characteristics given by CDC. Socioeconomic status was assessed using the Kuppuswamy socioeconomic status scale.<sup>10</sup>

The periodontal examination included Silness and Loe plaque index, Loe and Silness gingival index, CAL and PPD. Number of sites with PPD  $\geq$  5mm, PPD  $\geq$  4 mm, CAL  $\geq$  6, CAL  $\geq$  4 and CAL  $\geq$  3 mm was noted. Venous blood was collected in the early morning (fasting) and submitted to the department of biochemistry for investigation.

Blood glucose was measured in Roche Cobas C 311 chemistry autoanalyzer using hexokinase method. Blood glucose level reported was assessed using the American Diabetes Association (ADA) criteria as normal fasting blood glucose level (< 100 mg/dl) or impaired fasting glucose level (100-125 mg/dl) or diabetic glucose level ( $\geq 126$  mg/dl).<sup>11</sup> Primary outcome measure was fasting blood glucose level. The secondary measures were the severity of chronic periodontitis, age, gender, smoking, socioeconomic status and BMI.

All the data were handled by a single investigator. Statistical Package for Social Sciences (SPSS) version 11.5 was used to enter the collected data. Supervision and monitoring were done for entered data by guide and co-guide at regular interval. Chi-square test was utilized to compare categorical data. Pearson correlation was used to calculate correlation among plaque index, gingival index and fasting blood glucose level and Spearman correlation among number of sites with PPD  $\geq 5$  mm, PPD  $\geq 4$  mm, CAL  $\geq 6$  mm, CAL  $\geq 4$  mm, CAL  $\geq 3$  mm and fasting blood glucose level. Logistic regression analysis was applied to find out the association of severity of chronic periodontitis and different variables like age, gender, smoking, socioeconomic status, and BMI with fasting blood glucose level. The probability of significance was set at 5% level.

## RESULTS

In this cross-sectional study, 141 patients aged 30-55 years ( $42.46 \pm 8.47$  years) were enrolled. Group A (mild periodontitis) accounted to be 43.26% while Group B (moderate and severe periodontitis) accounted to be 56.74%. The average fasting blood glucose level was 121 mg/dl. Out of 141 patients examined, 51.06% had impaired fasting glucose, 22.7% had diabetes while 26.24% had normal fasting blood glucose level. The relationship of severity of chronic periodontitis and the categories of fasting blood glucose was evaluated using the Chi-square test and was statistically significant. It was found out that

57.4% of mild periodontitis patients presented with impaired fasting glucose and 9.8% were found to be diabetic. However, in moderate/severe periodontitis 46.3% of patients presented with impaired fasting glucose but 32.5% were found to be diabetic. Therefore, more patients with moderate/severe periodontitis were diabetic in comparison to mild periodontitis group.

Multivariate logistic regression analysis was performed. For diabetic blood glucose level, variable severe periodontitis was significant which indicates that severe periodontitis may serve as an independent risk factor for diabetes. The risk of acquiring diabetes in mild periodontitis is 0.255 times less likely than in severe periodontitis (OR=0.255, CI 0.065-0.997) (Table 1). For impaired fasting glucose, variables age (OR=1.08), gender (OR=3.48) and BMI (OR=0.38) were significant. With 1-year increase in age, the impaired fasting blood glucose level increases by 1.083 times. The chance for impaired fasting glucose level in males is 3.48 times more than that of females. Non-obese/overweight individuals are 0.38 times less likely to have impaired blood glucose level than obese/overweight individuals. (Table 1).

Out of the participants, 32.62 % were males and 67.38 % were females. 14 were former smokers, 21 current smokers, and 106 nonsmokers. As indicated by Kuppaswamy socioeconomic status scale, a large number of the patients were in the lower middle category (74.5%) trailed by the upper middle one (25.5%). On categorization of BMI; 49.6 % were overweight followed by normal (45.4%), obese (3.5%) and underweight (1.4%). When all the individual groups were plotted in a pie, mild periodontitis accounted to be 41.84%, while moderate periodontitis 31.91% and severe periodontitis 26.24%. Distribution of Mean  $\pm$  S.D of Age, BMI, PI, GI, Number of sites with PD  $\geq 5$  mm, PD  $\geq 4$  mm, CAL  $\geq 6$  mm, CAL  $\geq 4$  mm, CAL  $\geq 3$  mm and fasting blood glucose of studied sample, n=141 is shown in Table 2.

**Table 1: Multivariate logistic regression analysis for risk factors for impaired glucose and diabetic glucose level**

Parameter estimates							
Impaired fasting glucose	B	SE	Wald	Sig	OR	95% CI	
Severity of periodontitis							
Mild vs Severe	0.81	0.59	1.91	0.167	2.26	0.71	7.2
Moderate vs Severe	1.13	0.66	2.91	0.088	3.11	0.85	11.41
Age	0.08	0.03	7.71	<b>0.005</b>	1.08	1.02	1.15
Gender (Males vs Females)	1.25	0.54	5.28	<b>0.022</b>	3.48	1.20	10.09
Smoking (Yes vs No)	-0.31	0.59	0.26	0.608	0.74	0.23	2.38
Socioeconomic status	0.709	0.59	1.43	0.231	2.03	0.64	6.48
Body mass index	-0.94	0.47	4.03	<b>0.045</b>	0.38	0.16	0.98

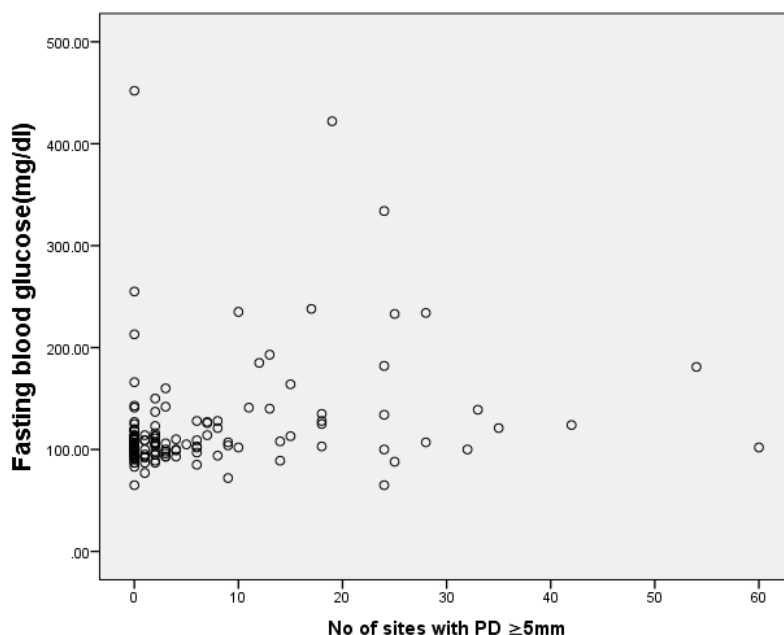
Diabetes	B	SE	Wald	Sig	OR	95% CI	
Severity of periodontitis							
Mild vs Severe	-1.37	0.69	3.86	<b>0.049</b>	0.255	0.065	0.997
Moderate vs Severe	0.44	0.67	0.42	0.515	1.55	0.41	5.81
Age	0.06	0.03	3.00	0.083	1.06	0.99	1.13
Gender (Males vs Females)	0.37	0.64	0.34	0.561	1.45	0.41	5.12
Smoking (Yes vs No)	0.22	0.69	0.10	0.751	1.25	0.32	4.83
Socioeconomic status	0.43	0.69	0.38	0.538	1.53	0.39	5.94
Body mass index	-0.64	0.56	1.32	0.251	0.53	0.18	1.58

**Table 2: Distribution of mean  $\pm$  s.d of all characteristics**

Characteristics	Mean	Std. Deviation
Age	42.46	8.47
Body mass index	25.11	2.08
Plaque index	1.34	0.29
Gingival index	1.32	0.29
No of sites with PD $\geq$ 5 mm	6.46	10.71
No of sites with PD $\geq$ 4 mm	19.22	16.12
No of sites with CAL $\geq$ 6 mm	5.98	11.85
No of sites with CAL $\geq$ 4 mm	17.84	26.85
No of sites with CAL $\geq$ 3 mm	35.56	36.90
Fasting blood glucose(mg/dl)	121.51	53.67

The relationships between selected variables like age, gender, socioeconomic status, smoking, and BMI with the severity of chronic periodontitis, and categories of fasting blood glucose level were

also analysed by the Chi-square test. Among all the variables, only BMI showed a statistically significant relationship with the severity of chronic periodontitis. Among the patients who



**Figure 1: Describes scatter plot between number of sites with probing depth (PD) ≥ 5mm and fasting blood glucose level**

were overweight/obese, 68% had moderate/severe periodontitis, while 32% had mild periodontitis. As far as the association of the selected variables with the categories of fasting blood glucose, a significant relationship was observed between BMI and categories of fasting blood glucose. Among the patients who had impaired fasting glucose, a greater number of patients were overweight or obese. A similar relation was observed between diabetic patients and overweight/obese patients.

The relationship between mean plaque index, mean gingival index, and mean fasting glucose was assessed using Pearson correlation. The result was a positive correlation and statistically significant. Correlation between PD ≥ 4 mm, PD ≥ 5 mm, CAL ≥ 3 mm, CAL ≥ 4 mm, CAL ≥ 6mm and fasting blood glucose level were assessed using Spearman correlation. Clinical parameters PD ≥ 5mm, PD ≥ 4 mm, and CAL ≥ 6 mm were significantly correlated with fasting blood glucose. Relationship between PD ≥ 5 mm and fasting blood glucose is shown in figure 1.

## DISCUSSION

Periodontal diseases exert a significant effect on the pathogenesis of various medical conditions, including diabetes mellitus (DM). This relationship prompts a necessity for oral health promotion in vulnerable patients and to execute a collaborative management protocol by the endocrinologist and dental specialist for timely diagnosis and effective management of both diseases. As far as we could possibly know, the current study is the first to investigate the effect of chronic periodontitis on fasting blood glucose level in systemically healthy patients visiting a tertiary care center in eastern Nepal. The study also examined the relationship between severity of chronic periodontitis and categories of fasting blood glucose level.

The mean fasting blood glucose level was 121.5 mg/dl (6.74 mmol/L) in the present study whereas that in Awuti et al<sup>12</sup> was 5.14±2.12 mmol/L which is comparable. The elevated mean fasting blood glucose level found in our study could be possibly due to a greater number of moderate/

severe periodontitis patients. The rationale behind choosing AAP/CDC classification in our study was that the periodontal disease peaks around 40 years and is analytically undervalued in older individuals when only pocket depth is computed. The contrary that attachment level measurement alone underrates prevalence in younger ages is also probably true. So, the combination criteria detailed a firmer meaning. Multivariate logistic regression analysis displayed that impaired fasting glucose was significantly related with age which is in agreement with a study by Song et al.<sup>13</sup> The likely reason is the impairment of oxidative phosphorylation and secretory functions of islet cells that might result in increase in glucose with age.<sup>13</sup> The elevated plasma levels of TNF- $\alpha$  and its soluble receptors, which are commonly associated with obesity may cause a hyper-inflammatory state accentuating the risks for periodontal disease and to some extent for insulin resistance. A statistically significant association was obtained between BMI and severity of chronic periodontitis which was in agreement with the results of Khader et al.<sup>14</sup>

The major finding of this investigation was that when the severity of periodontitis was compared with the categories of fasting blood glucose level, there was a statistically significant relationship ( $p < 0.05$ ). Compared with mild periodontitis, moderate/severe periodontitis patients showed higher fasting blood glucose level. This is uniform with the findings of Perez et al.<sup>15</sup> 191 Hispanic adults aged 40-65 years, free of diabetes, enrolled in San Juan Overweight Adults Longitudinal Study. Pre-diabetes was defined as impaired fasting glucose (IFG). Chronic periodontal inflammation can result in increased serum levels of TNF- $\alpha$ , which begin phosphorylation of serine remnants in the insulin receptor substrate-1, inducing insulin resistance in the target cells and intensifying the synthesis of C-reactive protein in liver. They may magnify and exacerbate low-grade inflammation. These processes may continue indefinitely through a positive feedback loop formed by the proinflammatory cytokines, and results in insulin resistance.<sup>16</sup> Another remarkable finding of our study was that 22.7% patients fell under diabetic category. Our findings

suggested that the risk of acquiring diabetes in mild periodontitis patients was 0.255 times less likely than patients with severe periodontitis. This finding is consistent with that of Awuti et al.<sup>12</sup> In the present study, the association between smoking and severity of chronic periodontitis was not statistically significant which was in contradiction to the findings of various studies like Perez et al.<sup>15</sup> 191 Hispanic adults aged 40-65 years, free of diabetes, enrolled in San Juan Overweight Adults Longitudinal Study. Pre-diabetes was defined as impaired fasting glucose (IFG) and Nibali et al.<sup>17</sup>. A potential clarification for the absence of association might be a fairly small number of current and past smokers in our study which was congruous with the observations by Khader et al.<sup>14</sup>

When plaque and gingival indices were correlated with fasting blood glucose level, the correlation was found to be positive and was statistically significant. Since, plaque is the main etiology for chronic periodontitis, the continued accumulation of plaque favours pocket formation which increases the severity of chronic periodontitis. A hyperinflammatory state (TNF- $\alpha$ , CRP) created might result in insulin resistance and hence, hyperglycemia. This might be the possible explanation for this significant finding.

Periodontal parameters like PD > 5 mm, PD > 4 mm and CAL > 6 mm were significantly correlated with fasting blood glucose level. Bacteria or bacterial products like lipopolysaccharides may gain entry into the general circulation through the ulcerated periodontal pocket, and cytokines such as tumor necrosis factor (TNF- $\alpha$ ), and interleukins (IL-6, IL-1 $\beta$ ) that are produced locally, will have systemic effects too resulting in change in the internal environment of the body. These mediators can result in persistent low-grade inflammation and occurrence of insulin resistance.<sup>18</sup> Our findings were in accordance with a study by Choi et al.<sup>19</sup> in which the highest quintile of CAL had higher prevalence odds of impaired fasting glucose (IFG) and diabetes. Dental visits are yet not thought a preventive dental behaviour; at present, it only relies upon curative needs. Thus, individuals from lower financial status neglect to make prophylactic

visits to a dentist therefore giving them inferior dental health. This can be related to the finding in our study that people from lower middle class had poor dental health.

Limitations of the study were that the inclusion of healthy samples could have permitted comparison of fasting blood glucose between periodontally healthy subjects and periodontitis patients. As of late, biochemical parameters like TNF- $\alpha$  and CRP in periodontitis patients are supposed to play a key part in the pathogenesis of diabetes.<sup>20</sup> The analysis of these parameters was not done in our investigation.

## CONCLUSIONS

The mean fasting blood glucose level in chronic periodontitis patients suggested that most of the patients had elevated fasting blood glucose. Since poor periodontal health brings about raised blood glucose level which increases the risk for diabetes, so periodontal screening is advisable at regular intervals for early diagnosis. The dental clinic may serve as an additional area for early diagnosis of Type II diabetes based on clinical periodontal manifestations.

**Conflict of interest:** None

NJHS

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