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Original Article

Prevalence and Determinants of Diabetes Mellitus Among the Adult Population of District Swat and Peshawar, Khyber Pakhtunkhwa, Pakistan

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Abstract

Background: Diabetes mellitus is a rapidly growing global public health challenge affecting both developed and developing countries. Its prevalence is strongly influenced by demographic, epidemiological, nutritional, and environmental determinants. South Asian countries, including Pakistan, are experiencing a disproportionate rise in diabetes burden due to urbanization, sedentary lifestyles, and dietary transitions.

Objective: To estimate the prevalence of diabetes mellitus and examine its association with selected modifiable and non-modifiable determinants among the adult population of District Swat and District Peshawar.

Methodology: After obtaining ethical approval, a descriptive cross-sectional study was conducted from February to June 2024 among adults aged 18 years and above residing in Swat and Peshawar districts. A sample size of 309 participants was calculated using standard prevalence-based assumptions. Data were collected using a structured and pre-tested proforma covering sociodemographic characteristics, lifestyle behaviors, dietary patterns, and clinical history. Diabetes mellitus was defined based on prior diagnosis, use of anti-diabetic medication, and/or HbA1c level >6.6.

Results: Out of 309 participants, 19.74% were found to have diabetes mellitus. Among diabetic individuals, 44.26% were aged above 60 years, 60.66% were males, and 68.85% belonged to urban or semi-urban areas. Overweight or obesity was present in 39.34%, while 40.98% were unemployed. Significant associations were observed between diabetes mellitus and tobacco smoking (57.38%, p<0.001), positive family history (31.15%, p=0.0248), sedentary lifestyle (67.21%, p=0.0003), lack of physical exercise (80.33%, p=0.011), and meat consumption (p<0.001). Advanced age, marital status, low income, and overweight/obesity also showed significant associations.

Conclusion: The prevalence of diabetes mellitus in the study population was lower than national estimates but showed strong associations with both modifiable and non-modifiable determinants.

Keywords: Diabetes Mellitus, Lifestyle, Prevalence, Physical Activity, Risk Factors, Tobacco Smoking.

Introduction

Diabetes mellitus is one of the most significant non-communicable diseases of the 21st century and a major contributor to morbidity and mortality worldwide. Globally, the prevalence of type 2 diabetes mellitus has increased dramatically, with estimates rising from approximately 300 million individuals to more than 550 million by 2021 [1,2]. This growing burden has positioned diabetes mellitus as a critical public health concern requiring urgent preventive and control strategies [3]. Evidence suggests that the prevalence of diabetes is substantially higher in urban populations and continues to rise with progressive urbanization and lifestyle changes [4–7].

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both [8,9]. It is a leading cause of cardiovascular disease, renal failure, blindness, and lower-limb amputations and is currently among the top causes of death worldwide [10–12]. The disease is strongly associated with unhealthy dietary habits, overweight and obesity, physical inactivity, tobacco smoking, and sedentary lifestyle patterns [10–14]. Numerous studies have demonstrated that type 2 diabetes mellitus is largely preventable through lifestyle modification and early risk-factor control [13,14].

Recent evidence indicates that dietary transitions characterized by increased consumption of fats, sugars, processed foods, and reduced intake of fruits and vegetables play a pivotal role in the development of diabetes mellitus [1,8,15-19]. Sedentary behavior and lack of physical activity further exacerbate insulin resistance and metabolic dysfunction [20,21]. According to the International Diabetes Federation, the global prevalence of diabetes is projected to reach approximately 650 million by 2030 and nearly 800 million by 2045 [8,17]. These trends underscore the urgent need for population-based surveillance and targeted preventive strategies.

South Asia has emerged as a high-risk region for diabetes mellitus, with Pakistan ranking among the countries with the highest disease burden [22-24]. In Pakistan, it is estimated that approximately 25 million adults were living with diabetes mellitus in 2021, and national surveys suggest a prevalence of around 26.6% among adults [25]. Rapid urbanization, socioeconomic disparities, unhealthy dietary practices, and limited physical activity are major contributors to this escalating burden [22,25,26].

Despite the high prevalence of diabetes mellitus in Pakistan, district-level data on its determinants remain limited, particularly in Khyber Pakhtunkhwa. Understanding local prevalence patterns and associated risk factors is essential for designing effective prevention and control strategies. Therefore, this study was conducted to estimate the prevalence of diabetes mellitus and examine its relationship with selected modifiable and non-modifiable determinants among the adult population of District Swat and District Peshawar, with the aim of informing evidence-based public health interventions at the community level.

Methodology

Study Design

A descriptive cross-sectional study design was employed to determine the prevalence of diabetes mellitus and its association with selected modifiable and non-modifiable determinants among adults. This design was considered appropriate for estimating disease burden and exploring associations between diabetes mellitus and demographic, behavioral, and lifestyle factors at a single point in time.

Ethics

Ethical approval was obtained from the Ethical Review Board of Saidu Medical College, Swat (Approval No. 125-ERB/024; dated 02-02-2024). All study procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from each participant prior to enrollment after explaining the study objectives, procedures, potential benefits, and confidentiality assurances.

Setting

The study was conducted in District Swat and District Peshawar, Khyber Pakhtunkhwa, Pakistan, from February to June 2024. These districts were selected to represent both urban/semi-urban and rural populations, allowing assessment of geographic and lifestyle-related variations in diabetes prevalence and associated determinants.

Participants

The study population comprised adults aged 18 years and above who were permanent residents of either Swat or Peshawar districts. Participants were selected using a probability sampling technique. Individuals with multimorbidity, severe acute illness, or those unwilling to participate were excluded. Eligibility criteria were applied uniformly to ensure homogeneity and reduce selection bias.

Variables

The primary outcome variable was diabetes mellitus status. An individual was classified as diabetic if they had a prior physician diagnosis, were currently using anti-diabetic medication, and/or had an HbA1c level greater than 6.6%. Independent variables included non-modifiable factors such as age, gender, marital status, educational level, family history of diabetes, and locality, as well as modifiable factors including body mass index (BMI), dietary preferences (fruits, vegetables, meat, sugar, and salt), tobacco smoking, physical activity, sedentary lifestyle, occupation, income, and presence of acute or chronic illness.

Data Sources/Measurement

Data were collected using a structured and pre-tested proforma developed after an extensive review of international literature, WHO and CDC guidelines, and consultation with public health experts, endocrinologists, and clinicians. Anthropometric measurements were recorded to calculate BMI. Dietary habits, physical activity, sedentary behavior, and smoking history were self-reported. HbA1c values were used to confirm diabetic status where applicable. All measurements followed standardized operational definitions to ensure consistency and reliability.

Bias

Several measures were adopted to minimize bias. Probability sampling reduced selection bias, while the use of a standardized questionnaire minimized information bias. Clear inclusion and exclusion criteria were applied to limit confounding from multimorbidity. Data collectors were trained to ensure uniform data recording, and validated definitions were used for diabetes mellitus and its determinants.

Study Size

The sample size was calculated using a standard sample size calculator for cross-sectional studies, assuming a prevalence of diabetes mellitus of 26.7%, a 95% confidence interval, and a 5% absolute precision. Based on these parameters, a minimum sample size of 309 participants was determined and achieved.

Quantitative Variables

Quantitative variables such as age and BMI were summarized using mean and standard deviation, while categorical variables were expressed as frequencies and percentages. Diabetes prevalence was reported with corresponding confidence intervals.

Statistical Methods

Data were entered and analyzed using SPSS version 26.0. Descriptive statistics were used to summarize participant characteristics. Associations between diabetes mellitus and independent variables were assessed using the chi-square test. A p-value of less than 0.05 was considered statistically significant. Results were presented in the form of tables and figures for clarity and interpretation.

Results

Participants

A total of 309 adults aged 18 years and above participated in the study from District Swat and District Peshawar during the study period. All selected participants fulfilled the eligibility criteria and provided informed consent. The study population represented both urban/semi-urban and rural settings, allowing assessment of diabetes prevalence and determinants across diverse demographic and lifestyle backgrounds.

Descriptive Data

Among the total study population, a wide variation in sociodemographic and lifestyle characteristics was observed. Participants included both males and females across different age groups, educational levels, occupational statuses, and income categories. The population demonstrated heterogeneous dietary preferences, physical activity patterns, and health behaviors, including tobacco smoking and sedentary lifestyle practices. Body mass index categories ranged from underweight to overweight/obese, and participants reported varying levels of physical exercise and dietary intake of fruits, vegetables, meat, sugar, and salt.

Outcome Data

The overall prevalence of diabetes mellitus among the study participants was 19.74% (95% CI: 18.86%–20.62%) (Figure 01). Among individuals diagnosed with diabetes mellitus, a higher proportion belonged to older age groups, particularly those aged 60 years and above. A considerable proportion of diabetic participants were males, resided in urban or semi-urban areas, and reported lower monthly income levels. Overweight and obesity were common among diabetics, along with unemployment and lower educational attainment. Behavioral and lifestyle factors such as tobacco smoking, sedentary lifestyle, and lack of regular physical exercise were frequently reported among diabetic individuals.

Main Results

Among participants diagnosed with diabetes mellitus, 44.26% were aged 60 years or above, while 60.66% were males. A substantial proportion (73.77%) reported a monthly income of less than PKR 50,000, and 34.43% were illiterate. Overweight or obesity was present in 39.34% of diabetic individuals, and 68.85% belonged to urban or semi-urban localities. Unemployment was reported by 40.98% of diabetic participants (Table 01). Tobacco smoking was significantly more common among diabetics, with 57.38% reporting a positive smoking history (p<0.001). A positive family history of diabetes mellitus was observed in 31.15% of diabetic individuals (p=0.0248). Dietary patterns revealed that 52.46% of diabetics did not prefer fruits, 26.23% did not prefer vegetables, and 37.70% preferred meat, with meat consumption showing a statistically significant association with diabetes mellitus (p<0.001). Sedentary lifestyle was reported by 67.21% of diabetic participants (p=0.0003), while 80.33% reported no regular physical exercise (p=0.011) (Table 02). Significant associations were observed between diabetes mellitus and advanced age, marital status, low income, overweight/obesity, tobacco smoking, family history of diabetes, sedentary lifestyle, and physical inactivity.

Table 1: Demographic determinants among diabetes mellitus & non diabetes mellitus population.

Variables		Diabetes Mellitus		Total (N=309)	p-value
		Yes (N=61)	No (N=248)		
Age (years)	< 30	4(6.56)	29(11.69)	33(10.68)	0.241
	30- 45	9(14.75)	47(18.95)	56(18.12)	0.149
	45-60	21(34.43)	79(31.85)	100(32.36)	0.149
	60 & above	27(44.26)	93(37.50)	120(38.83)	0.005*
Gender	Male	37(60.66)	167(67.34)	204(66.02)	0.320
	Female	24(39.34)	81(32.66)	105(33.98)	
Occupation	Labor	6(9.84)	64(25.81)	70(22.65)	0.010*
	Government Servants	17(27.87)	73(29.44)	90(29.13)	0.800
	Housewife	11(18.03)	31(12.50)	42(13.59)	0.258
	Students	2(3.28)	29(11.69)	31(10.03)	0.050
	None	25(40.98)	51(20.56)	76(24.60)	<0.000*
Educational Status	Literate	40(65.57)	159(64.11)	199(64.40)	0.831
	Illiterate	21(34.43)	89(35.89)	110(35.60)	
Monthly Income PKR	< 30000	28(45.90)	76(30.65)	104(33.66)	0.023*
	30000-50000	17(27.87)	90(36.29)	107(34.63)	0.304
	50000-100000	11(18.03)	49(19.76)	60(19.42)	0.304
	100000 & Above	5(8.20)	33(13.31)	38(12.30)	0.276
Marital Status	Married	43(70.49)	64(25.81)	107(34.63)	< 0.000*
	Unmarried	18(29.51)	184(74.19)	202(65.37)	
BMI	Underweight	9(14.75)	27(10.89)	36(11.65)	0.345
	Normal	17(27.87)	133(53.63)	150(48.54)	0.001*
	Overweight/obese	24(39.34)	67(27.02)	91(29.45)	0.001*
Locality	Rural	19(31.15)	102(41.13)	121(39.16)	0.152
	Urban/Semi-Urban	42(68.85)	146(58.87)	188(60.84)	

Chi square/ Fischer's exact test applied; p-value <0.05 is considered statistically significant

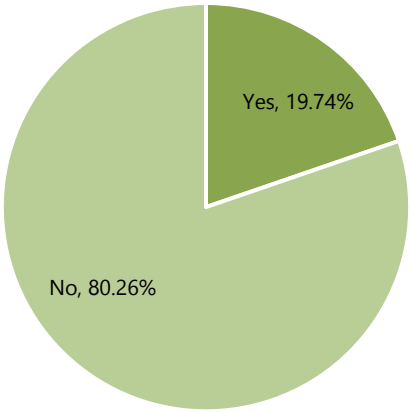


Figure 1: Prevalence of diabetes mellitus among adults of district Swat & Peshawar.

Table 2: Modifiable and non-modifiable determinants among diabetes mellitus & non diabetes mellitus population.

Variables		Diabetes Mellitus		Total (N=309)	p-value
		Yes (N=61)	No (N=248)		
Tobacco Smoking	Yes	35(57.38)	67(27.02)	102(33.01)	< 0.000*
	No	26(42.62)	181(72.98)	207(66.99)	
Positive Family History of DM	Yes	19(31.15)	45(18.15)	64(20.71)	0.024*
	No	42(68.85)	203(81.85)	245(79.29)	
Have any acute disease	Yes	13(21.31)	25(10.08)	38(12.30)	0.016*
	No	48(78.69)	223(89.92)	271(87.70)	
Have any Chronic Disease	Yes	20(32.79)	52(20.97)	72(23.30)	0.050*
	No	41(67.21)	196(79.03)	237(76.70)	
Do you like Salt in food	Yes	46(75.41)	176(70.97)	222(71.84)	0.489
	No	15(24.59)	72(29.03)	87(28.16)	
Do you like too Much Salt	Yes	7(11.48)	31(12.50)	38(12.30)	0.700
	No	39(63.93)	145(58.47)	184(59.55)	
Do you like Sugar in food/drinks	Yes	42(68.85)	157(63.31)	199(64.40)	0.417
	No	19(31.15)	91(36.69)	110(35.60)	
Do you like too Much Sugar	Yes	18(29.51)	49(19.76)	67(21.68)	0.156
	No	24(39.34)	108(43.55)	132(42.72)	
Do you like Fruits	Yes	29 (47.54)	198(79.84)	227(73.46)	<0.000*
	No	32(52.46)	50(20.16)	82(26.54)	
Do you like Vegetables	Yes	45(73.77)	161(64.92)	206(66.67)	0.1889
	No	16(26.23)	87(35.08)	103(33.33)	
Do you like Meat	Yes	23(37.70)	187(75.40)	210(67.96)	0.000*
	No	38(62.30)	61(24.60)	99(32.04)	
Are you living a sedentary Life Style	Yes	41(67.21)	103(41.53)	144(46.60)	0.000*
	No	20(32.79)	145(58.47)	165(53.40)	
Do you do any physical Exercise	Yes	12(19.67)	91(36.69)	103(33.33)	0.011*
	No	49(80.33)	157(63.31)	206(66.67)	

Chi square/ Fischer's exact test applied; p-value <0.05 is considered statistically significant.

Discussion

The present study was conducted to estimate the prevalence of diabetes mellitus and to identify its key modifiable and non-modifiable determinants among the adult population of District Swat and District Peshawar, Khyber Pakhtunkhwa, Pakistan. The overall prevalence of diabetes mellitus observed in this study was 19.74%, which, although lower than the national estimates reported by the Pakistan Health Research Council, remains substantial and reflects a growing public health concern at the community level [25-28]. Comparable prevalence rates have been reported in several international studies, including those by Yan et al. and Alhusseini et al., where prevalence ranged between 17% and 19% [5,18]. However, lower prevalence figures have been documented in some African settings, such as Ethiopia, highlighting regional and contextual differences in risk exposure and lifestyle factors [3,4].

Advanced age emerged as one of the strongest non-modifiable determinants of diabetes mellitus in this study, with nearly half of diabetic individuals aged 60 years and above. This finding is consistent with multiple international studies demonstrating a strong association between increasing age and diabetes mellitus, likely due to progressive insulin resistance, pancreatic beta-cell dysfunction, and cumulative exposure to metabolic risk factors [15,16]. Similar age-related trends have been documented in population-based studies from West Africa, Europe, and Asia [15,16].

Socioeconomic factors also played a significant role in diabetes prevalence. A higher proportion of diabetic participants were unemployed and belonged to lower income groups, findings that align with previous evidence linking low socioeconomic status with poor dietary quality, reduced access to healthcare, and limited opportunities for physical activity [9,13,22]. Urban and semi-urban residence was more common among diabetic individuals, supporting the well-documented association between urbanization and increased diabetes risk due to sedentary lifestyles, dietary transitions, and psychosocial stress [14,21,22].

Among modifiable determinants, overweight and obesity showed a significant association with diabetes mellitus, reinforcing the established link between excess adiposity, central obesity, insulin resistance, and metabolic dysregulation [10,28]. The proportion of overweight/obese individuals among diabetics in this study was comparable to findings from international studies conducted in South Asia and Africa [14,24]. Tobacco smoking was also significantly associated with diabetes mellitus, with more than half of diabetic participants reporting a positive smoking history. This finding is consistent with evidence suggesting that smoking contributes to insulin resistance, chronic inflammation, and increased risk of type 2 diabetes mellitus [14,24].

Dietary habits emerged as important modifiable determinants in this study. Lower preference for fruits and higher preference for meat were significantly associated with diabetes mellitus, supporting existing literature that emphasizes the protective role of fruits and vegetables and the adverse metabolic effects of diets high in animal fats and processed foods [1,17,18]. Although vegetable intake did not show a statistically significant association in this study, the overall dietary pattern suggests suboptimal nutritional practices among diabetic individuals, consistent with findings from previous regional and international studies [12,19].

Physical inactivity and sedentary lifestyle were among the most prominent modifiable risk factors identified. A substantial proportion of diabetic participants reported sedentary behavior and lack of regular physical exercise, findings that mirror evidence from large epidemiological studies highlighting physical inactivity as a key driver of diabetes mellitus [6,20]. These findings further support the need for community-based interventions promoting active lifestyles as a cornerstone of diabetes prevention and control [7,29].

Limitations

This study has several limitations that should be acknowledged. First, the descriptive cross-sectional design limits the ability to establish causal relationships between diabetes mellitus and its associated determinants. Second, although the sample size met the calculated requirement, a larger sample including additional districts would enhance generalizability and statistical power. Third, the study relied partly on self-reported data for dietary habits, physical activity, and smoking history, which may be subject to recall and reporting bias. Additionally, multivariate logistic regression analysis was not performed, which could have provided more robust estimates of independent predictors of diabetes mellitus. Despite these limitations, the study provides valuable district-level evidence on diabetes prevalence and determinants in a region where data remain limited.

Conclusion

This study concludes that diabetes mellitus is prevalent among nearly one-fifth of the adult population in District Swat and District Peshawar. Both modifiable and non-modifiable determinants were significantly associated with diabetes mellitus, including advanced age, family history, overweight/obesity, tobacco smoking, sedentary lifestyle, physical inactivity, and unfavorable dietary patterns. Although the observed prevalence was lower than national estimates, the strong associations with lifestyle-related factors underscore the urgent need for comprehensive prevention strategies. Community-based interventions focusing on healthy diet, increased physical activity, tobacco cessation, and early screening particularly among high-risk groups are essential to curb the rising burden of diabetes mellitus and its long-term complications.

Authors' Contributions:

All authors meet the ICMJE criteria for authorship.

Author 1: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 2: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 3: Analysis and interpretation of data, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 4: Analysis and interpretation of data, critical revision, final approval, agreed to be accountable for all the work.
Author 5&6: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 7&8: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.

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