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ORIGINAL ARTICLE

Prevalence and risk factors of Type II diabetes under the age of 30 years in district of Faisalabad.

Muhammad Owais Fazal[1], Ghulam Abbas Tahir[2], Muhammad Usman Ali[3], Muhammad Abid Rasheed[4], Sultan Ayaz[5], Ali Siftain[6]

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ABSTRACT… Objective: To identify key sociodemographic and clinical factors associated with hypertension and obesity among adults using multivariate logistic regression. **Study Design:** Cross-sectional Survey. **Setting:** Allied Hospital, Faisalabad. **Period:** June 2024 to December 2024. **Methods:** Collected data on sociodemographic and clinical variables, including sex, residence, blood glucose type, age, smoking, and income. Logistic regression models assessed their associations with hypertension and obesity, with model fit evaluated via Deviance, Pearson, and Hosmer-Lemeshow tests. **Results:** The hypertension model was significant (p=0.023), with a deviance R-squared of 23.76%. Females had lower odds of hypertension (OR=0.113; p=0.006), while urban residents had over five times higher risk than rural residents (OR=5.125; p=0.023). Participants with fasting blood glucose were less likely to be hypertensive compared to those with random blood glucose (OR=0.243; p=0.021). The obesity model was also significant (p=0.006), with a deviance R-squared of 34.2%. Sex was the sole significant predictor (p<0.001), indicating males had a higher risk of obesity. **Conclusion:** Gender was a consistent predictor for both conditions, with male predominance. Urban residence and blood glucose type significantly influenced hypertension risk. These findings suggest the need for targeted interventions and emphasize the importance of fasting glucose monitoring in hypertension screening.

Key words: Blood Glucose, Hypertension, Obesity, Sociodemographic Factors.

INTRODUCTION

Millions of people worldwide suffer from type 2 diabetes mellitus (T2DM), which is mainly brought on by a sedentary lifestyle and other contributing factors that lead it to start at a very young age.[1] Rapid economic growth, significant lifestyle changes, and an ageing population have made T2DM a major global public health issue, particularly in emerging nations.[2-4] The most recent International Diabetes Federation (IDF) report estimates that by 2045, there would be 783.2 million individuals (12.2%) with diabetes globally, with the prevalence of type 2 diabetes in adults being 536.6 million (10.5%) in 2021.[5] The prevalence of type 2 diabetes is also very high in Pakistan; according to health statistics, 16.98% of Pakistanis currently have the disease.[6] Furthermore, micro and macrovascular problems brought on by uncontrolled or untreated hyperglycemia increase the risk of premature death for people with type 2 diabetes.[7] Treatment of T2DM patients with various comorbidities is made more challenging by the associated financial burden and access to care.[8]

Pakistan is a South Asian nation with a low-middle income. The second National Diabetic Survey of Pakistan (NDSP) conducted from 2016 to 2017 found that 26.3% of people had diabetes. (28.3% in cities and 25.3% in rural regions), whereas 14.4% of people had pre-diabetes.[9] The fifth largest population nation in the world is Pakistan. According to the most current IDF Atlas, 33 million people in Pakistan have diabetes, making them the third-largest diabetic population in the world.[10] Diabetes is a significant public health issue in the nation, with 8.9 million people living with the disease undiagnosed and an additional 11 million individuals having decreased tolerance to glucose.[11]

1. MBBS, MCPS, FCPS (Med), MRCP, MsPH. Associate Professor Medicine, Faisalabad Medical University, Faisalabad.
2. MBBS, FCPS, Assistant Professor Medicine, FMU, Faisalabad.
3. BS Hon, Physiology. Research Officer, Faisalabad Medical University, Faisalabad.
4. MBBS, FCPS (Surg), CMT, Ph.D, Professor and Dean Faculty of Medical Sciences, Government College University, Faisalabad.
5. MSPH, Ph.D, Associate Professor Faculty of Medical Sciences, Government College University. Faisalabad.
6. M.Phil (Epidemiology), MSPH, Lecturer Medical Sciences, Government College University, Faisalabad.

Correspondence Address:
Dr. Muhammad Owais Fazal
Department of Medicine
Faisalabad Medical University, Faisalabad.
drowais78@hotmail.com

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The poor status of non-communicable disease risk factors in the nation, including poor diet, sedentary lifestyles, rising tobacco use, and overweight and obesity, can be blamed for the high prevalence.[12,13]

Urinary tract infections (UTI) and renal impairment are two of the most common long-term consequences of type 2 diabetes. An elevated level of glucose in the urine encourages the colonisation of microorganisms in the urine, increasing the risk of kidney microvascular disease. Due to numerous studies showing a high prevalence of UTI in individuals with type 2 diabetes, this has also grown to be a serious concern.[14] Diabetes patients' clinical profiles reveal some of the contributing factors that lead to a rise in UTI rates among diabetics include poor circulation, a weakened immune system because white blood cells are less able to fight infections, and inadequate bladder contractions that result in bladder dysfunction.[15] Furthermore, several physiological characteristics are thought to be predisposing factors for a higher prevalence of UTI in diabetics, including age, gender, duration of diabetes, long-term use of anti-diabetic medications, and other diabetic sequelae such as neuropathy and glycosuria. Patients with diabetes may get asymptomatic or symptomatic UTIs, which include urethritis, cystitis, prostatitis, pyelonephritis, and asymptomatic bacteriuria (ABU).[16]

Despite the growing global and national burden of type II diabetes mellitus, limited data are available regarding its early onset, particularly in individuals under the age of 30 in Pakistan. Most epidemiological studies in the country have focused on adult populations above 30 years, leaving a significant research gap in understanding the early prevalence and associated risk factors among younger age groups.[17-20] The lack of region-specific data, especially from populous districts like Faisalabad, hinders the development of targeted prevention and intervention strategies. This study aims to address this gap by investigating the prevalence and identifying the potential sociodemographic, lifestyle, and genetic risk factors associated with type II diabetes in individuals below 30 years of age in the Faisalabad district. By shedding light on this underexplored population, the findings of this study will contribute to early diagnosis, effective public health planning, and tailored interventions to reduce the burden of early-onset type II diabetes in Pakistan.

METHODS

A cross-sectional study was set out to evaluate the risk variables for type II diabetes among patients under age 30 at Allied Hospital Faisalabad, for 6 months after approval from the ERC/Erb vide letter Reference No: GCUF/ERC/471-A Dated: 24-09-2024. In this study, 100 patients from Allied Hospital were selected by purposive sampling. Participation was restricted to individuals under 30 years of age and without a history of type I or type II diabetes. Perceived seriousness, perceived severity, and self-efficacy were investigated regarding type II diabetes risk factors. Finding the common risk factors and perceived threat of type II diabetes among college students can help build targeted marketing efforts and patient-specific therapies. The design of this cross-sectional study was based on the American Diabetes Association's (ADA) classification of type II diabetes risk factors. The risk variables served as a reference for the development of the study's questionnaire. A written survey was utilized to collect descriptive data from a large sample of people. The data was evaluated using the electronic version of the Statistical Package for the Social Sciences Version 19 (SPSS), and the results were then directly applied to the study's research questions. Data relevant to the research themes were obtained through measurements of the study's variables. The independent variables were confidence, gender, risk factors, and a family history of type II diabetes. Perceived severity and perceived seriousness were the dependent variables in this study.

By taking capillary whole blood samples from the patient's fingertip for random and fasting blood sugar testing, the prevalence of diabetes was ascertained. Testing was then carried out in accordance with the manufacturer's standard operating procedure after the blood drop was

put on a test strip that was connected to a glucose monitoring device (One Touch® Select SimpleTM).

Random blood sugar (RBS) was defined as the reading taken after two hours post-prandial, after the start of the first bite. Fasting blood sugar (FBS) was defined as the sugar level taken 8 hours after fasting. Patients who were chosen for FBS testing were directed to fast for eight hours the night before retesting. If the FBS result showed diabetes, it was regarded as a favorable result for DM. To guarantee study participation, results were discussed with the patient and recorded appropriately.

A type II diabetes risk screening questionnaire and an implied consent form with study details were given to the patients.

Microsoft Excel was used to compute and analyze data for risk assessments and sociodemographic findings. The Statistical Package for the Social Sciences (SPSS) was then used to perform bivariate and multivariate analyses.

RESULTS

Univariate Analysis

The prevalence of type T2DM under the age of 30 years in the district of Faisalabad is given in Table-I. The total population was 100, out of which 66% were female, and 34% were male. The total population was 100, out of which 59% were tested with FBS, and 41% were tested with RBS. The majority of respondents lived in urban areas (53%), while 47% were from rural areas. The education levels of the participants varied, with 41% having higher education, 33% having secondary education, 15% having primary education, and 11% being illiterate. 52% of participants were between the ages of 18 and 24, 47% were between the ages of 24 and 30, and 1% were between the ages of 30 to onward. Most respondents were currently married (65%), while 31% were never married. A small percentage were widowed (2%), and no participants reported being divorced. 72% of participants were engaged in physical activity, while 28% were not engaged in any activity. 60% of participants were engaged in walking while 40% were not engaged in going for walk. 77% of participants had a family history of diabetes, while 23% had not had family history of diabetes. 70% of participants had not one parent affected with diabetes while 30% family history of diabetes while 23% have one parent affected with diabetes. 32% of participants did not have two parents affected with diabetes while 30% family history of diabetes while 68% have two parents affected with diabetes.

69% of participants did not have siblings affected by diabetes while 31% have siblings affected by diabetes. 21% of participants did not have relatives affected with diabetes while 79% have relatives affected by diabetes. 91% of participants did not smoking currently while 9% smoking currently. 99% of participants do not consume alcohol currently while 1% consume alcohol currently. 29% of participants were not serving fruit and vegetables while 71% were serving fruit and vegetables. 63% of participants had a history of obesity while 37% did not have a history of obesity. 61% of participants had a history of raised cholesterol while 39% did not have history of raised of cholesterol. 33% of participants had a history of hypertriglyceridemia while 67% did not have history of hypertriglyceridemia. The average monthly income of the respondents was 27,467.25 ± 30,619.4 rupees, with a median income of 23,000 rupees. The income ranged from a minimum of 5,000 to a maximum of 150,000 rupees.

The mean BMI of the participants was 25.14 ± 6.19 kg/m^2, with a median of 25.62 kg/m^2. BMI values ranged from 5.1 to 46.75 kg/m^2. The mean waist circumference was 34.78 ± 7.67 inches, with a median of 34 inches. The range of waist circumference was from 20.67 to 105 inches. The average diastolic blood pressure was 81.51 ± 13.0 mmHg, with a median of 80 mmHg. The average systolic blood pressure was 123.7 ± 22.6 mmHg, with a median of 120 mmHg. Additionally, 31% of respondents had siblings with diabetes, and 79% had affected relatives. 37% of respondents reported a family history of obesity, while 63% did not. 64% reported a family history of high blood

pressure, while 36% did not. 33% of participants had a history of hypertriglyceridemia, while 67% did not. The study population was predominantly female, with a majority aged 18–37 years. Most participants were engaged in some form of physical activity, with nearly 77% consuming the recommended servings of fruits and vegetables daily. A high prevalence of family history of diabetes (77%) and high blood pressure (64%) was observed. Anthropometric measurements revealed a mean BMI of 25.14 kg/m^2, indicating an overweight population, with a mean waist circumference of 34.78 inches. Blood pressure values were within the borderline hypertensive range for a subset of participants. These findings highlight the significant prevalence of modifiable risk factors, such as obesity, physical inactivity, and dietary habits, which may contribute to the development of diabetes and associated comorbidities.

The chi-square analysis revealed several significant associations between categorical variables as shown in Table-II. Sex was significantly associated with a family history of diabetes ($p = 0.036$), diabetic relatives ($p = 0.045$), current smoking status ($p = 0.004$), and family history of high blood pressure ($p = 0.011$). These findings suggest that health risks and behaviors such as smoking and hereditary predisposition to metabolic conditions differ between males and females. Residence showed a significant association with having one parent affected by diabetes ($p = 0.032$) and a family history of high blood pressure ($p = 0.001$). This indicates that urban or rural living conditions may influence hereditary health trends. Family history of diabetes (DM) was strongly associated with having one parent ($p = 0.011$), two parents ($p < 0.05$), siblings ($p = 0.000$), or relatives ($p = 0.000$) affected by diabetes. Moreover, it was also significantly associated with a family history of high blood pressure ($p = 0.001$), highlighting familial clustering of these metabolic disorders. Physical activity was significantly linked with the habit of going for walks ($p = 0.000$), reinforcing that walking is a major component of overall physical activity among participants. All other variable combinations not listed above showed no statistically significant association ($p > 0.05$) and were excluded from this summary.

Factors	Percent (%)
Male	34
Female	66
Blood glucose FBS >126 mg/dl	59
Blood glucose RBS >200 mg/dl	41
Physical activity Yes	72
Physical activity No	28
Going for a walk: Yes	40
Going for a walk. No	60
Family history of DM: Yes	77
Family history of DM No	23
One Parent Affected Yes	30
One Parent Affected No	70
Two Parent Affected Yes	32
Two Parent Affected No	68
Siblings affected yes	31
Siblings affected no	69
Relatives affected yes	79
Relatives affected no	21
Residence Rural	47
Residence Urban	53
Smoking yes	9
Not smoking	91
Alcoholic	2
Non alcoholic	98
Servings of Fruits & Vegetables Daily Yes	77
Servings of Fruits & Vegetables Daily No	32
Family History of Obesity Yes	37
Family History of Obesity No	63
Family History of High BP Yes	64
Family History of High BP No	36
Hypertriglyceridemia Yes	33
Hypertriglyceridemia No	67

Table-I. Prevalence of risk factors of diabetic patients

The heatmap in Figure-1 visualizes the significant results from the bivariate analysis, highlighting associations with p-values less than 0.05. Darker colors represent stronger statistical significance. BMI and Waist Circumference ($p < 0.001$) and Systolic Blood Pressure ($p = 0.006$), reinforcing the role of obesity indicators in influencing blood

pressure. Systolic and Diastolic Blood Pressure ($p < 0.001$), a well-established physiological correlation. Sex and Smoking ($p = 0.004$), which suggests the need for sex-specific tobacco control strategies. Family history (FH) of obesity and hypertriglyceridemia ($p = 0.001$), supporting the genetic link to metabolic risks. The heatmap visually confirms that sex, residence, and family history variables are significantly linked to metabolic and lifestyle outcomes. These findings underline the importance of targeted interventions based on demographic and genetic factors.

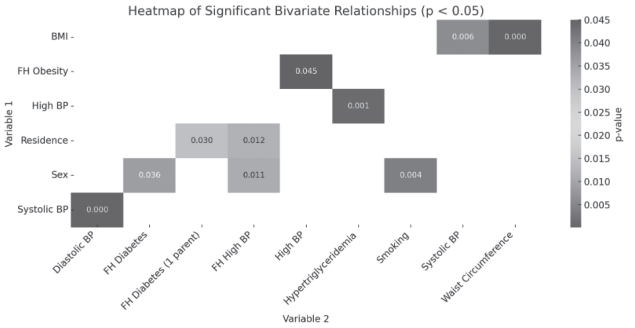

Figure-1. Heat map of significant factors in bivariate analysis.

Based on the multivariate analysis results for hypertension and obesity, the statistically significant factors ($p < 0.05$) are given in Table-III.

The multivariate binary logistic regression analysis identified several significant predictors for hypertension and obesity among the surveyed individuals as shown. For hypertension, the overall model was statistically significant ($p = 0.023$), explaining approximately 23.76% of the variability as shown in Table-III. Among the variables assessed, sex, residence, and blood glucose type were significantly associated with hypertension. Males were significantly more likely to have hypertension compared to females ($p = 0.006$), with an odds ratio of 0.1128, suggesting females had a substantially lower risk. Urban residents showed a significantly higher risk of hypertension than rural counterparts ($p = 0.023$), with an odds ratio of 5.1253. Additionally, individuals with fasting blood glucose (FBS) were less likely to have hypertension compared to those with random blood sugar (RBS) ($p = 0.021$, $OR = 0.2434$).

Variable Pair	Chi-Square (χ^2)	DF	P-Value	Interpretation
Sex × Family History of Diabetes	4.397	1	0.036	Significant
Sex × Relatives with Diabetes	4.002	1	0.045	Significant
Sex × Current Smoker	8.447	1	0.004	Significant
Sex × Family History of High Blood Pressure	6.417	1	0.011	Significant
Residence × One Parent Affected	4.590	1	0.032	Significant
Residence × Family History of High Blood Pressure	11.375	1	0.001	Significant
Family History of DM × One Parent Affected	6.456	1	0.011	Significant
Family History of DM × Two Parents Affected	14.057	2	<0.05	Significant
Family History of DM × Siblings Affected	13.420	1	0.000	Significant
Family History of DM × Relatives Affected	35.203	1	0.000	Significant
Family History of DM × Family History of High Blood Pressure	11.067	1	0.001	Significant
Physical Activity × Going for Walk	17.493	1	0.000	Significant

Table-II. Chi-square test results for significant categorical variables.

Predictor Variable	Outcome	Odds Ratio	95% CI	P-Value
Sex (Male vs Female)	Hypertension	0.1128	(0.0185, 0.6897)	0.006
Residence (Urban vs Rural)	Hypertension	5.1253	(1.1552, 22.7399)	0.023
Blood Glucose (FBS vs RBS)	Hypertension	0.2434	(0.0701, 0.8454)	0.021
Sex (Male vs Female)	Obesity	—	—	0.000

Table-III. Statistically significant predictors for hypertension and obesity

In the case of obesity, the overall model was also significant ($p = 0.006$), with a deviance R-square of 34.2%. Among all predictors, sex was the only statistically significant factor ($p < 0.001$), indicating that gender plays a crucial role in obesity risk, although the exact odds ratio was not specified in the output. Goodness-of-fit tests (Deviance, Pearson, and Hosmer-Lemeshow) showed acceptable model fit for both hypertension and obesity, with all p-values greater than 0.05.

DISCUSSION

Univariate Analysis

66% of participants in the study were female, according to the gender distribution of the population, which may reflect higher participation rates of women in health-related studies due to greater awareness or availability. This aligns with prior studies that observed a higher female representation in similar research. Urban residents (53%) slightly outnumbered rural participants (47%), which aligns with the gradual urbanization of developing regions. Urban areas often provide better healthcare access, contributing to early detection and reporting of conditions like diabetes and associated risk factors. The educational status of participants varied significantly, with the largest group (41%) having higher education, suggesting that the study participants may have a better understanding of health and lifestyle factors. This is important since education correlates strongly with health literacy, influencing lifestyle choices like diet, exercise, and healthcare-seeking behaviour. The marital status of the participants showed that most were currently married (65%), followed by 31% who were never married. Previous research has suggested that married individuals often have better health outcomes due to shared responsibilities, but this can also increase risks related to sedentary lifestyles.[19]

The age distribution shows that the majority of participants (99%) were aged 18–30 years, with only 1% above this age range. This younger demographic highlights the importance of addressing diabetes risk factors early in life, as this age group is most likely to develop modifiable behaviors that impact long-term health. The mean monthly income of participants was 27,467.25 ± 30,619.4 rupees, with a wide income disparity ranging from 5,000 to 150,000 rupees. This large range suggests socio-economic diversity among participants, which could influence access to healthcare, diet quality, and lifestyle choices. The average BMI of participants was 25.14 ± 6.19 kg/m^2, with a median of 25.62 kg/m^2, indicating an overweight population according to WHO classifications.[21] This finding is concerning, as overweight and obesity are strongly associated with increased diabetes risk. The wide range of BMI values (18.25 to 59.9 kg/m^2) highlights significant individual variability, with some participants falling into severely obese categories. High BMI is a known risk factor for insulin resistance and diabetes development, particularly in younger populations.[21]

The mean waist circumference (34.78 ± 7.67 inches) was near the threshold for central obesity, which is a critical risk factor for metabolic syndrome and type 2 diabetes. A subset of participants exceeded 40 inches, indicative of higher visceral fat content, which is directly linked to insulin resistance. Blood pressure measurements revealed that the mean systolic blood pressure was 123.7 mmHg, and the mean diastolic blood pressure was 81.51 mmHg. While these values fall within the upper range of normal, a subset of participants may be at risk of hypertension, further exacerbating the risk of cardiovascular complications in this population. Elevated blood pressure is also strongly correlated with diabetes, creating a bidirectional risk factor relationship.[22] Physical activity levels showed a promising trend, with 72% of participants engaging in some form of physical activity. However, only 40% reported regular walking, which is one of the simplest and most effective forms of exercise for diabetes prevention.[23] The remaining 60% who did not walk regularly represent a missed opportunity for a low-cost, accessible preventive measure. Smoking and alcohol consumption were reported by only 9% and 2% of participants, respectively, reflecting a low prevalence of these high-risk behaviors in this population. These rates are lower compared to national averages, which may be due to cultural or religious influences

in the region. Nevertheless, even occasional smoking and alcohol consumption are known to exacerbate oxidative stress and inflammation, further increasing the risk of metabolic disorders.[24]

The majority of participants (77%) reported consuming the recommended daily servings of fruits and vegetables, indicating a generally healthy dietary pattern. However, the remaining 23% who did not meet this criterion are at higher risk of developing nutrient deficiencies and metabolic imbalances. Fruits and vegetables are rich in antioxidants, vitamins, and minerals that play a crucial role in maintaining insulin sensitivity and preventing inflammation. A high prevalence of family history of diabetes (77%) was observed, with significant contributions from both parents (32%) and siblings (31%). This finding is consistent with previous studies that highlight the genetic predisposition to diabetes. The presence of a strong family history, particularly with multiple affected relatives (79%), underscores the role of hereditary factors in diabetes development. The family history of obesity (37%) and high blood pressure (64%) further supports the interconnected nature of these risk factors in diabetes pathogenesis. Hypertriglyceridemia, reported in 33% of participants, is a known component of dyslipidemia associated with metabolic syndrome and type 2 diabetes. The findings of this study highlight a worrying trend of overweight and obesity, central adiposity, and strong familial predisposition to diabetes in a relatively young population. Despite a high percentage of participants engaging in physical activity and consuming fruits and vegetables, modifiable risk factors like lack of regular walking, low income, and borderline high blood pressure remain significant challenges.

Bivariate Analysis

The bivariate analysis revealed several statistically significant associations between demographic and health-related variables. Sex was significantly associated with smoking behavior ($p = 0.004$), with findings supporting existing literature that males tend to smoke more than females, highlighting the need for sex-specific interventions in smoking cessation. Additionally, a significant association was observed between sex and family history of diabetes ($p = 0.036$), suggesting that genetic or lifestyle factors may vary by sex, influencing diabetes risk. Sex was also significantly related to family history of high blood pressure ($p = 0.011$), indicating the potential role of sex-specific predispositions or behaviors in hypertension risk. In contrast, no significant associations were found between sex and variables such as physical activity, dietary habits, obesity, or hypertriglyceridemia, although a near-significant trend for walking ($p = 0.058$) suggests that further exploration could be worthwhile.

With respect to residence, significant associations were identified with having one parent affected by diabetes and with family history of high blood pressure. These findings imply that urban or rural living conditions may influence genetic and environmental factors contributing to these diseases. However, other lifestyle-related factors such as physical activity, walking, smoking, alcohol intake, and dietary habits did not show significant associations with place of residence. Family history of obesity was significantly linked to both high blood pressure and hypertriglyceridemia, reinforcing the known relationship between obesity and cardiovascular risk. Additionally, a strong association was found between high blood pressure and hypertriglyceridemia, underscoring the interconnected nature of metabolic conditions. Physical activity showed a significant relationship with walking but was not associated with other lifestyle or health outcomes in this analysis.

Among the continuous variables, BMI demonstrated a significant positive correlation with systolic blood pressure ($r = 0.275$, $p = 0.006$) and waist circumference ($r = 0.477$, $p < 0.001$), confirming BMI as a key indicator of cardiovascular and metabolic risk. Systolic blood pressure was strongly correlated with diastolic blood pressure ($r = 0.667$, $p < 0.001$), reflecting expected physiological patterns. Diastolic blood pressure and income showed no statistically significant correlations with BMI, waist circumference, or systolic blood pressure. Although diastolic pressure and income had weak trends with some variables, their associations were not significant

and may require larger sample sizes for further validation.

Overall, the results highlight the importance of sex, residence, family history, and BMI in understanding the risk factors for diabetes and cardiovascular conditions. Factors such as physical activity, diet, and income showed limited or non-significant associations in this sample, suggesting the need for broader models incorporating socioeconomic and behavioral variables in future studies.

Multivariate Analysis

The findings of this study highlight the critical roles that sex, residence, and blood glucose monitoring type play in the risk of developing hypertension, while sex alone significantly influences the risk of obesity. The significantly lower odds of hypertension among females may reflect protective physiological or behavioral factors, such as hormone levels or healthcare-seeking patterns. The elevated risk among urban dwellers likely relates to sedentary lifestyles, dietary patterns, and stress levels commonly associated with urban living. Blood glucose type (FBS vs. RBS) emerged as a significant variable, with those undergoing fasting tests demonstrating lower hypertension risk. This may indicate better metabolic control or health awareness among individuals opting for FBS assessments. For obesity, the highly significant association with sex suggests that gender-based biological or behavioral factors contribute to weight gain, possibly due to differences in fat distribution, metabolic rate, or physical activity patterns.[25] Overall, these findings emphasize the need for gender-sensitive public health strategies, urban-targeted interventions, and enhanced screening using FBS for better management and prevention of hypertension and obesity.

CONCLUSION

This study identified key factors contributing to the risk of hypertension and obesity through multivariate analysis. Sex was found to be a significant determinant for both conditions, suggesting the necessity of gender-specific prevention strategies. Urban residence significantly increased the likelihood of hypertension, pointing to the influence of environmental and lifestyle factors. Additionally, fasting blood glucose monitoring was associated with a lower risk of hypertension, implying better metabolic control or health awareness in such individuals. These insights emphasize the importance of targeted public health policies addressing gender, urban health disparities, and metabolic monitoring to effectively reduce the burden of hypertension and obesity.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Muhammad Owais Fazal:** Conception of the idea, manuscript writing.
2	**Ghulam Abbas Tahir:** Data analysis, result formulation.
3	**Muhammad Usman Ali:** Data collection.
4	**Muhammad Abid Rasheed:** Manuscript writing.
5	**Sultan Ayaz:** Data analysis.
6	**Ali Siftain:** Data analysis, result formulation.