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Gender and Family Medical History as Determinants of Type-2 Diabetes Mellitus Complications: A Cross-Sectional Assessment from Haripur, Pakistan

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ABSTRACT

Type-2 diabetes mellitus (T2DM) has emerged as a leading cause of disability worldwide. In recent years, non-communicable diseases (NCDs) have been responsible for approximately 41 million deaths annually, with the majority occurring in low- and middle-income countries (LMICs). **Objectives:** To explore type 2 diabetic associated complications, and investigate the factors associated with type 2 diabetes complications in patients at the District Headquarter Hospital (DHQ) in Haripur, Pakistan. **Methods:** A cross-sectional study was conducted at DHQ Hospital, Haripur, using a convenience sampling technique. A study involving 422 patients diagnosed with type 2 diabetes mellitus. Data were collected using a self-structured questionnaire that assessed diabetes-related complications. The collected data were analyzed using SPSS version 22.0. **Results:** Significant associations were found between gender and several health indicators, including blood glucose levels, HbA1c, eye pain/redness, and sleep disturbances ($p<0.050$). Additionally, family medical history showed significant associations with multiple diabetic complications, including blurred vision, blindness, eye redness, swelling of feet/ankles/hands, loss of sensation in feet, ingrown toenails or fungal infections, and changes in skin color ($p<0.050$). These relationships were supported by significant crude odds ratios (CORs), indicating strong statistical relevance. **Conclusions:** The study found a strong link between type 2 diabetes complications and factors such as family history, gender, income, and lab results (HbA1c, RBS, FBS). It is recommended to strengthen routine screening and early intervention, especially among high-risk groups, to prevent complications.

INTRODUCTION

Type-2 diabetes mellitus (T2DM) is a persistent state of hyperglycemia and glucose intolerance that occurs when the body cannot respond fully to insulin, followed by an increase in insulin production and a subsequent insulin deficiency [1]. The largest cause of death in 2019 was diabetes. According to the World Health Organization (WHO), the prevalence is high in low and middle-income countries, and Pakistan is the country that has diabetes related death [2]. In a recent survey, the second National Diabetes Survey of Pakistan (NDSP), conducted between 2016 and 2017, it was estimated that around 26.3% of the population above 19 years of age in the country had diabetes. Among them, 19.2% were known diabetics, while 7.1% were newly diagnosed cases [3]. According to

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estimates from the Global Burden of Diseases, Injuries, and Risk Factors Study, diabetes was the 8th leading cause of death and disability combined in the world, with nearly 460 million people across every country and age group living with the disease in 2019 [4]. The number of adults living with Type-2 Diabetes (T2D) is estimated to increase from 463.0 million to 700.2 million between 2019 and 2045 [5]. International Diabetes Federation IDF data states that Pakistan ranks 4th in the world, and the prevalence of diabetes is 19.4 million [6]. There were so many complications that 76.4% of diabetic individuals reported having at least one [7]. Recent studies propose that irregular sleep patterns may be just as significant a risk factor for diabetes as obesity and physical inactivity [8]. Nephropathy and retinopathy are among the microvascular complications that can result from diabetes mellitus. Global prevalence of diabetic retinopathy and projection of burden through 2045 [9]. According to reports, diabetic retinopathy (DR) is the primary cause of blindness in people with diabetes [10]. Additionally, it has been estimated that 4.1% and 6.2% of diabetics, respectively, have sight-threatening conditions [11]. Therefore, assessment of diabetic complications plays a central role in clinical practice. The early detection of these complications through regular assessments enables timely intervention, slows disease progression, and helps prevent irreversible damage [12, 13].

The majority of research in Pakistan has been on large metropolitan areas; there is a dearth of region-specific data on T2DM issues in rural areas like Haripur. The distinct effects of family medical history on particular microvascular vs macrovascular issues in the local population have not been well investigated. Gender, family history, and diabetes problems cannot be causally linked due to the cross-sectional methodology. This study aimed to explore the factors associated with T2DM complications in patients at the District Headquarter Hospital (DHQ) in Pakistan.

METHODS

A cross-sectional study was conducted from March to May 2023 among patients with T2DM at the District Headquarter Hospital in Haripur, Khyber Pakhtunkhwa, Pakistan. Before participation, all eligible individuals were informed about the procedure and objective of the study, and written informed consent was obtained, in accordance with the ethical principles outlined in the Declaration of Helsinki. A self-structured questionnaire was used to assess T2DM complications and demographic characteristics. The questionnaire was divided into two sections: the first section focused on the demographic characteristics, such as gender, age, and marital status, while the second section comprised diabetic complications. Data were collected through face-to-face interviews to ensure accurate and complete response and questions were explained in simple terms when necessary to facilitate participant understanding were conducted with the participants. The sample size for this study was calculated using the single population proportion formula for an infinite population: $n = (Z^2 \times p(1-p)) / e^2$, where $Z = 1.96$ for a 95% confidence level, $p = 0.5$ (assuming a 50% proportion to maximize sample size), and $e = 0.05$ as the margin of error. Applying these values, the calculation was $n = (1.96^2 \times 0.5(1-0.5)) / 0.05^2 = (3.8416 \times 0.25) / 0.0025 = 0.9604 / 0.0025 = 384.16$, which was rounded up to 385 participants. To account for potential non-response and incomplete questionnaires, an additional 15% was added ($385 \times 0.15 = 58$), resulting in a target sample size of 443 participants. A final analyzable sample of 422 participants resulted from some people not responding during data collection. Convenience sampling was used. To ensure that the study addressed the appropriate group, participants had to be 18 years of age or older and have a verified diagnosis of type 2 diabetes. Pregnant patients, those with mental illness or cognitive impairment that precluded informed consent, and those with inadequate medical records pertinent to the research variables were also eliminated. To evaluate dependability in terms of internal consistency, Cronbach's alpha statistics were computed for the entire scale.

The Statistical Package for the Social Sciences (SPSS), version 22.0, was used to analyze the data. Demographic traits and complications associated with diabetes were compiled using descriptive statistics. Categorical data were represented as frequencies and percentages, whilst continuous variables were shown as means with standard deviations. Associations between independent factors and complications associated with diabetes were examined using the chi-square test; a p-value of less than 0.050 was considered statistically significant.

RESULTS

According to an analysis of the demographic data, there were more women (65.6%) than men in the research sample, and more than one-third of participants (37.0%) were older than 60 years, with a significant number of those over 60 (37.0%). A significant percentage (22.7%) of individuals had a family medical history, and the majority were married. A significant portion had either no qualifications (25.2%) or "10 years or less of education" (29.3%). Agriculture accounted for 57.6% of all occupational categories. Government employees (19.2%) and those with other specified occupations (20.6%) came next. The majority of participants had one to three children, and 65.2% of them earned less than $25,000 a month. It's

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interesting to note that 50% of individuals either had cultivable land or did not. The examination of relationships between these characteristics and the medical parameters indicated in the study is contextualized by these demographic findings. The research participants' sociodemographic details, such as gender, age, marital status, education, employment, income, number of children, and land ownership, are displayed. To investigate their relationship to pertinent medical indicators in the research, these factors were examined (Table 1).

Table 1: Socio-Demographic Characteristics of Respondents

Variables	Category	n (%)
Gender	Male	145 (34.4%)
	Female	277 (65.6%)
Age (Years)	18-26	21 (5.0%)
	27-37	65 (15.4%)
	38-48	93 (22.0%)
	49-59	87 (20.6%)
	Above 60	156 (37.0%)
Marital Status	Married	366 (86.7%)
	Single	26 (6.2%)
	No Response	326 (77.3%)
Qualification	Nil	92 (25.2%)
	10 Years or Less of Education	107 (29.3%)
	12 Years of Education	50 (13.7%)
	Undergraduates	60 (16.4%)
	Graduates	56 (15.3%)
Occupation	Farmer	243 (57.6%)
	Businessman	11 (2.6%)
	Govt Employee	81 (19.2%)
	Other Specify	67 (20.6%)
Monthly Income (PKR)	<25000	275 (65.2%)
	25000-50000	144 (34.1%)
	>50000	3 (0.7%)
How Many Children Do You Have?	1-3	180 (42.7%)
	4-8	227 (53.8%)
	>8	15 (3.6%)
Have any Cultivatable Land	Yes	211 (50%)
	No	211 (50%)

Source= primary data, n = frequency, % = Percentage

The findings revealed a high prevalence of diabetes indicators: 75.1% had fasting blood sugar >125 mg/dl, 90.5% had random blood sugar >180 mg/dl, and 68.7% had HbA1c >6.5%. Common complications included blurred vision (73.2%), numbness (93.6%), tingling (86.3%), limb swelling (69.4%), and increased urination (92.2%). Elevated blood pressure was noted in 69.0% of participants, with weight loss (76.5%) and sleep disturbances (83.4%), further suggesting serious health burdens (Table 2).

Table 2: Description of Complications of Type-2 Diabetic Patients

Variables	Category	n (%)
Fasting Blood Sugar	Less than 100mg/dl	13 (2.0%)
	100-125mg/dl	92 (19.0%)
	More than 125mg/dl	317 (70.0%)
Random Blood Glucose Level (mg/dl)	100-180	40 (9.0%)
	More than 180	382 (90.5%)
HbA1c	Below 6%	18 (4.3%)
	6%-6.4%	1 (0.2%)
	Greater than 6.5%	290 (68.7%)
	None	113 (26.8%)
Blurred Vision	Present	309 (73.2%)
	Absent	113 (26.8%)
Blindness	Present	114 (27.0%)
	Absent	308 (73.0%)
Eye Pain / Redness	Present	296 (70.1%)
	Absent	126 (29.9%)
High Blood Pressure	Present	291 (69.0%)
	Absent	131 (31.0%)
Swelling of Feet, Ankles and Hands	Present	293 (69.4%)
	Absent	129 (30.6%)
Increased Need to Urinate	Present	389 (92.2%)
	Absent	33 (7.8%)
Numbness	Present	395 (93.6%)
	Absent	27 (6.4%)
Tingling Sensation	Present	634 (86.3%)
	Absent	58 (13.7%)
A Burning or Sharp Pain in the Feet	Present	365 (86.5%)
	Absent	57 (13.5%)
Loss of Feeling in Feet	Present	115 (27.3%)
	Absent	307 (72.7%)
In-Grown Toenail or Toenail Infected with Fungus	Present	64 (15.2%)
	Absent	358 (84.8%)
Change in Skin Color	Present	69 (16.4%)
	Absent	353 (83.6%)
Length of Stay in Hospital (Days)	0	221 (52.4%)
	<10	107 (25.4%)
	10-20	88 (20.9%)
	>20	6 (1.4%)
A Problem in Work Life	Yes	350 (82.9%)
	No	72 (17.1%)
Decreased Energy Level	Yes	373 (88.4%)
	No	49 (11.6%)
Comorbidity	Heart Disease	113 (31.5%)
	Liver Disease	32 (7.6%)
	Kidney Disease	69 (16.4%)
	Other	63 (14.9%)
	None	125 (29.6%)
Duration of Illness	<1	–
	1-5	154 (36.5%)
	6-10	138 (32.7%)
	>10	85 (20.1%)

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Antibiotic Drug Prescribed	1	119 (28.2%)
	2	175 (41.5%)
	3	126 (29.9%)
	4	2 (0.5%)
Antibiotic Medication	Insulin	8 (1.9%)
	Oral	266 (63.0%)
	Insulin + Oral	148 (35.1%)
Weight Change	Loss	323 (76.5%)
	Gain	16 (3.8%)
	No Change	83 (19.7%)
Sleep Disturbance	Present	352 (83.4%)
	Absent	70 (16.6%)
Delayed Wound Healing	Present	252 (59.7%)
	Absent	170 (40.3%)
Dry Skin and Mouth	Present	403 (95.5%)
	Absent	19 (4.5%)
Current Status	Present	292 (69.2%)
	Absent	130 (30.8%)

Except for eye irritation or redness, most problems were more common in women, and there was no statistically significant difference in the likelihood of suffering them. For instance, the odds ratio was not significant (COR = 0.723, 95% CI: 0.463-1.129, p=0.950), despite the fact that hazy vision was more prevalent among females in the chi-square analysis. The difference between the two tests, chi-square, determines if a connection exists, whereas logistic regression measures the strength of that correlation, which explains this apparent disparity. Even little variations in prevalence can provide significant chi-square values in large samples, but if the impact size is tiny, the related odds ratios might not be significant. Eye pain/redness was the only complication that maintained significance in both analyses (COR = 0.592, 95% CI: 0.385-0.910, p=0.012), indicating that males had significantly lower odds of reporting this symptom compared to females. The findings present the association between gender and diabetes-related complications using crude odds ratios (CoR), 95% confidence intervals (CI), and p-values from binary logistic regression. A p-value less than 0.050 was considered statistically significant (*)(Table 3).

Table 3: Associated Factors of Gender with Complications of Type 2 Diabetes Mellitus

Variables	Gender		COR (CI)	p-value
	Male	Female		
Blurred Vision				
Present	100	209	0.723 (0.463-1.129)	0.950
Absent	45	68		
Blindness				
Present	45	70	1.288 (0.825-2.012)	0.159
Absent	101	207		
Eye Pain /Redness				
Present	91	205	0.592 (0.385-0.910	0.012*
Absent	54	72		
High Blood Pressure				
Present	100	191	1.001 (0.648-1.545)	0.545
Absent	45	86		
Swelling of Feet, Ankles, and Hands				
Present	97	196	0.835 (0.542-1.286)	0.239
Absent	48	81		
Increased Need To urinate				
Present	133	256	0.909 (0.434-1.905)	0.469
Absent	12	21		
Numbness				
Present	135	260	0.883 (0.393-1.981)	0.455
Absent	10	17		
Tingling Sensation				
Present	129	235	1.441 (0.779-2.664)	0.154
Absent	42	16		
Loss of Sensation in the Feet				
Present	40	75	1.026 (0.65-1.610)	0.499
Absent	105	202		
In Grow Toenail or Toenail Infected with Fungus				
Present	22	42	1.001 (0.572-1.752)	0.552
Absent	123	235		
Change in Color				
Present	21	48	0.808 (0.463-1.411)	0.272
Absent	124	229		
Sleep Disturbance				
Present	120	232	0.931 (0.545-1.592)	0.447
Absent	25	45		
Delayed Wound Healing				
Present	89	163	1.112 (0.737-1.677)	0.345
Absent	56	114		
Dry Skin and Mouth				
Present	138	265	0.893 (0.344-2.319)	0.469
Absent	7	12		

CoR = Crude Odds Ratio; CI = Confidence Interval; *p<0.050

The findings showed many significant associations between a positive family medical history and certain diabetes-related issues in females. Women with a favourable medical history were much less likely to experience blurred vision, ocular discomfort or redness, and loss of foot feeling. However, adverse effects include blindness, swelling of the hands, ankles, and feet, fungal infections or ingrown toenails, and changes in skin tone were more common. No statistically significant associations with other symptoms were discovered. Significant findings are indicated (p<0.050) and presented as crude odds ratios (CoR) with 95% CI and p-values. The results show crude odds ratios (CoR) with 95% confidence intervals (CI) and p-values assessing the association between female medical history (Yes/No) and diabetes-related complications. Significant results are highlighted

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where the p-values are less than 0.050 (Table 4).

Table 4: Association of Family Medical History with Complications of Diabetes Mellitus

Variables	Female Medical History		COR (CI)	p-value
	Yes	No		
Blurred Vision				
Present	53	225	0.351 (0.217-0.569)	<0.001***
Absent	42	71		
Blindness				
Present	38	57	2.193 (1.351-3.559)	<0.001***
Absent	76	250		
Eye Pain /Redness				
Present	56	239	0.523 (0.324-0.842)	0.006**
Absent	39	87		
High Blood Pressure				
Present	67	223	1.105 (0.671-1.820)	0.398
Absent	28	103		
Swelling of Feet, Ankles, and Hands				
Present	80	212	2.868 (1.579-5.208)	<0.001***
Absent	15	114		
Increased Need To urinate				
Present	89	299	1.339 (0.536-3.347)	0.352
Absent	6	27		
Numbness				
Present	88	306	0.822 (0.336-2.006)	0.409
Absent	7	20		
Tingling Sensation				
Present	85	278	1.468 (0.712-3.025)	0.192
Absent	10	48		
A Burning and Sharp Pain in the Feet				
Present	84	280	1.255 (0.622-2.530)	0.328
Absent	11	46		
Loss of Sensation in the Feet				
Present	18	96	0.560 (0.318-0.986)	0.027*
Absent	77	230		
In a Toenail or Toenail Infected with Fungus				
Present	26	37	2.943 (1.671-5.184)	<0.001***
Absent	69	289		
Change in Color				
Present	29	39	3.233 (1.865-5.605)	<0.001***
Absent	66	287		
Problems in Work				
Present	82	267	1.394 (0.728-2.669)	0.199
Absent	13	59		
Decrease Energy Level				
Present	85	287	1.155 (0.553-2.410)	0.430
Absent	10	39		
Sleep Disturbance				
Present	81	270	1.200 (0.635-2.267)	0.349
Absent	14	56		
Delayed Wound Healing				
Present	52	199	0.772 (0.487-1.224)	0.163
Absent	43	127		
Dry Skin and Mouth				
Present	93	309	2.558 (0.580-11.276)	0.157
Absent	2	17		

CoR = Crude Odds Ratio; CI = Confidence Interval; *p<0.050, **p<0.01, ***p<0.001

DISCUSSION

Patients at the District Headquarter Hospital in Haripur, Pakistan, had their type-2 diabetes mellitus (T2DM) problems evaluated. The results showed that several microvascular and macrovascular problems were highly prevalent and offered important new information about the relationships between these complications and gender and family history. Gender and a family history of diabetes were the main exposure variables in this study, while a variety of microvascular and macrovascular problems linked to type 2 diabetes were the outcome variables. While family history acts as a stand-in for genetic predisposition influencing disease susceptibility and progression [14], gender was examined due to data suggesting biological and healthcare-seeking differences influence diabetes complications [15]. The findings complement and contribute to our knowledge of type 2 and its complex health outcomes. The chronic and progressive nature of untreated type 2 diabetes is evident in the fact that most of the patients had sequelae, including reduction in eyesight, neuropathy, hypertension, oedema of limbs, sleep problems, and delayed wound healing (high frequency of sequelae in the study) [16]. The results presented support other recent studies carried out to prove that complications of diabetes are more prevalent in those groups with poor glycaemic control or limited access to healthcare services [17, 18]. On the same note, studies in the rural areas of Asia have revealed similarities in that women tend to develop complications that are related to diabetes, but this is related to late diagnosis and under management [19, 20]. Moreover, studies in Saudi Arabia and India prove that people whose family has a history of diabetes experience more serious metabolic problems and develop the problems more quickly [21, 20]. However, the same research in the rural Asian areas found that females had higher chances of developing diabetic complications, which were linked to late diagnosis and insufficient treatment [19]. Other parallel relations were observed in research performed in Saudi Arabia and India; the participants who reported a family history of diabetes exhibited higher metabolic derangements and rapid progression of the complications [21, 20]. A study by [22] has established that there were significant differences in the glycaemic control measures (fasting blood sugar, random blood glucose, and HbA1c) in participants who had a family history of diabetes. In these persons, there might be a need to treat them using more intensive and specific

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measures, including early medication interventions and lifestyle change. Foot issues like ingrained toenails and colour change of the skin were also the most related to the gender and family history. The findings are consistent with estimates around the world, which show approximately 6 percent of diabetic people have diabetic foot ulcers [12]. Interestingly, a number of the characteristics, including delays in wound healing and some chronic conditions, were not found to have a significant relationship with gender, although many of the issues were revealed to significantly vary across groups. This suggests that alternative forms of variables like disease duration and glycaemic control might have a greater effect [23]. Such a conclusion could be justified by the findings of the research that indicate chronic hyperglycemia is the strongest predictor of complications of diabetes, no matter gender [18].

There are some limitations to consider when interpreting the results. The weaknesses include a low level of generalizability, as convenience sampling is performed in one tertiary care facility, and causal relationships are not possible, as the study has a cross-sectional design. Using self-reported problems only can cause recall bias, and the lack of HbA1c results in over 25% of patients would also impact the assessment of glycaemic control. The objective clinical assessment and longitudinal research design using multi-center random sampling methods would help future research comprehend the issue in greater detail and formulate focused intervention measures in high-risk populations.

CONCLUSIONS

The present study indicates that diagnosis with a high burden of comorbidities related to diabetes is strongly correlated with poor glycaemic control, a favourable family history, and the gender of women. These findings highlight the pressing need for targeted screening of high-risk groups and early intervention efforts. Strengthening national diabetes policy to incorporate risk-based prevention strategies could improve patient outcomes and help reduce rates of long-term complications.

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Authors' Contribution

Conceptualization: SA, KM, IR, MJ
Methodology: SA, KM, IR, MJ, MSN, M, HA, VK
Formal analysis: SA, KM, IR, MJ, MSN, M, HA, VK
Writing and Drafting: SA, KM, IR, MJ, MSN, M, HA, VK
Review and Editing: SA, KM, IR, MJ, MSN, M, HA, VK

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

The authors declare no conflict of interest.

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