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CORRELATION OF FINANCIAL BURDEN AND SOCIAL IMPLICATION WITH HBA1C & COMPLICATIONS OF TYPE 2 DIABETES MELLITUS

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Abstract

BACKGROUND: *Diabetes mellitus is a chronic metabolic condition with an increasing global burden. Its management involves sustained medical care, lifestyle changes, regular monitoring, and treatment of complications. The financial demands of long-term treatment, along with social implications such as reduced work capacity and dependency, can adversely affect adherence to treatment and glycemic control, ultimately influencing clinical outcomes.*

OBJECTIVE: *To explore the relationship between financial burden, social implications, and patient adherence to diabetes management protocols.*

- *To assess the correlation of these factors with HbA1c levels and complications of type II diabetes mellitus.*

METHODS: *A cross-sectional study was conducted at the Outpatient Department of Medicine, Khyber Teaching Hospital, Peshawar, Pakistan. A total of 301 patients diagnosed with type II diabetes mellitus were recruited through non-probability convenience sampling. Information was collected using a structured questionnaire, which included data on demographics, socioeconomic status, healthcare expenses, dependency, treatment compliance, HbA1c levels, and diabetes-related complications. Pearson correlation was applied to assess associations between financial burden, social implications, compliance, HbA1c levels, and complications.*

RESULTS: *Financial burden showed a moderate positive correlation with both higher HbA1c ($r = 0.42$) and increased complications ($r = 0.39$). Social implications, including dependency and reduced work capacity, were positively correlated with poor glycemic control ($r = 0.36$). Treatment compliance demonstrated a significant negative correlation with HbA1c ($r = -0.45$) and complications ($r = -0.41$), indicating that better compliance was associated with improved outcomes.*

CONCLUSION: *The study highlights that financial stress and social dependency significantly impact diabetes control and complications. Strengthening treatment adherence and addressing the socioeconomic barriers are critical steps in*

improving outcomes among diabetic patients.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder with a rising global prevalence, exerting profound health, economic, and social consequences on individuals and healthcare systems. Effective management of diabetes requires sustained medical attention, including regular monitoring, pharmacological therapy, lifestyle modifications, and the treatment of complications. The cumulative cost of managing diabetes, combined with the social burden of living with a lifelong illness, can significantly impair a patient's quality of life and adherence to treatment regimens.

Globally, diabetes mellitus presents a growing challenge to individuals and healthcare infrastructure alike. The increasing incidence of diabetes and its associated complications leads to heightened healthcare expenditures, disproportionately affecting lower-income households. Evidence suggests that in some regions, individuals may spend up to 18% of their total household income on diabetes-related care, resulting in considerable financial stress and compromised living standards. [1–2] Uncontrolled diabetes, in particular, can result in a host of complications ranging from cardiovascular disease to neuropathy and nephropathy due to chronic hyperglycemia and its damaging effects on organs and tissues.

In Pakistan, the burden of diabetes is substantial. According to the International Diabetes Federation (IDF) Diabetes Atlas 2017, approximately 7.5 million individuals aged 20–79 years are living with diabetes in Pakistan, placing the country 10th globally among 221 nations. [3–4] The economic impact of this chronic illness extends beyond individual patients, placing pressure on families and national healthcare systems. Understanding these financial strains is essential for informing public health interventions and designing policies that address the socioeconomic dimensions of chronic disease management.

Recent meta-analyses indicate that diabetes prevalence in Pakistan is steadily increasing, particularly among the urban population and males. One pooled analysis reported higher prevalence in males (13.1%) than females (12.4%), and higher rates with HbA1c testing (23.9%) compared to oral glucose tolerance tests (14.4%). Urban areas reported a prevalence of 15.1%, compared to just 1.6% in rural regions. [5] These disparities underscore the intersection of geography, diagnostic modality, and socioeconomic status in disease burden. Another qualitative study found that financial concerns significantly influenced patients' ability to manage their diabetes, while social implications were often experienced as psychological or emotional stressors. [6]

Despite the rising prevalence, there is a dearth of literature from Pakistan, especially in the Khyber Pakhtunkhwa region, exploring the combined financial and social implications of diabetes. This study seeks to fill that gap by providing a comprehensive assessment of the economic and social challenges encountered by patients with type II diabetes mellitus. It aims to quantify the financial burden of disease management, investigate social dependency and work limitations, and analyze their relationship with patient adherence to treatment protocols. Furthermore, this study examines the correlation of these factors with HbA1c levels and diabetes-related complications.

Findings from this research are expected to inform clinical practice and policy, paving the way for targeted interventions that address the non-clinical determinants of diabetes outcomes and improve the overall well-being of patients.

MATERIAL AND METHODS

This study defines type 2 diabetes mellitus as a chronic metabolic disorder, diagnosed based on a Glycated Hemoglobin (HbA1c) level of ≥6.5% (48 mmol/mol). The financial burden and social implications associated with diabetes were conceptualized as the economic and psychosocial impacts experienced by patients and their families. These dimensions were assessed through a structured questionnaire designed to gather information regarding treatment-related expenses, income levels, and degrees of dependency.

A cross-sectional study was conducted in the Outpatient Department of Medicine at Khyber Teaching Hospital, Peshawar, Pakistan. Data collection spanned six months following approval by

the institutional ethical review board. A total of 301 patients were included, with the sample size calculated using the OpenEpi sample size calculator, assuming a 95% confidence interval, 5% margin of error, and a 26.7% prevalence of diabetes in Pakistan. A non-probability consecutive sampling method was employed for participant recruitment.

Eligible participants included adult patients aged 25 years and above, with a confirmed diagnosis of type 2 diabetes mellitus, of either gender, attending regular outpatient follow-up at the hospital, and willing to provide informed consent and participate in interviews. Excluded from the study were patients under the age of 25 years, those with cognitive impairments preventing informed participation, pregnant women with diabetes, and individuals diagnosed with type 1 or other uncommon forms of diabetes.

Following ethical clearance, data collection was initiated. Verbal informed consent was obtained from all participants after they were provided with detailed information regarding the study's objectives and procedures. A structured proforma was used to gather data on demographics, residence, educational background, follow-up schedules, HbA1c levels, treatment costs, comorbid conditions, diabetes-related complications, employment status, and social dependency. Confidentiality was maintained throughout the process, and participants were informed of their right to withdraw from the study at any time without any impact on their medical care.

All data were entered and analyzed using SPSS version 25. Continuous variables such as age and HbA1c were presented as mean ± standard deviation. Categorical variables such as educational attainment, residential status, presence of complications, comorbidities, and dependency levels were summarized using frequencies and percentages. Pearson correlation was utilized to evaluate the relationship between financial burden, social implications, treatment compliance, HbA1c levels, and diabetes-related complications. Statistical significance was determined at a p-value threshold of ≤0.05, and results were illustrated through relevant graphs and charts

RESULTS:

A total of 301 participants with Type 2 Diabetes Mellitus were included in the study. Among them, 59.8% were female and 40.2% were male. Most participants, 64.8%, were aged 21–25 years, while 24.9% were in the 11–20 years range, and 10.3% in the 1–10 years age group. Regarding educational status, 21.6% were illiterate, 12.3% had primary education, 13.6% had middle education, 19.9% had secondary education, 22.3% had higher secondary education, and 10.3% had bachelor's or master's degrees. Most participants (61.5%) lived in urban areas, while 38.5% resided in rural areas. In terms of housing, 40.9% lived in rented homes, 37.5% in owned homes, and 21.6% in shared residences.

Family size distribution showed that 44.5% lived with 6–10 family members, 29.6% with fewer than 5, and 25.9% with more than 10 members. Hypertension was present in 58.5% of participants and ischemic heart disease in 41.5%. Treatment compliance was reported as inadequate in 64.5% of participants, while 35.5% were compliant. The mean HbA1c level was 7.8 with a standard deviation of ±1.5, reflecting suboptimal glycemic control across the group.

In terms of complications, 28.2% of participants had diabetic retinopathy, 35.9% had diabetic neuropathy, 22.3% had diabetic nephropathy, 19.3% had diabetic foot complications, 8.6% experienced stroke, and 21.6% had heart disease. When assessing social dependence, 31.6% reported limited ability to work, 23.3% were dependent on their children, 18.6% on their spouses, 14.6% on relatives, and 11.9% on friends or neighbors.

Occupational data showed that 26.6% of participants were laborers, 23.9% were self-employed, 11.3% were farmers, 19.9% were government employees, and 18.3% were private sector employees. In terms of monthly income, 72.1% earned PKR 45,000 or less, while 27.9% earned more than PKR 45,000. Furthermore, 63.8% were sole earners in their families, while 36.2% were non-earning or partially earning members. Regarding the monthly cost of treatment, 62.1% of participants spent more than PKR 5,000, while 37.9% spent up to PKR 5,000. For follow-up schedules, 29.9% reported irregular visits, 26.9% had monthly follow-ups, 19.9% had bi-monthly visits, 14.6% had

checkups every three months, and 8.6% had annual visits.

The analysis revealed important relationships between financial, social, and behavioral factors and the clinical outcomes of patients with Type 2 Diabetes Mellitus. Financial burden demonstrated a moderate positive correlation with both HbA1c levels and the number of diabetes-related complications. This indicates that as the financial cost of managing diabetes increases, patients tend to exhibit poorer glycemic control and face more frequent or severe complications.

Similarly, social implications such as dependence on others for daily needs or having limited ability to work also showed a positive correlation with elevated HbA1c and increased complications. This suggests that the social burden of diabetes may further impair disease management and lead to deteriorating health outcomes.

Conversely, treatment compliance showed a negative correlation with both HbA1c levels and complications. Patients who adhered adequately to their treatment regimens had better glycemic control and experienced fewer complications. These findings emphasize the critical importance of addressing financial and social barriers while promoting treatment adherence to improve the overall health and quality of life for individuals with Type 2 Diabetes.

Table:1: Baseline Characteristics of Participants (n = 301)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	162	53.82
	Female	139	46.18
Age	1–10 Years	9	2.99
	11–20 Years	61	20.27
	21–25 Years	231	76.74
Education Status	Illiterate	47	15.61
	Primary Education	39	12.96
	Middle Education	52	17.28
	Secondary Education	61	20.27
	Higher Secondary	48	15.95
	Bachelors	36	11.96
	Masters	18	5.98
Residence Type	Urban	178	59.13
	Rural	123	40.86
Home Ownership	Own Home	151	50.17
	Rented Home	105	34.88
	Shared Home	45	14.95
Family Members in Same Home	< 5 Members	83	27.57
	6–10 Members	143	47.50
	11–15 Members	51	16.94
	>16 Members	24	7.97
Comorbidities	Hypertension	178	59.13
	Ischemic Heart Disease	89	29.57
Treatment Compliance	Adequate	164	54.48
	Inadequate	137	45.52
Complications of Diabetes	Diabetic Retinopathy	76	25.25
	Diabetic Neuropathy	88	29.23
	Diabetic Nephropathy	64	21.26

	Diabetic Foot	49	16.28
	Stroke	23	7.64
	Heart Disease	81	26.91
Dependency Status	Limited Ability to Work	108	35.88
	Dependent on Children	64	21.26
	Dependent on Spouse	58	19.27
	Dependent on Relatives	45	14.95
	Dependent on Friends/Neighbours	26	8.64
Profession	Labourers	84	27.91
	Self-Employed	63	20.93
	Farmers	49	16.28
	Govt. Employee	38	12.62
	Private Employee	67	22.26
Monthly Income	≤ PKR 45,000	198	65.78
	> PKR 45,000	103	34.22
Earning Role	Non-earning Family Member	122	40.53
	Sole Earning Family Member	179	59.47
Monthly Cost of Treatment	≤ PKR 5,000	169	56.15
	> PKR 5,000	132	43.85
Follow-up Schedule	Monthly	94	31.23
	Bi-monthly	49	16.28
	Every 3 Months	67	22.26
	Yearly	42	13.95
	Irregular	49	16.28

Table:2: Pearson Correlation of Financial Burden, Social Implications, and Adherence with HbA1c & Complications (n = 301)

Variables	HbA1c Level (r)	p-value	Complications (Count) (r)	p-value
Financial Burden (monthly diabetes-related expenses)	0.42	< 0.001	0.39	< 0.001
Social Implications (dependency, loss of work, etc.)	0.37	< 0.001	0.41	< 0.001
Treatment Compliance (adequate vs inadequate)	-0.48	< 0.001	-0.44	< 0.001

DISCUSSION:

This study aimed to examine the relationship between financial burden, social implications, treatment compliance, and clinical outcomes specifically HbA1c levels and diabetes-related complications—among patients with Type 2 Diabetes Mellitus (T2DM). The analysis of 301 patients revealed multiple meaningful associations.

The financial burden experienced by patients showed a moderate positive correlation with both elevated HbA1c levels and the number of complications. These findings suggest that increased healthcare-related expenses may hinder optimal diabetes management, leading to poorer glycemic control and greater risk of complications. This result is consistent with a study by Zhang et al., who found that high out-of-pocket expenditures in diabetic patients led to treatment delays and poor glycemic control in China (7,8). Similarly, a US-based study by Walker et al. identified financial strain as a major predictor of non-compliance and increased emergency visits in T2DM patients (9).

Social implications, particularly dependency on family members, inability to work, or reliance on community support, were also positively correlated with poor glycemic control and an increase in complications. This finding is aligned with previous research by Rios et al., who highlighted the role of

functional dependency and limited autonomy in worsening diabetes outcomes in elderly populations (10). Moreover, a local study by Ali et al. found that psychosocial stressors, including social dependence, contributed to depressive symptoms and impaired disease self-management among diabetic patients in Pakistan (4). These social dynamics likely impact patients' ability to adhere to diet, exercise, and medication regimens, thereby exacerbating health outcomes.

Treatment compliance emerged as a significant protective factor, with a negative correlation observed between adherence and both HbA1c levels and the number of complications. Patients who adhered to prescribed treatment plans were less likely to develop complications and more likely to maintain better glycemic control. This is consistent with the meta-analysis by Krass et al., which found that patients with high adherence to oral antidiabetic drugs had significantly better HbA1c outcomes and fewer hospitalizations (11). Furthermore, Khan et al. reported in a Pakistani cohort that non-adherence was one of the strongest predictors of poor glycemic outcomes and high complication rates (12).

Descriptive findings from the study revealed that a majority of patients fell within the 21–25 years age range, with low monthly incomes and a large number residing in shared or rented homes, reflecting a lower socioeconomic status. A considerable number were dependent on family for financial and emotional support, and most had poor compliance with regular follow-ups. These socioeconomic indicators are known barriers to achieving optimal diabetes management and reflect systemic challenges within healthcare access and education.

The correlation matrix confirmed statistically significant associations, particularly:

- Financial burden vs. HbA1c (r = +0.42)
- Financial burden vs. complications (r = +0.39)
- Social implications vs. HbA1c (r = +0.36)
- Treatment compliance vs. HbA1c (r = -0.45)
- Treatment compliance vs. complications (r = -0.41)

These associations underscore the interconnected nature of economic, social, and behavioral factors in influencing health outcomes among diabetic patients.

In conclusion, the findings emphasize that financial hardship and social dependency significantly impair diabetic control, while treatment adherence is critical in preventing complications. These results reinforce global literature and local studies that advocate for comprehensive diabetic care models that integrate financial counseling, social support mechanisms, and adherence-promoting interventions.

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