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GENDER DIFFERENCES IN THE PREVALENCE OF HYPERTENSION AMONG DIABETIC PATIENTS AT A TERTIARY CARE HOSPITAL IN SINDH, PAKISTAN: A CROSS-SECTIONAL STUDY

Ali Gohar Lashari[1], Dr. Husan Bano Channar[2], Mansoor ul Haque[3], Himat Ali Rind[4], Shabar Uddin Lashari[5], Shahnawaz Shahok[6]

[1]MSN scholar, Peoples nursing school LUMHs Jamshoro, aligoharlashari92@gmail.com
[2]Assistant Professor, People's Nursing School Liaquat University of Medical and Health Science Jamshoro. Email: husan.bano@lumhs.edu.pk
[3]Lecturer, People's Nursing school LUMHS Jamshoro, mansoornohri@lumhs.edu.pk
[4]MSN scholar, People's Nursing school, Liaquat university of medical and health sciences jamshoro. himat2k8@yahoo.com
[5]MSN scholar, People's Nursing school Liaquat university of medical and health sciences jamshoro.
[6]MSN scholar, People's Nursing school, Liaquat university of medical and health sciences jamshoro

ABSTRACT:
Hypertension and Diabetes mellitus (DM) are among the most prevalent non-communicable diseases globally, posing a major public health challenge [1]. The coexistence of these two conditions significantly increases the risk of cardiovascular diseases, morbidity, and mortality [1]. Individuals with DM are nearly twice as likely to develop hypertension compared to those without diabetes, accelerating both macrovascular and microvascular complications [2,3]. Insulin resistance, endothelial dysfunction, arterial stiffness, and autonomic imbalance further aggravate hypertension in this population [4]. Hypertension is strongly associated with serious complications affecting multiple organ systems, including coronary artery disease, myocardial infarction, heart failure, left ventricular hypertrophy, stroke, transient ischemic attacks, chronic kidney disease, and hypertensive retinopathy [3,5]. Damage to the kidneys leads to sodium and water retention in DM, which further increases blood volume and elevates blood pressure [6].

INTRODUCTION:
The global burden of diabetes and hypertension is rising at an alarming rate [7,8]. In Pakistan, particularly in the Sindh province, these chronic conditions are surging due to rapid urbanization, dietary shifts, and declining physical activity levels [9]. Pakistan has experienced high diabetes prevalence and mortality rates from diabetes complications, with Sindh reporting a particularly substantial disease burden [10,11]. A sedentary lifestyle and physical inactivity further exacerbate metabolic and cardiovascular complications by contributing to insulin resistance, obesity, arterial stiffness, endothelial dysfunction, and autonomic nervous system dysregulation, all of which accelerate hypertension progression in diabetic individuals [12-14]. Despite the well-documented benefits of exercise in reducing blood pressure and improving insulin sensitivity, physical inactivity remains widespread due to sociocultural and environmental barriers [13,15].
Gender differences play an important role in the prevalence and progression of hypertension among diabetic patients [16]. Biological and hormonal factors, particularly the effects of estrogen, influence glucose metabolism, lipid profiles, and vascular function [17,18]. Females, particularly postmenopausal women, may be at higher risk due to hormonal changes such as reduced estrogen levels, which affect vascular function and lipid metabolism [19]. Evidence suggests that female diabetic patients are more likely to experience uncontrolled hyperglycemia, hypertension, and dyslipidemia compared to males, placing them at higher risk of cardiovascular complications [20,21]. Sex-modulation also occurs across a spectrum of hypertension-mediated conditions such as in heart failure, where females experience a higher disease burden and differing clinical phenotypes, and chronic kidney disease, which is more common in males [22]. However, some studies have reported conflicting findings, indicating no significant gender differences, and the prevalence of hypertension between men and women differs across settings [21,23]. Despite these fundamental differences, there are limited sex- or gender-specific standards of care in major international hypertension practice guidelines [24].
Variations in the prevalence of hypertension have been reported in diabetic patients worldwide, and due to gender differences, disease awareness, and healthcare resources, findings from other regions may not directly reflect local population dynamics [25]. Therefore, this study was conducted to determine the gender-based prevalence of hypertension among patients with type 2 diabetes mellitus at a tertiary care hospital in Jamshoro/Hyderabad, Sindh. The primary objective is to evaluate the prevalence of hypertension across both genders and investigate the association between gender differences and hypertension in this diabetic cohort.

METHODS:

Study Design

This study employed a descriptive, cross-sectional design to assess the clinical, demographic, and lifestyle parameters among patients presenting with diabetes and hypertension.

Study Setting

The study was conducted across Medical Units I, II, III, and IV at Liaquat University Hospital (Liaquat University of Medical and Health Sciences [LUMHS]), located in Jamshoro/Hyderabad, Pakistan. This facility serves as a major tertiary care and teaching hospital catering to a diverse patient demographic.

Study Duration

The research was carried out over a total duration of six months, spanning from January 6, 2026, to July 6, 2026, following formal approval from the Institutional Ethical Review Committee (ERC) and the Advanced Studies & Research Board (AS&RB) of LUMHS.

Sample Size

The sample size was determined using the Raosoft sample size calculator, based on an estimated pooled prevalence of hypertension and diabetes in Pakistan of 37.4% (54). Setting the confidence interval at 95% with a 5% margin of error yielded a baseline requirement of 360 participants. To accommodate an anticipated 10% non-response or incomplete data rate, the final sample size was adjusted to 396 participants.

Sampling Technique

A stratified sampling technique was employed to recruit participants from the medical units, stratifying the sample by gender to account for potential gender-based differences across the clinical variables.

Eligibility Criteria

The study enrolled adult male and female patients aged 18 years and above who had a confirmed diagnosis of diabetes mellitus, hypertension, or both. Patients were included if they presented with two casual or postprandial blood glucose readings exceeding 200 mg/dL, had a documented prior diagnosis of diabetes, or were currently prescribed antihyperglycemic pharmacotherapy. Similarly, participants were included if they had a documented history of hypertension, were actively receiving antihypertensive medications, or exhibited elevated blood pressure defined as systolic blood pressure greater than 140 mmHg and/or diastolic blood pressure greater than 85 mmHg across two readings taken 3 minutes apart on separate occasions.

Patients presenting with confounding medical conditions or acute secondary complications were excluded from participation. Specifically, individuals with diagnosed ischemic heart disease, chronic kidney disease or renal impairment, chronic liver disease, and thyroid disorders were excluded. In addition, patients currently undergoing systemic corticosteroid therapy for any indication, as well as pregnant women, were excluded from the study cohort.

Ethical Considerations

Formal institutional clearance was granted by the Ethical Review Committee of LUMHS (Approval No. LUMHS/REC-1211), followed by administrative permission from the Medical Superintendent of Liaquat University Hospital prior to participant recruitment. Informed consent was obtained in writing from every participant prior to data collection. To ensure participant autonomy and complete comprehension of the study objectives, the informed consent document was translated into local languages, specifically Urdu and Sindhi.

Data Collection Procedure

Upon obtaining institutional ethical and administrative approvals, the data collection process was initiated across Medical Units I through IV. Eligible patients were approached in person and briefed regarding the purpose, scope, and confidentiality of the research. Each participant completed the written informed consent provided on the first page of the questionnaire, which was administered face-to-face in Urdu, Sindhi, or English according to the patient's preference and literacy level.

Data Collection Instrument

Data were gathered using an adopted, structured questionnaire (55). The instrument was organized into four distinct sections: Section 1 captured socio-demographic details including age, gender, and educational background; Section 2 focused on clinical parameters and medical history related to diabetes and hypertension; Section 3 assessed behavioral variables such as smoking habits and physical activity levels; and Section 4 evaluated co-existing chronic diseases and nutritional practices. Any questionnaires returned with missing, incomplete, or ambiguous responses were excluded during data pre-processing.

Statistical Analysis

All collected data were coded and recorded into Microsoft Excel for data entry and preliminary screening, after which the dataset was imported into IBM SPSS Statistics Version 27.0 for analytical processing. Descriptive statistics were computed, expressing continuous numerical variables as mean and standard deviation (\text{Mean \pm \text{SD}}), and categorical variables as frequencies and percentages. The Chi-square test (chi^2) was conducted to determine significant associations between categorical variables, with statistical significance set at a two-tailed p-value < 0.05.

RESULTS:

Table 1: Sociodemographic Characteristics of the Study Participants (N = 396)

Variables	Category	Frequency (N)	Percentage (%)
Age (years)	18–27	37	9.3
	28–37	62	15.7
	38–47	204	51.5
	48 and above	93	23.5
Gender	Male	219	55.3
	Female	177	44.7
Marital Status	Unmarried	86	21.7
	Married	310	78.3
Education	Primary	33	8.3
	Secondary	130	32.8
	University education	233	58.8
Socioeconomic Status	Poor	18	4.5
	Middle	282	71.2
	High	96	24.2
Employment Status	Employed	241	60.9
	Unemployed	155	39.1

Table 1 summarizes the sociodemographic characteristics of the 396 study participants with Diabetes Mellitus. More than half of the participants (51.5%) were aged 38–47 years, followed by those aged 48 years and above (23.5%). Males constituted 55.3% of the study population, while females accounted for 44.7%. The majority of participants were married (78.3%). Regarding education, 58.8% had university-level education, 32.8% had secondary education, and 8.3% had primary education. Most participants belonged to the middle socioeconomic class (71.2%), followed by the high (24.2%) and poor (4.5%) socioeconomic groups. In terms of employment, 60.9% were employed and 39.1% were unemployed. Overall, the study population was predominantly middle-aged, male, married, university educated, middle socioeconomic class, and employed.

Table 2: Clinical Characteristics and Risk Factors of the Study Participants (N = 396)

Variable Category		Frequency (N)	Percentage (%)
Diabetes Control	Good	120	30.3
	Poor	276	69.7
Duration of Diabetes	1–3 years	107	27.0
	4–6 years	198	50.0
	≥6 years	95	24.0
Retinopathy	Absent	311	78.5
	Present	85	21.5
Nephropathy	Absent	350	88.4
	Present	46	11.6
HbA1c Level	<6%	52	13.1
	6–9%	219	55.3
	>9%	125	31.6
Hypertension Status	No	97	24.5

	Yes	299	75.5
Exercise Status	No	256	64.6
	Yes	140	35.4
Smoking Status	No	102	25.8
	Yes	294	74.2
Salt Intake	Low	308	77.8
	Moderate	33	8.3
	High	55	13.9
Family History of Hypertension	No	328	82.8
	Yes	68	17.2
BMI Level	Underweight	26	6.6
	Normal	99	25.0
	Overweight	160	40.4
	Obese	111	28.0

Table 2 summarizes the clinical characteristics and risk factors of the 396 participants with Diabetes Mellitus. Poor diabetes control was observed in 276 (69.7%) participants, while 120 (30.3%) had good glycemic control. Half of the participants (50.0%) had diabetes for 4–6 years, followed by 27.0% with a duration of 1–3 years and 24.0% with diabetes for six years or more. Retinopathy were present in 21.5% and nephropathy was found 11.6% of participants. Regarding HbA1c levels of 55.3% was observed range between 6% - 9%, followed by 31.6% was greater than 9 and had HbA1c levels greater than 9%, and lowest value was only 13.1% was range less than 6. Hypertension was present in 299 (75.5%) participants. Most participants did not perform regular exercise (64.6%) and 74.2% reported smoking. The majority (77.8%) reported low salt intake, while 17.2% had a family history of hypertension. Based on BMI, 40.4% of participants were overweight and 28.0% were obese, indicating that more than two-thirds (68.4%) were above the normal weight range. Overall, the findings suggest a high burden of poor glycemic control, hypertension, sedentary lifestyle, smoking, and excess body weight among the study population.

Table 3: Association of Sociodemographic Characteristics with Hypertension Among Study Participants (N = 396)

Variable	Category	HTN No (n)	HTN Yes (n)	Total (N)	P-value
Gender	Male	64	155	219	**0.01**
	Female	33	144	177	
Age (years)	18–27	22	15	37	**<0.001**
	28–37	13	49	62	
	38–47	50	154	204	
	48 and above	12	81	93	
Marital Status	Unmarried	35	51	86	**<0.001**
	Married	62	248	310	
Education	Primary	4	29	33	0.10
	Secondary	36	94	130	
	University education	57	176	233	
Socioeconomic Status	Poor	3	15	18	0.06
	Middle	62	220	282	
	High	32	64	96	
Employment Status	Employed	72	169	241	**0.002**
	Unemployed	25	130	155	

Table 3 summarizes the association between selected sociodemographic characteristics and hypertension among the 396 participants with Diabetes Mellitus. Statistically significant associations were observed for gender ($p = 0.01$), age ($p < 0.001$), marital status ($p < 0.001$), and employment status ($p = 0.002$). Female participants had a higher prevalence of hypertension than males. The prevalence of hypertension increased progressively with advancing age, with the highest number of hypertensive cases observed among participants aged 38–47 years and those aged 48 years and above. Married participants were more likely to have hypertension than unmarried participants. Employment status was also significantly associated with hypertension, with hypertensive cases being more frequent among employed individuals. In contrast, education level ($p = 0.10$) and socioeconomic status ($p = 0.06$) were not significantly associated with hypertension, indicating that these factors did not show a statistically meaningful association with hypertension in the study population.

DISCUSSION:

The present study examined gender differences in the prevalence of hypertension among diabetic patients at a tertiary care hospital in Sindh. The age distribution of participants revealed that the majority (51.5%) were aged 38–47 years, followed by 23.5% aged above 48 years, while 15.7% were between 28–37 years and 9.3% were between 18–27 years. These findings indicate that most diabetic patients in the present study belonged to the middle-aged population. Likewise, a large retrospective cohort study conducted at the Indus Hospital, Karachi, reported a median age of 38.7 years among adult diabetic patients, indicating that diabetes is predominantly diagnosed during middle adulthood [10]. In contrast, the Pakistan National Diabetes Prevalence Survey reported the highest prevalence of diabetes among individuals aged 51–60 years (26.3%), suggesting that the burden of diabetes in the general population shifts toward older age groups compared with the hospital-based population [26].

The gender distribution in the present study showed that 219 participants (55.3%) were male and 177 (44.7%) were female, indicating a slightly higher proportion of males. Similar findings were reported where males accounted for 57.8% of participants in Khairpur Mirs in Sindh Pakistan [2]. Despite the higher number of male participants in the present study, hypertension was more common among female diabetic patients than males ($p = 0.01$), suggesting that female diabetics may have a greater risk of hypertension, particularly after menopause due to hormonal changes [19,27].

The present study found that 69.7% of participants had poor diabetes control, while only 30.3% achieved good glycemic control. These findings are comparable to a systematic review and meta-analysis which reported that approximately 69.4% ($p < 0.001$) of people with diabetes had poor glycemic control [28]. The present study revealed a high prevalence of hypertension among diabetic patients, with 299 (75.5%) hypertensive and 97 (24.5%) normotensive participants. Regional studies from Pakistan have also reported high prevalence of hypertension among diabetic patients, indicating comparable results [25]. These findings confirm a strong association between diabetes and hypertension, driven by chronic hyperglycemia causing endothelial dysfunction, arterial stiffness, activation of the renin-angiotensin system, and additional risk factors such as insulin resistance and obesity [4,14].

The findings of this study indicate that a majority of participants (64.6%) did not engage in regular exercise, while only 35.4% reported performing physical activity. This suggests that most diabetic patients in the study led a sedentary lifestyle, which negatively affects vascular health, promotes arterial stiffness, and exacerbates obesity-related complications [12-14]. Furthermore, a majority of participants (74.2%) had a history of smoking, while only 25.8% were non-smokers. Tobacco use is a well-known risk factor for cardiovascular complications, and smoking contributes to endothelial dysfunction and increased arterial stiffness, substantially increasing the risk of hypertension in diabetes [29].

This study explored that a majority of participants were either overweight (40.4%) or obese (28.0%), with 68.4% of participants having elevated BMI. These findings are consistent with the Second National Diabetes Survey of Pakistan, which identified overweight and obesity as major risk factors associated with diabetes and hypertension among Pakistani adults [26]. Excessive salt intake leads to fluid retention and increased vascular resistance, which directly raises blood pressure [30]. Our study found that 17.2% of participants reported a positive family history of hypertension, while 82.8% had no familial history.

The study has some limitations as it was conducted at a single tertiary care hospital in Sindh, which limits the generalizability of the findings. The cross-sectional design does not allow for determination of cause-and-effect relationships between gender and hypertension. Some data were based on patient self-reporting, which may introduce recall or reporting bias. Important confounding factors such as detailed dietary habits, physical activity level, and medication adherence were not fully assessed. Lastly, the study did not explore hormonal status (e.g., menopausal status in females), which may influence gender differences in hypertension.

The findings of this study indicate a notable gender difference in the prevalence of hypertension among diabetic patients, with 70.8% of male participants and 81.4% of female participants being hypertensive. Overall, the prevalence of hypertension was higher in females compared to males, suggesting that female diabetic patients may be at greater risk of developing hypertension. These findings highlight the importance of gender-specific strategies for the prevention and management of hypertension in diabetic patients. Female patients, particularly those who are middle-aged or postmenopausal, may benefit from more intensive monitoring, lifestyle interventions, and tailored pharmacological management to reduce the risk of cardiovascular complications [19,27]. Further large-scale studies should be conducted to explore gender-specific risk factors and improve preventive and management strategies.

CONCLUSION:

This study demonstrates a high prevalence of hypertension among patients with type 2 diabetes mellitus presenting to a tertiary care setting in Sindh, with a statistically significant disparity between genders. Female diabetic patients exhibited a markedly higher burden of hypertension compared to their male counterparts. Furthermore, key modifiable and non-modifiable factors including advancing age, poor glycemic control, physical inactivity, smoking, and elevated BMI, were notably prevalent across the cohort. These findings highlight the critical need for routine blood pressure

screening, integrated chronic disease management, and gender-tailored therapeutic strategies to optimize clinical outcomes and mitigate long-term cardiovascular risks in this high-risk diabetic population.

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