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PREVALENCE OF LIPITENSION AND ITS ASSOCIATED RISK FACTORS AMONG TYPE 2 DIABETIC PATIENTS

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ABSTRACT

Objective: To determine the prevalence of concurrent hypertension and dyslipidemia among individuals with type 2 diabetes mellitus (T2DM) and to evaluate the impact of demographics, clinical, and lifestyle factors on this coexistence.

Methodology: A cross-sectional study was carried out at the Diabetes Clinic, Medical Unit III, JPMC, between July 2023 and March 2024. A total of 248 adults with T2DM were enrolled using convenience sampling. Demographic data, along with duration of diabetes, family history, lifestyle habits, body mass index (BMI), waist circumference, and blood pressure, were recorded. Laboratory assessments included fasting blood glucose (FBG), glycated haemoglobin (HbA1c), detailed lipid profile, and liver enzymes. Hypertension and dyslipidemia were classified according to standard diagnostic criteria. Data were analysed using SPSS version 25, applying descriptive statistics and chi-square tests, with significance set at $p < 0.05$.

Results: Out of 248 type 2 diabetic patients, 150 (60.5%) had coexisting hypertension and dyslipidemia (lipitension). The prevalence increased with age, reaching 71.3% in patients aged 60+ years. Females had a higher prevalence (45.2%) compared to males (15.3). A sedentary lifestyle was significantly associated with lipitension (50.4% vs. 10.1%, $p = 0.01$), and longer diabetes duration also increased the prevalence (70.0% for >10 years, $p = 0.04$). Family history of hypertension (66.0%, $p = 0.03$) and dyslipidemia (70.1%, $p = 0.04$) further increased the likelihood of lipitension.

Conclusion: The coexistence of hypertension and dyslipidemia is common in T2DM, particularly in older, sedentary patients with prolonged disease duration or positive family history. Early detection and risk-factor modification are essential to reduce cardiovascular complications.

INTRODUCTION:

The simultaneous occurrence of hypertension and dyslipidemia in an individual can increase the risk of cardiovascular complications by up to three times [1][2]. Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide, with global deaths rising from 12.4 million in 1990 to 19.8 million in 2022. The burden is disproportionately higher in low- and middle-income countries, which account for more than 75% of global CVD cases. In Pakistan, mortality from ischemic heart disease exceeds 150 per 100,000 people, contributing substantially to the national health burden [3][4].

Much of this burden is preventable through control of modifiable risk factors, including physical inactivity, unhealthy diet, obesity, alcohol use, and smoking. These behaviours often manifest clinically as hypertension, hyperglycemia, dyslipidemia, and obesity [5]. International guidelines, such as those from the National Institute for Health and Care Excellence and the European Society of Cardiology, emphasize prevention strategies targeting these risks [6–8].

In individuals with type 2 diabetes mellitus (T2DM), hypertension and dyslipidemia frequently coexist and are recognized as key drivers of cardiovascular morbidity and mortality [9]. Components of metabolic syndrome, including raised blood pressure, hyperglycemia, central obesity, and abnormal lipid profiles, further elevate the likelihood of developing CVD, stroke, and diabetes-related complications [10]. Pakistan faces a growing burden of metabolic disorders, with studies reporting high rates of low high-density lipoprotein (HDL), elevated triglycerides, and abdominal obesity in the general population [11]. In addition, the prevalence of diabetes has surged from 5.2 million in 2000 to more than 33 million in 2021, underscoring the urgent need to evaluate combined risk conditions such as the coexistence of hypertension and dyslipidemia in diabetic populations [12].

RATIONALE:

Since T2DM, dyslipidemia, and hypertension are concurrent, the incidence of hypertension is considerably greater in individuals with type 2 diabetes than in the general population [13]. Lipitension can triple the risk of cardiovascular issues, necessitating prompt diagnosis and effective treatment. Dyslipidemia and hypertension are significant and prevalent chronic conditions in diabetic patients. Therefore, it is crucial to estimate their prevalence along with other associated risk factors among patients with type 2 diabetes in the Pakistani population.

OBJECTIVE:

To determine the prevalence of coexistence of hypertension and dyslipidemia among patients with type 2 diabetes and to evaluate the impact of demographics, clinical, and lifestyle factors on this coexistence (lipitension) in this population.

OPERATIONAL DEFINITION:

Dyslipidemia: Dyslipidemia was identified based on the presence of at least one of the following criteria:

1. Elevated LDL cholesterol (≥100 mg/dL) or ongoing therapy for high LDL.
2. Elevated triglycerides (TAG ≥150 mg/dL) or ongoing therapy for hypertriglyceridemia.
3. Low HDL cholesterol (<40 mg/dL in men and <50 mg/dL in women)[14].

Hypertension: Hypertension is defined as systolic blood pressure ≥130 mmHg and/or diastolic blood pressure ≥80 mmHg, or current antihypertensive treatment (two readings taken after five minutes of rest in a seated position, averaged for analysis) [15].

Central Obesity: Central obesity has been defined as a waist circumference ≥90 cm for

men and ≥80 cm for women, based on Asian-specific cut-offs [15].

Lipitension: Lipitension is the presence of hypertension and dyslipidemia in one person [16].

Diabetes: The diagnostic criteria according to WHO:

Fasting Blood Glucose (FBS) > 126mg/dl

A Random Blood Glucose (RBS) >200mg/dl.

Hba1c (Glycated hemoglobin) >6.5% [17]

Sedentary Lifestyle

Defined as NOT meeting the WHO recommendation of 150-300 minutes of moderate-intensity physical activity, or 75 minutes of vigorous-intensity activity throughout the week. Assessment was based on self-reported physical activity during routine history taking. [17].

Citation: World Health Organization. WHO guidelines on physical activity and sedentary behaviour. Geneva: World Health Organization; 2020. Licence: CC BY-NC-SA 3.0 IGO.

METHODOLOGY

The research, following a cross-sectional design, was conducted at the Diabetes Clinic, Medical Unit III, JPMC, Karachi, from July 2023 to March 2024. Type 2 diabetic patients aged over 18 who provided informed consent were recruited through non-probability convenience sampling. A comprehensive medical history was obtained, followed by a physical examination and laboratory tests, including fasting blood glucose, HbA1c, LFTs, and lipid profile assessments. The sample size was calculated using OpenEpi version 3.01, assuming a prevalence of lipitension of 50% (to ensure maximum variability), a 95% confidence interval, and a 6.5% margin of error. Using the formula for cross-sectional studies:

$n=Z^2 \cdot P \cdot (1-P)/d^2$

Where:

- $Z=1.96$ (standard score for 95% confidence level)
- $P=0.5$ (assumed prevalence of lipitension)
- $d=0.065$ (desired margin of error, 6.5%)

$n=(1.96)2 \cdot 0.5 \cdot (1-0.5)/(0.065)^2 \approx 227$

To account for potential incomplete data or non-response, a total of **248 participants** were enrolled.

Data was analyzed using SPSS 25. Descriptive statistics were applied to summarize baseline characteristics, including age, sex, duration of diabetes, lifestyle (sedentary/non-sedentary), family history of hypertension and dyslipidemia, BMI, waist circumference, blood pressure, fasting glucose, HbA1c, liver enzymes (ALT/AST), and lipid profile (total cholesterol, triglycerides, HDL, LDL). Categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using Pearson's chi-square test. Specifically, age group, sex, duration of diabetes, lifestyle, and family history were assessed for association with lipid abnormalities (cholesterol, triglycerides, HDL, LDL) and liver enzyme categories (ALT/AST). Hypertension status was also analyzed in relation to HDL and triglyceride categories. A p-value of <0.05 was considered statistically significant. Approval from the Institutional Review Board (IRB) of Jinnah Postgraduate Medical Centre was obtained (Reference No: F.2-81/2023-GENL/44/JPMC). All ethical guidelines were strictly followed, ensuring the integrity of the research, and safeguarding the rights and well-being of the participant.

RESULTS:

A total of 248 patients with type 2 diabetes mellitus were enrolled. Most participants were women, and most were older than 40 years. More than two-thirds reported a sedentary lifestyle, and nearly half had diabetes for over 10 years (Table 1).

Table 1. Baseline demographic and clinical characteristics of participants

Category	Factors	Frequency (n)	Percentage (%)
Age (years)	20–30	9	3.6
	30–40	31	12.5
	40–50	56	22.6
	50–60	72	29.0
	60+	80	32.3
Gender	Male	73	29.4
	Female	175	70.6
Duration of diabetes (years)	1–5	71	28.6
	6–10	67	27.0
	11–15	70	28.2
	>15	40	16.1
Lifestyle	Sedentary	177	71.4
	Active	71	28.6
Family history	Hypertension (Yes)	159	64.1
	Hypertension (No)	89	35.9
	Dyslipidemia (Yes)	67	27.0
	Dyslipidemia (No)	181	73.0
BMI (kg/m²)	<18.5 (Underweight)	8	3.2
	18.5–22.9 (Normal)	42	16.9
	23–24.9 (Overweight)	50	20.2
	≥25 (Obese)	148	59.7

Table 2 presents the prevalence of lipitension (coexistence of hypertension and dyslipidemia) across various demographic and clinical characteristics of type 2 diabetic patients. The table shows that the prevalence of lipitension increases with age, with the highest prevalence observed in the **60+ years** age group (23.0%). Significant associations are found between age and lipitension (p = 0.02), with older age groups showing higher rates of coexistence. The gender-based comparison reveals a higher prevalence in females (45.2%) compared to males (15.3%), though this difference is not statistically significant (p = 0.18).

A sedentary lifestyle is strongly associated with a higher prevalence of lipitension, affecting 50.4% of sedentary individuals compared to just 10.1% of active individuals (p = 0.01). Additionally, longer duration of diabetes is linked to a higher prevalence of hypertension and dyslipidemia, with 19.8 % of those with diabetes for 11–15 years having lipitension, and 11.3% among those with diabetes for more than 15 years (p = 0.04).

Family history plays a crucial role, with those having a family history of hypertension (42.3%) or dyslipidemia (18.9%) showing a significantly higher prevalence of lipitension compared to those without a family history of these conditions (p = 0.03 and p = 0.04, respectively). These findings emphasize the importance of age, lifestyle, diabetes duration, and family history in the development of lipitension among diabetic patients.

Table 2. Prevalence of coexistence of hypertension and dyslipidemia by demographic and clinical characteristics

Factor	Present n (%)	Absent n (%)	Total n	p-value
Age group				
20–30 years	3 (1.2%)	6 (2.4%)	9	
30–40 years	11 (4.4%)	20 (8.1%)	31	0.02
40–50 years	30 (12.1%)	26 (10.5%)	56	
50–60 years	49 (19.8%)	23 (9.3%)	72	
60+ years	57 (23.0%)	23 (9.3%)	80	
Gender				0.18
Male	38 (15.3%)	35 (14.1%)	73	
Female	112 (45.2%)	63 (25.4%)	175	
Lifestyle				0.01
Sedentary	125 (50.4%)	52 (21.0%)	177	
Active	25 (10.1%)	46 (18.5%)	71	
Duration of diabetes				0.04
1–5 years	35 (14.1%)	36 (14.5%)	71	
6–10 years	38	29	67	

	(15.3%)	(11.7%)		
11–15 years	49 (19.8%)	21 (8.5%)	70	
>15 years	28 (11.3%)	12 (4.8%)	40	
Family history				
Hypertension (Yes)	105 (42.3%)	54 (21.8%)	159	0.03
Hypertension (No)	45 (18.1%)	44 (17.7%)	89	
Dyslipidemia (Yes)	47 (18.9%)	20 (8.1%)	67	0.04
Dyslipidemia (No)	103 (41.5%)	78 (31.5%)	181	

Raised LDL cholesterol was observed in 110 participants (44.4%), while elevated triglycerides were present in 95 (38.3%). Low HDL was noted in 65 men (26.2%) and 72 women (29.0%). Elevated liver enzymes were also documented, with ALT >40 U/L in 52 participants (21.0%), AST >40 U/L in 47 (19.0%), and GGT >50 U/L in 35 (14.1%). The prevalence of lipid and liver enzyme abnormalities increased with age, with participants aged ≥60 years showing the highest frequencies of raised LDL (55.0%) and abnormal liver function tests (24.0%).

Table 3. Prevalence of Lipid Abnormalities and Elevated Liver Enzymes in Study Participants (n=248)

Parameter	n (%)
Raised LDL cholesterol (≥100 mg/dL)	110 (44.4%)
Raised triglycerides (≥150 mg/dL)	95 (38.3%)
Low HDL – Men (<40 mg/dL)	65 (26.2%)
Low HDL – Women (<50 mg/dL)	72 (29.0%)
Elevated ALT (>40 U/L)	52 (21.0%)
Elevated AST (>40 U/L)	47 (19.0%)
Elevated GGT (>50 U/L)	35 (14.1%)

Sedentary lifestyle was significantly associated with raised triglyceride levels (67.8% vs. 47.9%, p = 0.028). Low HDL was more frequent in hypertensive patients compared to non-hypertensives (25.2% vs. 11.2%, p = 0.016). Differences in liver enzymes were not statistically significant (Table 4).

Table 4. Association of Lifestyle and Hypertension Status with Lipid Abnormalities and Liver Enzyme Elevations in Type 2 Diabetic Patients

Risk Factor	Raised Triglycerides n (%)	Low HDL n (%)	Elevated Liver Enzymes n (%)	p-value *
Lifestyle				
Sedentary	120 (67.8)	40 (22.6)	60 (33.9)	0.028
Active	34 (47.9)	10 (14.1)	21 (29.6)	
Hypertension status				
Hypertensive	100 (62.9)	40 (25.2)	50 (31.4)	0.016
Non-hypertensive	54 (60.7)	10 (11.2)	31 (34.8)	

Fisher's exact test applied where expected cell counts were <5; significant at $p < 0.05$.

Logistic Regression Analysis

Logistic regression showed that **sedentary lifestyle, older age, and longer duration of diabetes** were independently associated with lipitension. After adjustment, sedentary individuals had over threefold higher odds of having lipitension (AOR 3.20, 95% CI 1.72–5.95, p = 0.01), while patients with diabetes duration >10 years had nearly double the odds (AOR 1.85, 95% CI 1.02–3.33, p = 0.04). Age above 60 years remained significantly associated (AOR 2.80, 95% CI 1.25–6.27, p = 0.02). **Associations with family history of**

hypertension and dyslipidemia were not statistically significant, as their confidence intervals crossed 1.0. Sex also showed no significant effect.

Table 5. Logistic Regression Analysis of Factors Independently Associated with Lipitension in Patients with Type 2 Diabetes

Factor	Present n (%)	Absent n (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)*	p-value
Age ≥ 60 years	57 (71.3)	23 (28.7)	3.10 (1.45–6.64)	2.80 (1.25–6.27)	0.02
Female sex	112 (64.0)	63 (36.0)	1.57 (0.91–2.70)	1.40 (0.78–2.50)	0.18
Sedentary lifestyle	125 (70.6)	52 (29.4)	3.60 (1.95–6.65)	3.20 (1.72–5.95)	0.01
Diabetes > 10 years	77 (70.0)	33 (30.0)	2.00 (1.11–3.61)	1.85 (1.02–3.33)	0.04
Family history of HTN	105 (66.0)	54 (34.0)	1.84 (1.05–3.22)	1.70 (0.96–3.00)	0.12†
Family history of dyslipidemia	47 (70.1)	20 (29.9)	1.75 (1.01–3.65)	1.62 (0.88–3.02)	0.11†

*Adjusted for age, sex, lifestyle, and duration of diabetes.

†Not statistically significant (95% CI crosses 1.0).

*Adjusted for age, sex, lifestyle, and duration of diabetes.

DISCUSSION:

Dyslipidaemia and hypertension are common and significant comorbidities among individuals with type 2 diabetes, contributing to increased cardiovascular morbidity and mortality. Understanding their coexistence and related risk factors is essential in improving outcomes for this population. In the present study, 60.5% of participants were identified with both conditions, a finding that underscores the substantial burden of combined cardiovascular risk factors in diabetic patients. The prevalence increased with advancing age, exceeding 70% in participants over 60 years, which aligns with existing evidence linking vascular changes and metabolic alterations in older adults with higher rates of these disorders [22]. Gender differences were observed, with a higher proportion of women affected than men, though this was not statistically significant. Lifestyle emerged as an important determinant, with sedentary individuals more than twice as likely to have coexisting hypertension and dyslipidaemia compared with physically active participants, suggesting the importance of modifiable behavioural factors in disease progression. Longer duration of diabetes was also associated with higher prevalence, reflecting the cumulative metabolic and vascular burden over time. Family history of both hypertension and dyslipidaemia further increased risk, supporting the role of genetic and shared environmental influences [23][24].

This study demonstrates a considerable burden of dyslipidemia and liver enzyme abnormalities among patients with type 2 diabetes. Raised LDL was present in 44.4% of the cohort, and prevalence increased with age, reaching 55.0% among participants aged 60 years and above. Elevated triglycerides were detected in 38.3% of patients, while low HDL was noted in 26.2% of men and 29.0% of women. Abnormal liver enzymes were also common, with ALT elevation observed in 21.0%, AST in 19.0%, and GGT in 14.1% of participants. These results suggest that older diabetic patients are more likely to exhibit lipid and hepatic derangements, which may contribute to heightened cardiovascular and metabolic risk. The association of dyslipidemia and abnormal liver enzymes with advancing age observed in this study is consistent with prior literature linking metabolic aging to worsening lipid profiles and hepatic dysfunction. Although raised liver enzymes were common, no meaningful associations were observed with other risk factors, which may point to non-alcoholic fatty liver disease as a silent contributor in the study [19]. These findings reinforce the complex interplay of insulin resistance,

vascular dysfunction, and lipid abnormalities that drive the development of hypertension and dyslipidaemia in patients with diabetes [21]. The results of this study carry important clinical implications. Given the high prevalence of coexisting hypertension and dyslipidaemia in diabetic patients, routine screening for both conditions should be integrated into diabetes care at primary and tertiary levels. Early identification of at-risk individuals, particularly those with longer diabetes duration, sedentary lifestyle, or family history, can guide timely interventions. Incorporating structured lifestyle modification programs within diabetic clinics could help mitigate the risk, alongside pharmacological management tailored to combined lipid and blood pressure abnormalities.

This study, however, has certain limitations. The majority of participants were overweight or obese, which may limit the applicability of findings to lean diabetic patients. Moreover, the single-centre design and use of convenience sampling may limit external validity, as the findings may not represent patients from other regions or healthcare settings in Pakistan. Despite these limitations, the study provides valuable insights into the burden and determinants of coexisting hypertension and dyslipidaemia in diabetic patients. Future research should build on these findings by adopting longitudinal designs to clarify causal pathways and to track the progression of cardiometabolic risk over time. Intervention-based studies that evaluate the effectiveness of lifestyle modification, combined pharmacological regimens, and structured screening strategies within diabetic clinics would further strengthen the evidence base. Such research could support the development of comprehensive guidelines for integrated management of type 2 diabetes with coexisting cardiovascular risk factors.

CONCLUSION:

Hypertension and dyslipidemia were frequently observed in patients with type 2 diabetes. Raised LDL levels and abnormal liver enzymes were common, though their association with clinical risk factors was not consistent. A sedentary lifestyle showed a link with higher triglycerides, and lower HDL was noted in hypertensive patients. Older age was also associated with unfavorable lipid changes and abnormal liver enzymes. These findings emphasize the need for early identification and management of cardiovascular risk factors in diabetics. Future studies with larger and more diverse groups, as well as longitudinal designs, are required to better define the burden and associators of lipitension in this population.

REFERENCES:

1. Dalal JJ, Padmanabhan TN, Jain P, Patil S, Vasnawala H, Gulati A. Lipitension: interplay between dyslipidemia and hypertension. *Indian J Endocrinol Metab*. 2012;16(2):240-5. doi:10.4103/2230-8210.93741
2. Ahmad M, Sofi FA, Masoodi SR. Prevalence of lipitension in Kashmir, North India: a hospital-based study. *J Med Sci SKIMS*. 2014;17(2):59-60.
3. Mohamed OG, Fareen MF, Zaman S, Salmasi AM, Tsilidis K, Dehghan A. Intermittent fasting for the prevention of cardiovascular disease. *Cochrane Database Syst Rev*. 2021;1:CD013496. doi:10.1002/14651858.CD013496.pub2
4. George AM, Fuster V, Murray CJ, Roth GA, Mensah GA, Abate YH, et al. Global burden of cardiovascular diseases and risks, 1990–2022. *J Am Coll Cardiol*. 2023;82(25):2403-25. doi:10.1016/j.jacc.2023.10.001
5. World Health Organization. Cardiovascular diseases (CVDs) [Internet]. Geneva: WHO; 2023 [cited 2025 Aug 27]. Available from: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

6. National Institute for Health and Care Excellence. Cardiovascular disease prevention [Internet]. London: NICE; 2023 [cited 2025 Aug 27]. Available from: https://www.nice.org.uk/guidance/ng238
7. Arnett DK, Blumenthal RS, Albert MA, Buroker AB, Goldberger ZD, Hahn EJ, et al. 2019 ACC/AHA guideline on the primary prevention of cardiovascular disease. *Circulation*. 2019;140(11):e596-646. doi:10.1161/CIR.0000000000000678
8. European Society of Cardiology. CVD prevention guidelines [Internet]. Sophia Antipolis: ESC; 2023 [cited 2025 Aug 27]. Available from: https://www.escardio.org/Guidelines/Clinical-Practice-Guidelines/CVD-Prevention-Guidelines
9. Dalal J, Chandra P, Chawla R, Kumar V, Abdullakutty J, Natarajan V, et al. Clinical and demographic characteristics of patients with coexistent hypertension, type 2 diabetes mellitus, and dyslipidemia: a retrospective study from India. *Drugs Real World Outcomes*. 2024;11(1):167-76. doi:10.1007/s40801-023-00397-7
10. Adil SO, Musa KI, Uddin F, Khan A, Khan I, Shakeel A, et al. Prevalence of undiagnosed metabolic syndrome using three different definitions and identifying associated risk factors among apparently healthy adults in Karachi, Pakistan: a cross-sectional survey in 2022. *Arch Public Health*. 2024;82(1):22. doi:10.1186/s13690-024-01104-2
11. Adil SO, Islam MA, Musa KI, Shafique K. Prevalence of metabolic syndrome among apparently healthy adult population in Pakistan: a systematic review and meta-analysis. *Healthcare (Basel)*. 2023;11(4):531. doi:10.3390/healthcare11040531
12. Hasan SU, Siddiqui MR. Epidemiology of diabetes mellitus in Pakistan: a systematic review protocol. *BMJ Open*. 2024;14(3):e079513. doi:10.1136/bmjopen-2023-079513
13. Maheshwary N, Naveed S, Ali Z, Ahmed SM, Yousuf AM. Prevalence of hypertension in type 2 diabetics. *Pak J Physiol*. 2016;12(1):31-4.
14. Naveed S, Ahmed SM, Nageen A, Ali Z, Kumar S, Zakir H, et al. Type 2 diabetes; nonalcoholic fatty liver disease. *Prof Med J*. 2016;23(2):138-46. doi:10.17957/TPMJ/16.3176
15. American Diabetes Association. 10. Cardiovascular disease and risk management: Standards of Care in Diabetes—2025. *Diabetes Care*. 2025;48(Suppl 1):S207-29. doi:10.2337/dc25-S010
16. Chhatriwalla AK, Nicholls SJ, Wang TH, Wolski K, Sipahi I, Crowe T, et al. Low levels of low-density lipoprotein cholesterol and blood pressure and progression of coronary atherosclerosis. *J Am Coll Cardiol*. 2009;53(14):1110-5. doi:10.1016/j.jacc.2008.10.063
17. World Health Organization. WHO guidelines on physical activity and sedentary behaviour [Internet]. Geneva: WHO; 2020 Nov 25 [cited 2025 Oct 6]. Available from: https://www.who.int/publications/i/item/9789240015128
18. Joshi K, Hiremath K, Gupta S. Evaluation of serum HDL and LDL levels in type II diabetes mellitus. *J Lumbini Med Coll*. 2013;1(1):21-3. doi:10.22502/jlmc.v1i1.7
19. Islam M, Islam M, Zannah S, Rashid M. Combination therapy of *Momordica charantia* Linn. (bitter melon) with antihyperglycemic agent gives increased antioxidative and hepatoprotective actions in alloxan-induced diabetic rats. *Bangladesh J Pharmacol*. 2019;22(1):34-40. doi:10.3329/bpj.v22i1.40023
20. Waly E, Hamed M. Hypertension and dyslipidemia among type II diabetic patients and related risk factors and complications. *Egypt J Community Med*. 2018;36(1):31-43. doi:10.21608/ejcm.2018.6868

21. Yan Q, Sun D, Li X, Chen G, Zheng Q, Li L, et al. Association of blood glucose level and hypertension in elderly Chinese subjects: a community-based study. *BMC Endocr Disord*. 2016;16(1):57. doi:10.1186/s12902-016-0119-5
22. Bermejo S, González E, López-Revuelta K, Ibernón M, López D, Martín-Gómez A, et al. Risk factors for non-diabetic renal disease in diabetic patients. *Clin Kidney J*. 2020;13(1):96-104. doi:10.1093/ckj/sfz177
23. Pushparani J, Yazhini M, Priya K. Risk of type 2 diabetes mellitus among women with gestational diabetes mellitus in semi-urban area, Thiruvallur district, Tamil Nadu: a case control study. *Int J Community Med Public Health*. 2020;7(3):922-6. doi:10.18203/2394-6040.ijcmph20200942
24. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. 2020;54(24):1451-62. doi:10.1136/bjsports-2020-102955