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Prevalence and Determinants of Diabetes Mellitus in Tehsil Khall, District Lower Dir

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Abstract

Background: Diabetes mellitus (DM) is a chronic metabolic disorder marked by persistent hyperglycemia due to impaired insulin secretion, insulin action, or both, and it is a leading contributor to global morbidity and mortality. Pakistan carries a rapidly increasing diabetes burden, influenced by lifestyle transitions and genetic susceptibility. **Objective:** This study aimed to (i) determine the prevalence of diabetes mellitus in the population of Tehsil Khall, District Lower Dir, Khyber Pakhtunkhwa, Pakistan, and (ii) assess key associated factors, particularly age, marital status, and family history of diabetes. **Methods:** A community-based cross-sectional study was conducted in multiple localities of Tehsil Khall. Using a convenient random sampling approach, **384 participants** were enrolled. Data were collected through structured interviews using a pre-designed questionnaire covering sociodemographic characteristics and risk factors. Blood glucose levels were measured using a glucometer for diabetes screening and classification. Statistical analysis was performed using **SPSS (version 25)** and Microsoft Excel. Associations between diabetes status and explanatory variables were assessed using cross-tabulation and **Pearson's Chi-square test**, with significance set at $p<0.05$. **Results:** The overall prevalence of diabetes was **20.6%**, including **7.3% Type I (n=28)** and **13.3% Type II (n=51)**, while **79.4% (n=305)** were normoglycemic. Diabetes status showed statistically significant associations with **marital status** ($p=0.003$), **family history of diabetes** ($p<0.001$), and **age group** ($p<0.001$). Higher proportions of both Type I and Type II diabetes were observed among married participants, individuals with a positive family history, and participants aged above 45 years, indicating these as major risk groups in the study area. **Conclusion:** Diabetes prevalence in Tehsil Khall is substantial, with Type II diabetes being more common than Type I. Age above 45 years, positive family history, and marital status were significantly associated with diabetes. The findings support the need for targeted screening, awareness programs, and preventive

strategies focusing on high-risk groups to reduce diabetes burden and complications in Tehsil Khall.

INTRODUCTION

Diabetes mellitus (DM) is a major global health concern and the third leading cause of death after cancer and cardiovascular diseases, contributing significantly to morbidity and mortality rates worldwide^1. DM is a metabolic disorder characterized by elevated blood glucose levels, either due to insulin resistance or insufficient insulin production^2. Insulin is a vital hormone that facilitates glucose transport into cells, and its deficiency or dysfunction leads to hyperglycemia, which manifests as symptoms like frequent urination, thirst, and hunger^2. Over time, chronic hyperglycemia can cause severe damage to blood vessels and nerves, resulting in complications such as heart disease, kidney failure, and nerve damage^2. According to projections, 537 million adults globally were living with diabetes in 2021, and this number is expected to rise to 853 million by 2050^3. The rise in diabetes prevalence is attributed to factors such as urbanization, aging populations, reduced physical activity, and increasing rates of obesity^4.

In Pakistan, diabetes is a growing epidemic. The International Diabetes Federation (IDF) reported that 26.7% of adults in Pakistan, or approximately 33 million people, are affected by diabetes, with estimates suggesting that this number could nearly double to 62 million by 2045^5. The country ranks among the highest in terms of diabetes prevalence, largely driven by factors such as urbanization, poor diet, physical inactivity, and genetics^6,7. Type 2 diabetes (T2D) accounts for 85-90% of all diabetes cases and is particularly common among South Asians, including Pakistanis^6. As of 2012, Pakistan was ranked 10th globally for diabetes prevalence, with 6.6 million adult cases^5. Without effective intervention, this burden is expected to rise significantly, placing an increasing strain on the healthcare system and economy^8.

The pathophysiology of diabetes involves a dysfunction in insulin secretion or action, leading to high blood glucose levels. Type 1 diabetes (T1D) is an autoimmune disorder where the immune system attacks insulin-producing cells in the pancreas, requiring lifelong insulin therapy^9. In contrast, T2D is typically associated with insulin resistance and can often be managed with oral hypoglycemic medications or insulin

therapy^10. Long-term uncontrolled diabetes can result in complications such as cardiovascular diseases, kidney damage, blindness, and amputations^11. The rising incidence of diabetes is largely attributed to population aging, urbanization, poor dietary habits, and sedentary lifestyles^12.

In Pakistan, the increasing burden of diabetes poses a significant health challenge, especially in low-resource settings with limited access to healthcare^6. The economic and healthcare burden is substantial, as diabetes-related complications contribute to high healthcare costs and reduced productivity^8. Moreover, untreated or poorly managed diabetes can lead to acute complications such as diabetic ketoacidosis and non-ketotic hyperosmolar coma, which can be life-threatening if not treated promptly^13. The complications of diabetes can also predispose individuals to bacterial and fungal infections, further complicating management^14. The treatment of diabetes involves a combination of lifestyle modifications, including dietary changes, physical activity, and pharmacological interventions such as oral hypoglycemic agents or insulin therapy^15,16. Type 2 diabetes is also closely linked with hypertension and cardiovascular diseases, making the management of blood pressure and cholesterol levels an integral part of diabetes care^17,18. Microalbuminuria, an early indicator of kidney damage, is another important complication of diabetes that necessitates regular screening and timely intervention^19.

The objectives of this research are to assess the prevalence of diabetes in Tehsil Khall, Khyber Pakhtunkhwa, Pakistan, based on comprehensive screening and diagnostic tests. Additionally, the study aims to investigate the socio-demographic factors (age, gender, occupation, and lifestyle) associated with the prevalence of diabetes in this region. The study also seeks to evaluate the awareness and knowledge of local residents regarding diabetes, its risk factors, and preventive measures. This research is crucial for informing public health strategies and interventions to combat the rising burden of diabetes in Pakistan, particularly in areas with limited access to healthcare.

METHOD

This study was conducted in various areas of Tehsil Khall, District Lower Dir, Khyber Pakhtunkhwa, Pakistan. For this study, a total of 384 participants were selected from Tehsil Khall, with a focus on confirmed the inclusion of individuals diagnosed with

diabetes. In addition, patients from the private sector healthcare facilities (e.g., private clinics and practices) in the region were also considered. The participants were from diverse socio-economic backgrounds, ranging from low, middle, and high-income individuals. A **convenient random sampling technique** was employed to select participants, ensuring the inclusion of a representative sample from both public healthcare centers and private sector patients. The sample comprised patients belonging to Tehsil Khall, ensuring geographic relevance to the study area. Data collection was conducted through structured interviews, utilizing a specially designed questionnaire that included questions on diabetes occurrence, gender, age, marital status, family history, complications, and monthly income. Blood glucose levels of participants were measured using glucose meters. The data was analyzed using **SPSS version 25** and **Microsoft Excel (CPMSE)**, and statistical categorization was done based on gender, socio-economic, and genetic factors to help identify key risk factors for diabetes in the region. Ethical approval was obtained from the **Ethical Review Committee** of **Shaheed Benazir Bhutto University Sheringal Department of Zoology**, with informed consent obtained from each participant or their guardian. Participation was voluntary, and confidentiality was maintained throughout the study.

RESULT

Among the 384 respondents, the overall prevalence of diabetes was 20.6%, with 7.3% diagnosed with Type I diabetes (n=28) and 13.3% with Type II diabetes (n=51), while 79.4% of participants were normal (Table 1). Marital status showed a statistically significant association with diabetes diagnosis (χ^2 = 11.873, df = 2, p = 0.003), with diabetes being more prevalent among married individuals (Type I: 8.7%, Type II: 15.7%) compared to single individuals (Type I: 2.4%, Type II: 4.8%) (Table 2; Table 5).Family history demonstrated the strongest association with diabetes (χ^2 = 131.549, df = 2, p < 0.001), as participants with a family history of diabetes exhibited significantly higher proportions of both Type I (22.2%) and Type II (41.1%) diabetes compared to those without a family history (Type I: 2.7%, Type II: 4.8%) (Table 3; Table 5).Age was also significantly associated with diabetes (χ^2 = 39.199, df = 8, p < 0.001), with the highest prevalence observed in the middle-aged and older age groups—particularly those aged 46–65 years (Type I: 9.7%, Type II: 20.1%) and 66–85 years (Type I: 12.1%, Type II: 33.3%).

This highlights the increased risk of diabetes after the age of 45 (Table 4; Table 5). In contrast, economic status did not show a significant association with diabetes (χ^2 = 7.879, df = 6, p = 0.247), indicating that diabetes was present across all income categories without meaningful statistical differences (Table 6; Table 5).

Table 1: Overall Prevalence of Diabetes in the Study Population (n = 384)

DIABETES STATUS	FREQUENCY (N)	PERCENTAGE (%)
TYPE I DIABETES	28	7.3
TYPE II DIABETES	51	13.3
NORMAL	305	79.4
TOTAL	384	100.0

Approximately 20.6% of the study population has diabetes, with Type II diabetes being more prevalent than Type I.

Table 2: Sex-wise Prevalence of Diabetes Mellitus

Gender	TYPE I N (%)	TYPE II N (%)	NORMAL N (%)	TOTAL N (%)
Male	11 (7.0%)	25 (15.8%)	122 (77.2%)	158 (100%)
Female	17 (7.5%)	26 (11.5%)	183 (81.0%)	226 (100%)
Total	28 (7.3%)	51 (13.3%)	305 (79.4%)	384 (100%)

Chi-Square Test:

Pearson Chi-Square = 1.511, p = 0.470

There is no significant sex-based difference in the prevalence of diabetes in the study population.

Table 3: Association Between Marital Status and Diabetes Diagnosis

MARITAL STATUS	TYPE I N (%)	TYPE II N (%)	NORMAL N (%)	TOTAL N (%)
MARRIED	26 (8.7%)	47 (15.7%)	227 (75.7%)	300 (100%)
SINGLE	2 (2.4%)	4 (4.8%)	78 (92.9%)	84 (100%)
Total	28 (7.3%)	51 (13.3%)	305 (79.4%)	384 (100%)

Chi-Square Test:

$x^2 = 11.873$, $p = 0.003$

Marital status is significantly associated with diabetes prevalence, with married individuals showing higher rates of both Type I and Type II diabetes compared to single individuals.

Table 4: Association Between Family History of Diabetes and Diabetes Diagnosis

FAMILY HISTORY	TYPE I N (%)	TYPE II N (%)	NORMAL N (%)	TOTAL N (%)
YES	20 (22.2%)	37 (41.1%)	33 (36.7%)	90 (100%)
NO	8 (2.7%)	14 (4.8%)	272 (92.5%)	294 (100%)
Total	28 (7.3%)	51 (13.3%)	305 (79.4%)	384 (100%)

Chi-Square Test:

$x^2 = 131.549$, $p < 0.001$

A very strong and statistically significant association exists between family history and diabetes. Individuals with a family history of diabetes are significantly more likely to develop Type II diabetes.

Table 5: Association Between Age Group and Diabetes Diagnosis

AGE GROUP (YEARS)	TYPE I N (%)	TYPE II N (%)	NORMAL N (%)	TOTAL N (%)
6–25	2 (3.0%)	2 (3.0%)	62 (93.9%)	66 (100%)
26–45	7 (5.4%)	7 (5.4%)	116 (89.2%)	130 (100%)

46–65	15 (9.7%)	31 (20.1%)	108 (70.1%)	154 (100%)
66–85	4 (12.1%)	11 (33.3%)	18 (54.5%)	33 (100%)
86+	0 (0.0%)	0 (0.0%)	1 (100.0%)	1 (100%)
Total	28 (7.3%)	51 (13.3%)	305 (79.4%)	384 (100%)

Chi-Square Test:

$x^2 = 39.199$, $p < 0.001$

Age is strongly associated with diabetes prevalence. The 46-65 age group has the highest prevalence, suggesting a higher risk of diabetes after age 45.

Table 6: Economic Status and Diabetes

Monthly Income of the Sample	TYPE I N (%)	TYPE II N (%)	NORMAL N (%)	TOTAL N (%)
Below 50,000	8 (7.3%)	18 (16.5%)	83 (76.1%)	109 (100%)
60,000–100,000	11 (8.3%)	20 (15.0%)	102 (76.7%)	133 (100%)
1 Lac–1.5 Lac	3 (3.7%)	5 (6.2%)	73 (90.1%)	81 (100%)
Above 1.5 Lac	6 (9.8%)	8 (13.1%)	47 (77.0%)	61 (100%)
Total	28 (7.3%)	51 (13.3%)	305 (79.4%)	384 (100%)

Chi-Square Test:

Pearson Chi-Square = 7.879, p = 0.247

Economic status is not significantly associated with diabetes prevalence, as indicated by the p-value greater than 0.05.

Table 7: Summary of Statistical Tests for Key Risk Factors

RISK FACTOR	TEST USED	x^2 VALUE	DF	P-VALUE	STATISTICAL SIGNIFICANCE
MARITAL STATUS	Pearson Chi-Square	11.873	2	0.003	Significant

FAMILY HISTORY	Pearson Chi-Square	131.549	2	<0.001	Highly Significant
AGE GROUP	Pearson Chi-Square	39.199	8	<0.001	Highly Significant
ECONOMIC STATUS	Pearson Chi-Square	7.879	6	0.247	Not Significant

Family history and age group have the strongest and most statistically significant associations with diabetes. Marital status is also significant, while economic status does not show a significant effect.

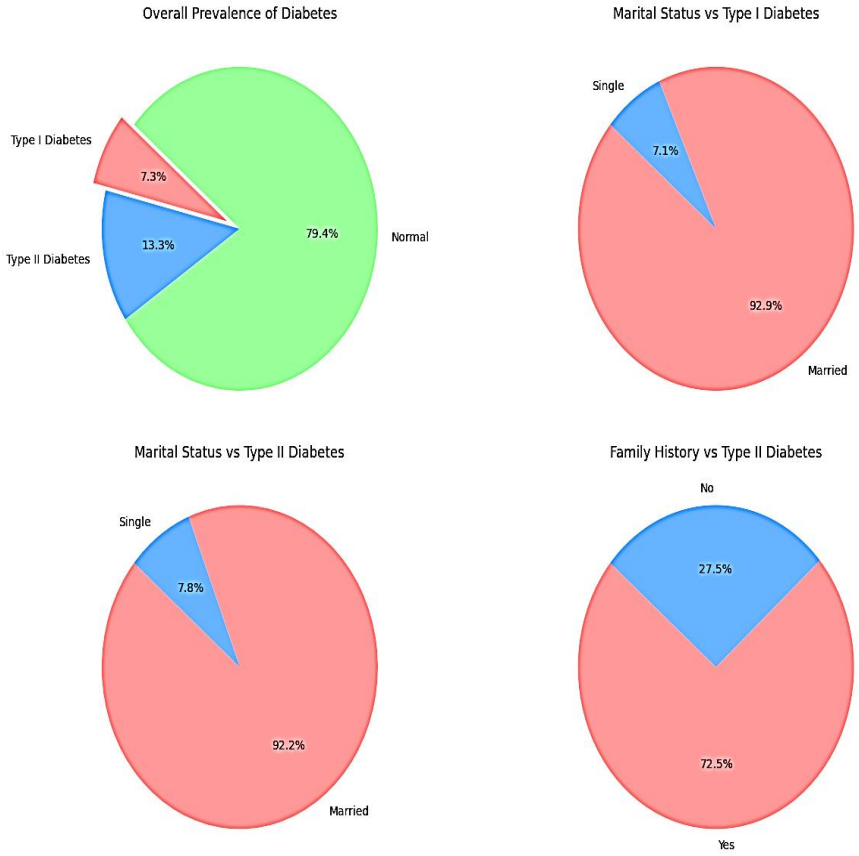

Fig: key findings of the results

DISCUSSION

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The present study was carried out to determine the prevalence of diabetes mellitus (DM) and to identify its associated risk factors in selected localities of Tehsil Khall, District Lower Dir, Khyber Pakhtunkhwa, Pakistan. The study area included Colony, Namser, Mansoor Abad, Kozkaly, Barkaly, Nimako, Kandaro, Shalfalam, Luqman Banda, Toormang-1, Toormang-2, and Rabat (Sabar Shah, Dab, Kotkay, Chenali, and Ganjla). Participants were randomly approached, interviewed, and screened using a structured questionnaire designed to obtain information regarding demographic characteristics, age, gender, family history of diabetes, clinical symptoms, treatment side effects, and economic status^11. The findings from Tehsil Khall represent a localized reflection of the wider and escalating diabetes burden in Pakistan. The overall prevalence of diabetes in the study population was 20.6%, indicating that nearly one out of every five individuals was affected. This prevalence falls within the range reported by earlier national surveys in Pakistan (11–26%) ^15. Among diabetic individuals, Type 2 diabetes (13.3%) was more common than Type 1 diabetes (7.3%), a pattern consistent with national, regional, and global trends. These findings further corroborate reports from the International Diabetes Federation, which have identified Pakistan as one of the countries with the highest diabetes prevalence worldwide^19. Recent estimates suggest that diabetes affects approximately 31.4% of adults aged 20–79 years in Pakistan, representing nearly 34.5 million individuals, with projections exceeding 70 million cases by 2050^20,21. In the present study, gender was not significantly associated with diabetes prevalence ($p=0.47$), indicating comparable susceptibility among males and females in Tehsil Khall. Specifically, Type 1 diabetes was observed in 7.0% of males and 7.5% of females, while Type 2 diabetes affected 15.8% of males and 11.5% of females. Although some previous studies have reported gender-based differences in diabetes prevalence, the findings from this study suggest that other factors, such as genetics and lifestyle, may exert a stronger influence within this population^22. Marital status demonstrated a statistically significant association with diabetes ($p=0.003$), with both Type 1 and Type 2 diabetes being more prevalent among married individuals compared to single participants. This association may be attributed to lifestyle-related factors linked with marriage, including dietary habits, reduced physical activity, psychosocial stress, and cultural responsibilities^23. Additionally, a strong genetic association was

observed between diabetes and a positive family history ($p<0.001$), particularly for Type 2 diabetes. This finding is consistent with previous studies emphasizing the role of hereditary factors in increasing susceptibility to diabetes^20,21

CONCLUSION

Diabetes—particularly Type 2 diabetes—constitutes a significant public health concern in Tehsil Khall. The disease burden is strongly influenced by age, marital status, and family history, underscoring the need for **targeted screening programs**, **early diagnosis**, **lifestyle modification interventions**, and **community-based awareness initiatives** to mitigate the rising prevalence of diabetes and its associated complications in this and similar regions.

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