# THE ASSOCIATION OF PERIODONTAL DISEASES WITH TYPE 2 DIABETES MELLITUS AND DIABETES LINKED DYSLIPIDEMIA IN PAKISTANI POPULATION

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## ABSTRACT

*Objective:* To determine the development of dyslipidemia in type 2 diabetics with and without periodontal diseases.

*Study Design:* Comparative cross-sectional study.

*Place and Duration of Study:* Fauji Foundation Hospital and Pak Emirates Military Hospital, Rawalpindi, Pakistan, from Jan 2018 to Jan 2019.

*Methodology:* Total number of participated subjects (males and females) was 75, with age ranging from 23 to 72 years. Their tests included blood sugar, lipid profile, HbA1c and hepatitis screening. Oral health parameters were divided into two categories; type 2 diabetes mellitus with and without periodontitis.

*Results:* Out of 75 patients, males and females were 19 (25.3%) and 56 (74.7%). Females with periodontitis 20 (74.1%) and without periodontitis 36 (75%) possessed larger numbers. Mean ages [56.33 ± 10.88 years] had a higher incline, along with significantly altered total cholesterol [5.41 ± 1.70 mmol/l], triglycerides [2.55 ± 1.46 mmol/l], low and high density lipoproteins [3.01 ± 1.22 mmol/l, 0.97 ± 0.48 mmol/l] in type 2 diabetes mellitus with periodontitis. Patients of diabetes without periodontitis showed mild derangements for triglycerides [1.88 ± 1.22 mmol/l]. Patients of diabetes with dyslipidemia and periodontitis 16 (59.3%) were documented highest in number, compared to other type 2 diabetes mellitus groups.

*Conclusion:* There was an overall significant association between type 2 diabetes mellitus related dyslipidemia and periodontitis. Also, significant difference in age and gender of study subjects was noted that affected middle aged females more often than middle to late aged males.

**Keywords:** Age, Dyslipidemia, Gender, Oral health, Periodontal diseases, Type 2 diabetes mellitus.

## INTRODUCTION

The diabetes mellitus (DM) is one of the 21st century's non communicable concocted metabolic disorder, generated due to the insulin (generation, utilization or combined) problems, characterized by the raised glucose levels of blood, and is spreading too fast, creating colossal endangerments[1,2]. Out of all the three types of DM (type 1, type 2 and gestational), the most common is type 2 (T2DM), that reports nearby 90-95% of all the diagnosed scenarios. The prevalence of DM across the globe includes population of 415 million, which is estimated to incline to 642 million in the near future, according to the International Diabetes Federation (IDF)[3]. There is very high prevalence of DM with its associated complications and risk factors in the Pakistani population as well. According to the WHO fact sheet, DM is 13% (7.1 million) prevalent in the country in both genders, affecting 17.15% of the rural and 22.04% of the urban areas[4]. Dyslipidemia as a complication of T2DM is getting massive prevalence in Pakistan, triggering atherosclerosis and many other health risks[5].

Oral health is a significant component of the systemic health, that plays an essential role in the maintenance of overall good health and well-being, which if not conserved can trigger worse circumstances. Also, DM has been reported to cause some noxious effects on the oral health of patients. Dyslipidemia and altered glucose metabolism in T2DM have shown positive associations with multiple periodontal and oral inflam-

matory diseases, owing certain roles to pro-inflammatory cytokines for inducing such hyper-inflammatory states[6]. Many other studies have also documented the correlation of oral health diseases with T2DM. A case control study was done in subjects of T2DM with observations of multiple oral impacts that included; root caries: plaque index: decay, missing and filled teeth index (DMFT): tooth mobility: probing depth and bleeding on probing. Dietary habits constituted a major role for ODIP (oral impact on daily performance) in the patients of diabetes. The consumption of bread and meat in patients of T2DM had a huge influence on ODIP, which was fluctuated according to their glycemic statuses[7]. A cross-sectional observational study showed 42.5% oral soft tissue lesions and 25% candidiasis in patients of T2DM, recommending early screening of diabetes in them[8].

A literature on subjects of T2DM revealed the severity of periodontitis to be more prevalent in males as compared to females, with the exception of cases that were on insulin therapies[9]. A research highlighted a significant association of periodontal diseases with T2DM, showing poor glycemic control and salivary chromogranin A presence as the risk factors for periodontitis development in the associated subjects[10]. Also, a cross-sectional study in T2DM non-smokers that were under anti-diabetic drugs, showed poor glycemic controls with moderate to severe periodontitis and better glucose control rates with mild to nil periodontitis. One more survey showed the positive association of T2DM or obesity linked T2DM with periodontitis in Vietnamese patients.

This above mentioned evidence on the association of periodontitis with T2DM is variable and shows multipronged findings. We planned to assess an association between T2DM related dyslipidemia and periodontitis in comparison to patients having T2DM without dyslipidemia. This evidence would highlight the gap in literature for the patients of diabetes with dyslipidemia in our local context. The aim of present study was to correlate the association of periodontal diseases with T2DM and diabetes linked

dyslipidemia in Pakistani population, jeopardizing general health.

## METHODOLOGY

This research study was done according to comparative cross-sectional design, using non-probability, consecutive sampling technique. The duration of study was one year, from January 2018 to January 2019. Subjects for sampling were enrolled from Fauji Foundation Hospital and Pak Emirates Military Hospital, Rawalpindi, Pakistan. Since the study investigations were based at Army Medical College, National University of Medical Sciences (NUMS), the ethical approval was taken from this institution ethics review committee. Freshly diagnosed patients having T2DM and T2DM linked dyslipidemia were included in the study. Sample size was calculated using standardized WHO calculator with following statistical assumptions; confidence level = 95%, alpha error = 5%, study power = 80%, anticipated diabetic population with dental problems = 73.3% and assumed relative precision of 10%[11]. The calculated sample size (N) was 75 subjects. Patients without T2DM but having dyslipidemia, those on lipid lowering drug therapies and those possessing comorbids/chronic illnesses were excluded from the study. Study began with an informed written consent, detailed history, general physical and systemic examinations and proforma (containing personal, lifestyle and health related laboratory tests details). Whole venous blood sample (5 ml) of each patient was drawn in fasting periods. Fasting blood sugar (FBS): ≥ 7.0 mmol/l and random blood sugar (RBS): > 11.1 mmol/l was marked as the cut off values, as per American Diabetes Association (ADA). HbA1c > 6.5% was considered significant for T2DM diagnosis. Fasting lipid profile encompassed serum TC > 5.20 mmol/l, TAGs > 1.70 mmol/l, LDL-C > 2.50 mmol/l and HDL-C < 1.0 mmol/l, for tagging patients of diabetes with dyslipidemia. Hepatitis screening included hepatitis B surface antigen (HBsAg) and hepatitis C antibody (Anti-HCV) tests. Among many studied parameters of this study, importance of oral health to general well-being of subjects of diabetes emerged as a

fundamental concern. Oral health parameters in our subjects were divided into two categories; T2DM with periodontitis and T2DM without periodontitis.

Data analysis was carried out using SPSS-21 software. The expression of data for baseline characteristics (age and gender) was executed in terms of frequencies and percentages, and the lipid profile data was expressed as mean ± standard deviation (SD). Differences between dental categories in T2DM and T2DM with dyslipidemia were analyzed using Pearson's chi-square test. Whereas, the association of baseline characteristics and lipid profile with periodontal diseases was done using independent samples t-test, with consideration of a significant $p$-value of ≤ 0.05.

## RESULTS

Out of 75 patients, percentage and frequency of males and females were [19 (25.3%)] and [56 (74.7%)], respectively (table-I). The percentage and frequency of age groups were; 21 to 30 years [4 (5.3%)], 31 to 40 years [5 (6.7%)], 41 to 50 years [25 (33.3%)], 51 to 60 years [22 (29.3%)] and > 61 years [19 (25.3%)] (table-I).

Patients of diabetes with dyslipidemia and diabetes without dyslipidemia displayed percentage and frequency of 37 (49.3%) and 38 (50.7%), respectively (fig-1).

Subjects of diabetes with dyslipidemia showed total cholesterol levels of 5.05 ± 1.36 mmol/l, triglycerides levels of 2.12 ± 1.34 mmol/l, low density lipoprotein levels of 2.64 ± 1.05 mmol/l and high density lipoprotein levels of 1.02 ± 0.38 mmol/l, respectively (table-II).

Percentage and frequency of males and females with diabetes and periodontitis were 7 (25.9%) and 20 (74.1%), and males and females with diabetes but without periodontitis were 12 (25%) and 36 (75%), respectively (table-III). Thus, results revealed that male patients of diabetes, with and without periodontitis 7 (25.9%) and 12 (25%) possessed lower numbers than female patients of diabetes, with and without periodontitis 20 (74.1%) and 36 (75%). Patients of diabetes

with periodontitis and diabetes without periodontitis had mean ages of [56.33 ± 10.88 years] and [50.31 ± 11.14 years], respectively (table-III). The results displayed mean ages with a higher incline towards T2DM with periodontitis group [56.33 ± 10.88 years], as compared to subjects of T2DM without periodontitis group [50.31 ± 11.14 years], which showed lower mean ages. T2DM with periodontitis showed total cholesterol levels of 5.41 ± 1.70 mmol/l, triglycerides levels of 2.55 ± 1.46 mmol/l, low density lipoprotein levels of 3.01 ± 1.22 mmol/l and high density lipoprotein levels of 0.97 ± 0.48 mmol/l, respectively (table-III). T2DM without periodontitis showed total

**Table-I: The baseline characteristics (age and gender) of study subjects (n=75).**

| Parameters | | n (%) |
|---|---|---|
| Gender | Male | 19 (25.3) |
| | Female | 56 (74.7) |
| Age (Years) | 21 to 30 | 4 (5.3) |
| | 31 to 40 | 5 (6.7) |
| | 41 to 50 | 25 (33.3) |
| | 51 to 60 | 22 (29.3) |
| | 61 and above | 19 (25.3) |

**Table-II: The status of lipid profile characteristics of study subjects (n=75).**

| Parameters | Mean ± SD |
|---|---|
| Total Serum Cholesterol (mmol/l) | 5.05 ± 1.36 |
| Serum Triglycerides (mmol/l) | 2.12 ± 1.34 |
| Serum Low Density Lipoprotein Cholesterol (mmol/l) | 2.64 ± 1.05 |
| Serum High Density Lipoprotein Cholesterol (mmol/l) | 1.02 ± 0.38 |

cholesterol levels of 4.84 ± 1.09 mmol/l, triglycerides levels of 1.88 ± 1.22 mmol /l, low density lipoprotein levels of 2.43 ± 0.89 mmol/l and high density lipoprotein levels of 1.04 ± 0.32 mmol/l, respectively (table-III). Therefore, results concluded that subjects of T2DM with periodontitis showed marked lipid profile derangements as compared to the subjects of T2DM without periodontitis. Total cholesterol, low density lipoproteins and high density lipoproteins were found raised in subjects of T2DM with periodontitis [5.41 ± 1.70 mmol/l], [3.01 ± 1.22 mmol/l] and [0.97 ± 0.48 mmol/l], when compared to the subjects of T2DM without periodontitis group [4.84 ± 1.09

mmol/l, 2.43 ± 0.89 mmol/l and 1.04 ± 0.32 mmol/l] that displayed no lipid profile derangements. However, triglycerides value in subjects of T2DM with periodontitis [2.55 ± 1.46 mmol/l] was

dyslipidemia and periodontitis [16 (59.3%)] were greater in number, when contrasted with subjects of T2DM without dyslipidemia and periodontitis [27 (56.3%)], subjects of T2DM with

**Table-III: The association of baseline and lipid profile characteristics of study subjects with periodontal diseases.**

| Parameters | | Oral Health Parameters | | p-value |
|---|---|---|---|---|
| | | Group I Type 2 Diabetes Mellitus with Periodontitis (n=27) | Group II Type 2 Diabetes Mellitus Without Periodontitis (n=48) | |
| Gender | Male | 7 (25.9%) | 12 (25%) | 0.929 |
| | Female | 20 (74.1%) | 36 (75%) | |
| Age (Years) | | 56.33 ± 10.88 | 50.31 ± 11.14 | 0.027 |
| Lipid Profile | Total Serum Cholesterol (mmol/l) | 5.41 ± 1.70 | 4.84 ± 1.09 | 0.082 |
| | Serum Triglycerides (mmol/l) | 2.55 ± 1.46 | 1.88 ± 1.22 | 0.037 |
| | Serum Low Density Lipoprotein Cholesterol (mmol/l) | 3.01 ± 1.22 | 2.43 ± 0.89 | 0.022 |
| | Serum High Density Lipoprotein Cholesterol (mmol/l) | 0.97 ± 0.48 | 1.04 ± 0.32 | 0.437 |
| Type 2 Diabetes Categories | Type 2 Diabetes Mellitus With Dyslipidemia | 16 (59.3%) | 21 (43.8%) | 0.197 |
| | Type 2 Diabetes Mellitus Without Dyslipidemia | 11 (40.7%) | 27 (56.3%) | |

pictured with marked abnormalities, as compared to the subjects of T2DM without periodontitis [1.88 ± 1.22 mmol/l] that showed mild alterations. Percentage and frequency of T2DM with dyslipidemia and periodontitis were 16 (59.3%),
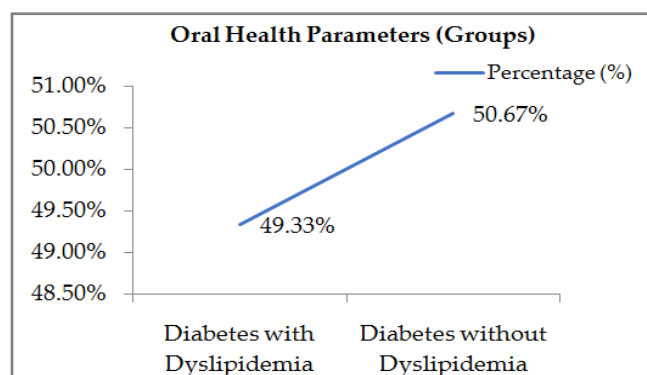


**Figure-1: General distribution of study subjects possessing type 2 diabetes mellitus with dyslipidemia and type 2 diabetes mellitus without dyslipidemia.**

T2DM with dyslipidemia and without periodontitis were 21 (43.8%), T2DM without dyslipidemia but with periodontitis were 11 (40.7%), and T2 DM without dyslipidemia and periodontitis were 27 (56.3%), respectively (table-III). Hence, it was concluded that the subjects of T2DM with

dyslipidemia and without periodontitis [21 (43.8%)], and subjects of T2DM without dyslipidemia but with periodontitis [11 (40.7%)].

## DISCUSSION

The current study proves significant derangement in the lipid profiles of patients presenting with coexistent T2DM and periodontal diseases, with affected number of cases to be 16 (59.3%). Age was also seen momentous in this research analysis, highlighting middle aged females to be influenced vastly, followed by middle to late aged males, for the prevalence of T2DM linked dyslipidemias and periodontitis. Diabetes mellitus is seen about 1 in every 11th adult and documented as the ninth major cause for worldwide mortalities that has affected global population in previous three decades up to four folds. The T2DM, also known as adult-onset diabetes is recorded to affect Asia frequently and making it the epicenter for the global T2DM epidemic[12].

Dyslipidemia is considered as a major risk factor for triggering cardiovascular events (CVDs) in T2DM, leading to marked morbidities and mortalities in male and female subjects[13].

Whereas, majority of the subjects of T2DM may carry certain additional concerns to CVDs, such as periodontitis. Periodontitis is an enduring infectious and inflammatory disorder, occurring due to sub gingival build-up of plaques and specific periodontopathogenic bacterial actions and it is seen three times superior in the cases of T2DM. Positive associations have been illustrious between the severity of periodontitis and degree of hyperglycemia[14]. Periodontitis has also proven its severity connections with CVD in subjects of T2DM. In order to ameliorate the life quality of subjects of T2DM suffering with CVDs and periodontitis, and impediment of their medical expense burden, nonsurgical periodontal treatment (root planning and scaling) is a requisite, along with life style modifications (healthy diet, healthy body weight maintenance and staying physically active).

The T2DM has been reported in previous literatures, such as in the WHO fact sheet of DM 2016 for Pakistan by Ms Laura Sminkey, to affect both the genders[4]. The DM prevalence is 17.15% in rural and 22.04% in urban areas of the country. The Khyber Pakhtun Khwa state showed prevalence rate of 11.1%, while Balochistan state uncovered the prevalence rate of 10.8% for diabetes in both sexes. Whereas, Punjab state revealed prevalence rate of diabetes in males as 16.6% and in females as 19.3%. On the other hand, Sindh state highlighted prevalence rate of 16.2% in males and 11.7% in females[15]. Some works such as diabetes fact sheets in Korea 2018 by Jong Chul Won, focused on males and females to be affected equally with T2DM, and with higher ascendancy towards increased ages, up to 60 years in men and 70 years in women[16]. Our findings included both males and females as well, but there were fewer males targeted as compared to females in the study, hence it was difficult to conclude that males were least prevalent than females for T2DM.

Past studies done by Sulaiman Nabil in subjects for early detection of T2DM in United Arab Emirates showed age groups between 40 to 60 years to be mostly influenced for the occurrence of T2DM, with early onset of dyslipidemias in young adults[17]. Our findings also showed middle aged males who suffered from T2DM linked dyslipidemia to be less predominant than females. Also, young (< 40 years) and older (> 61 years) ages were little prevalent for the onset of T2DM in our survey, that was quite similar to many former work results. Past literatures, such as studies conducted in Karachi, Pakistan by Sehrish Shafique in 2019, have shown positive association of T2DM with dyslipidemia in males affecting old ages. Out of targeted 383 patients of T2DM, 210 patients accompanied dyslipidemia[18]. Also, late ages (> 50 years in obese and ≤ 45 in non-obese) females were seen frequently suffering from T2DM without dyslipidemia in a research conducted at Beijing by Jiajia Jiang in 2019, while determining the association between age at natural menopause and risk of T2DM in postmenopausal women with and without obesity[19]. These prior study results appeared similar to our outcomes, which also presented T2DM males with dyslipidemia and T2DM females without dyslipidemia to be more endemic in late ages. The lipid profile derangements in T2DM with dyslipidemia have been seen followed by many mixed patterns. One similar study was conducted in Pakistan by Fauzia Jan in 2018 on patients of T2DM showed alteration in the lipid profile parameters (i.e. positive association between FBS and TC, TAGs and LDL-C and negative correlation between FBS and HDL-C)[20]. In our outcomes, serum triglycerides and LDL-C levels in patients of T2DM with dyslipidemia displayed marked derangements, while total cholesterol and HDL-C levels exhibited normal picture.

Dental problems in our subjects included dental caries, artificial teeth, swollen and painful gums, tooth losses, plaques and root canal treatments. Previous reports on T2DM linked with dyslipidemia and periodontitis have been documented with striking changes in the TC, TAGs and LDL-C values. Thus, positive ties have been found between periodontitis and T2DM with dyslipidemia (correlation of pro-inflammatory cytokines with worsened glycemic, lipid and periodontal parameters), affecting middle to late

ages in a research conducted by Rafael Nepomuceno in 2019 at Brazil. Lipid derangements documented were high TC, LDL-C and TAGs levels[6]. Similar lipid profile modifications were seen in our subjects of T2DM with periodontitis as well, which included raised TC, TAGs, LDL-C with addition of diminished HDL-C values. While, our subjects of T2DM without periodontitis showed near normal lipid profile parameters with exception of minute changes in TAGs (mildly raised) only. Thus, it was concluded that subjects of T2DM with periodontitis showed marked changes in the lipid profile, when contrasted to subjects of T2DM without periodontitis.

The T2DM with dyslipidemia has been evidenced to directly associate with active periodontitis (1.20 times higher risk) less distinctly in males as compared to females, affecting late ages, followed by the middle ages, in a Korean study by Jae-Hong in 2019[21]. However, this present study conclusion disclosed that middle to late aged males were led by middle aged females for T2DM linked dyslipidemia and periodontitis. And our cases of T2DM without periodontitis also exposed males in lesser records than females. Hence, determined that females who suffered from T2DM associated periodontitis were more dominant than males of the same group and also were more prevalent than females and males of T2DM without periodontitis group.

Preceding researches, one such directed by Baochen *et al* in 2019 at United States of America, has documented mean ages of subjects of T2DM with periodontitis to be around 51.5 ± 2.9 years[22]. This nearly parallels with our findings too, which displayed mean age of 56.33 ± 10.88 years to be more highlighted in the subjects of T2DM with periodontitis. Whereas, subjects of T2DM without periodontitis showed mean age around 50.31 ± 11.14 years, which relates with older investigates as well that displayed middle ages to be more affected in cases of T2DM without periodontitis. Thus, it could be drawn from our study conclusions that higher leaning was seen in mean ages of T2DM linked with periodontitis group as compared to T2DM linked without periodontitis group.

Many former revisions have displayed strong correlation of T2DM with periodontitis and risk of dyslipidemia, accompanied with poor glycemic controls in the affiliated subjects, such as a cross-sectional study on T2DM non-smokers, under anti-diabetic drugs, investigated by Zuila Albuquerque in 2018 at urban area of Sobral, Ceara, Brazil. Subjects with no or mild periodontitis showed FBS levels of 6.8 ± 2.0 mmol/l, as compared to the subjects with moderate to severe periodontitis that displayed FBS levels of 7.6 ± 1.9 mmol/l[23]. Our results correlated with these earlier literatures, showing relationship of T2DM with dyslipidemia and periodontitis to be more prevalent and resilient, as compared to T2DM without dyslipidemia and periodontitis, T2DM with dyslipidemia but without periodontitis, and T2DM without dyslipidemia but with periodontitis. Thus, periodontitis has been documented to impart dominant role in its association with T2DM linked and non-linked dyslipidemia. Our results also correlated with multiple former studies, implicating the medical significance of periodontitis as a risk indicator for T2DM.

## RECOMMENDATION

Good glycemic control maintenances and healthy lifestyle modifications can prevent the development of diabetes linked micro and macrovascular complications, and consequently periodontitis too. Also, further epidemiological and molecular researches will be required to ascertain the risk factors responsible for triggering periodontitis linked diabetic dyslipidemia.

## CONCLUSION

It is concluded that there was an overall significant association between type 2 diabetes mellitus related dyslipidemia and periodontitis. Further, there was significant difference in age and gender of the study subjects, as we found middle to late aged males to be less affected, whereas middle aged females were more often affected.

## CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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