

PHYSICAL ACTIVITY LEVELS AND PREVALENCE OF HYPERTENSION AMONG PATIENTS WITH TYPE 2 DIABETES IN A TERTIARY CARE CENTRE IN KATHMANDU

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ABSTRACT

Physical inactivity is a major modifiable risk factor for hypertension and type 2 diabetes mellitus (T2DM), both of which increase cardiovascular morbidity and mortality. However, evidence regarding physical activity and hypertension among Nepalese patients with T2DM remains limited. To assess physical activity levels, determine hypertension prevalence, identify factors associated with hypertension among patients with T2DM. A hospital-based cross-sectional study was conducted among 363 patients with T2DM attending Nepal Medical College Teaching Hospital, Kathmandu, Nepal, from November 2025 to April 2026. Data were collected through structured interviews, medical record reviews, anthropometric measurements. Physical activity was assessed using the WHO Global Physical Activity Questionnaire (WHO-GPAQ) and expressed as metabolic equivalent (MET)-minutes/week. Hypertension was defined as systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90 mmHg, or current antihypertensive medication use. Data were analyzed using descriptive statistics, chi-square tests, and multivariable logistic regression. The mean age was 54.43 ± 11.86 years, and 55.1% were female. Hypertension was present in approximately one-third of participants. Significant associations were observed with age >53 years ($p < 0.001$), diabetes duration >4 years ($p < 0.001$), smoking ($p < 0.001$), marital status ($p = 0.036$), occupation ($p < 0.001$), and BMI ($p = 0.006$). Physical activity was not significantly associated with hypertension ($p = 0.152$). Independent predictors included diabetes duration >4 years (AOR=76.94), age >53 years (AOR=15.46), smoking (AOR=4.36), and marital status (AOR=1.75). Hypertension is prevalent among patients with T2DM. Older age, longer diabetes duration, smoking, and higher BMI are important determinants. Lifestyle interventions promoting physical activity may improve cardiovascular health.

KEYWORDS

Type 2 diabetes mellitus, hypertension, physical activity, GPAQ, Nepal

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INTRODUCTION

Physical activity encompasses all forms of bodily movement—during leisure, occupation, transportation, or household tasks—that enhance overall health and well-being.^{1,2} Regular physical activity improves cardiovascular function, glycaemic control, and body weight regulation, thereby reducing the risk of major noncommunicable diseases (NCDs) such as obesity, diabetes, and hypertension. According to the WHO, these conditions are among the leading global risk factors for cardiovascular disease (CVD), which accounts for approximately 17.9 million deaths annually, or about 31% of all global mortality.^{3,4}

Type 2 diabetes mellitus (T2DM) is a major contributor to this burden.⁵ Chronic hyperglycaemia promotes vascular injury and accelerates atherosclerosis, significantly increasing the risk of heart disease and stroke. The coexistence of diabetes with hypertension and obesity amplifies cardiovascular risk. In South Asia, the prevalence of these interrelated metabolic disorders has risen sharply, heightening regional susceptibility to CVD.⁶

Hypertension frequently accompanies T2DM, reflecting shared pathophysiological mechanisms such as insulin resistance. Epidemiological studies - including large cohort and population - based investigations - demonstrate that individuals with hypertension are more likely to develop diabetes and vice versa, indicating a bidirectional relationship between the two conditions.^{3,5,7,8}

In T2DM, multiple mechanisms contribute to hypertension, including activation of the renin-angiotensin-aldosterone system (RAAS) and sympathetic nervous system (SNS), oxidative stress, inflammation, mitochondrial dysfunction, gut microbiota imbalance, and SGLT2-mediated renal sodium retention. Visceral adiposity further exacerbates these effects by releasing proinflammatory adipokines (e.g., leptin, aldosterone) that induce endothelial dysfunction, arterial stiffness, and vascular inflammation.⁹⁻¹²

Both diabetes and hypertension independently and synergistically damage the vasculature through endothelial dysfunction, oxidative stress, and inflammatory remodeling.^{13,14} Persistent hyperglycaemia accelerates the formation of advanced glycation end-products (AGEs), which interact with their receptors (RAGE) to trigger oxidative and inflammatory pathways, promoting atherosclerosis and vascular stiffening.^{15,16} Hypertension, in turn,

contributes to left ventricular hypertrophy, microvascular injury, and end-organ damage, thereby compounding cardiovascular morbidity and mortality.¹³

Physical activity remains a modifiable determinant of these interlinked disorders. The WHO Global Physical Activity Questionnaire (GPAQ) quantifies activity levels in Metabolic Equivalents (METs), assigning 4 METs to moderate and 8 METs to vigorous activity. Weekly MET-minutes classify individuals into low, moderate, or high physical activity categories,¹⁷ providing a standardized tool to assess lifestyle-related cardiovascular risk. The objectives of this study were to assess physical activity levels, determine the prevalence of hypertension, and identify associated factors among patients with T2DM.

MATERIALS AND METHODS

This hospital-based cross-sectional descriptive study was conducted in the Department of Medicine, Nepal Medical College Teaching Hospital (NMCTH), Kathmandu. Ethical clearance was obtained from the Institutional Ethical Review Committee (IRC) of NMCTH (Ref. No. 31-082/083). Informed consent was taken from all participants prior to data collection.

Patients previously diagnosed with type 2 diabetes, aged 35 years and above of both genders, attending the NMCTH from November 2025 to April 2026, were included in the study. Patients who were known case of hypertension but had recently been diagnosed as type 2 diabetes, and pregnant women were excluded. Total number of patients included in the study is 363.

Sample Size:

$$n = \frac{Z\alpha/2^2 Pq}{d^2} = \frac{1.96^2 \times 0.63 \times (1-0.63)}{0.05^2} \approx 356$$

Where,

$$Z\alpha/2 = 1.96 \text{ (Value of Z at 5\% level of significance } \alpha)$$

$P=63.2\% \approx 63\%$ prevalence of hypertension among patients with diabetes (PWD), and $q = 1 - p$.

$d = 0.05$ (Margin of error)

Prevalence of hypertension among PWD is 63.2%.³²

Convenience sampling technique was used. Data was collected through: face-to-face interviews using a structured questionnaire to obtain socio-demographic and behavioral

information. Medical record review was done to get clinical parameters including systolic and diastolic blood pressure, fasting blood glucose, postprandial blood glucose, and glycated hemoglobin (HbA1c). Physical activity was measured using the Global Physical Activity Questionnaire (GPAQ) developed by the WHO as part of the STEPwise approach to surveillance (STEPS).¹⁷

Key features of GPAQ included 16 questions covering three domains: occupational activity, transport-related activity, and leisure-time physical activity. Items on sedentary behavior (time spent sitting or reclining) were also considered. Activity was recorded as frequency (days/week) and duration (minutes/day). The calculation was done by MET-minutes/week = MET value × minutes/day × day/week. The formula considered MET values: 8.0 for vigorous activity, 4.0 for moderate activity, 4.0 for walking/transport. So, physical activity levels were considered as: High: ≥3000 MET-min/week; Moderate: ≥600 MET-min/week; Low: <600 MET-min/week.

For anthropometric measurements weight was measured using a calibrated weighing scale, without footwear, and recorded in kilograms (kg). Height was measured against a wall with a non-stretchable measuring tape, recorded in centimeters (cm). Body Mass Index (BMI) was calculated using Quetelet's formula:

$$\text{BMI (kg/m}^2\text{)} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

A BMI of ≥25 kg/m² was considered overweight, and a BMI of ≥30 kg/m² was considered obesity, according to the WHO classification. There is a BMI classification for Asia-Pacific population which was also considered.^{38,39}

Data was analyzed using statistical software SPSS-17 and MS Excel, using chi-square test, logistic regression analysis. Significance was set at $p < 0.05$.

RESULTS

Age demonstrated a strong and statistically significant association with hypertension ($p < 0.0001$), with a markedly higher prevalence among participants aged >53 years (54.7%) compared to ≤53 years (7.1%).

Smoking status demonstrated a highly significant association ($p < 0.0001$), with more than half of smokers (53.2%) being hypertensive compared to only 16.2% of non-smokers.

Marital status showed a modest but statistically significant association ($p = 0.036$), with a

higher prevalence of hypertension among married individuals (32.8%) than single (19%). Occupation was also highly significant ($p < 0.0001$); retired individuals exhibited the highest prevalence (67.8%), while employed participants had the lowest (10.2%).

Duration of diabetes was strongly associated with hypertension ($p < 0.0001$), with those having diabetes for >4 years showing a substantially higher prevalence (68.2%) compared to ≤4 years (2.9%).

Table 2 summarizes the central tendency and dispersion of key biological and diabetes-related variables among the study participants.

Fig. 1 shows the total study population was 363 persons with T2DM, with mean age of 54.4 years, (SD = 11.81 years), age ranging from 39 to 89. Among them 200 (55.1%) were female and 163 (44.9%) male. Prevalence of hypertension among patients with T2DM was found to be 31% (111, with 57 females and 54 males).

Table 3 shows the association of BMI categories and physical activity levels with hypertension status among patients with T2DM.

A statistically significant association was observed between BMI categories and hypertension ($\chi^2 = 12.565$, $p = 0.006$). The prevalence of hypertension increased progressively with higher BMI categories. Participants with normal BMI had the lowest prevalence of hypertension (25%), followed by overweight individuals (22.2%). In contrast, the prevalence was higher among those with obese class I (29.4%) and markedly elevated among those with obese class II and III (45.2%). These findings indicate a clear positive relationship between increasing adiposity and the likelihood of hypertension among patients with T2DM.

Table 4 presents the distribution of WHO BMI categories across different levels of physical

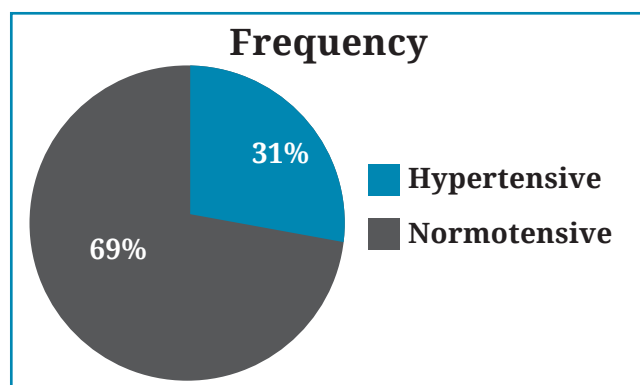


Fig 1: Prevalence of hypertension in Type II patients with diabetes

Table 1: Socio-demographic and diabetes related factors categorized by hypertension status among person with Type II Diabetes (n=363)

Variables		Non-hypertensive	Hypertensive	Total	Chi-square test
Gender	Female	143 (71.5%)	57 (28.5%)	200	$\chi^2 = \mathbf{0.906}$, p-value = 0.341
	Male	109 (66.9%)	54 (33.1%)	163	
Age group (years)	≤ 53	171 (92.9%)	13 (7.1%)	184	$\chi^2 = \mathbf{97.2}$, p-value < 0.0001**
	> 53	81 (45.3%)	98 (54.7%)	179	
	Mean age = 54.43, SD = 11.81, Median age = 53, IQR = 45 - 64				
Ethnicity	<i>Brahmin/ Chhetri</i>	87 (64.9%)	47 (35.1%)	134	$\chi^2 = \mathbf{2.02}$, p-value = 0.155
	<i>Janajati/Dalit/Others</i>	167 (75.9%)	634 (24.1%)	229	
Smoking	Non - smoker	186 (83.8%)	36 (16.2%)	222	$\chi^2 = \mathbf{55.536}$, p-value < 0.0001**
	Smoker	66 (46.8%)	75 (53.2%)	141	
Marital status	Married	205 (67.2%)	100 (32.8%)	305	$\chi^2 = \mathbf{4.385}$, p-value = 0.036*
	Single	47 (81.0%)	11 (19%)	58	
Occupational status	Unemployed	31 (72.1%)	12 (27.9%)	43	$\chi^2 = \mathbf{83.292}$, p-value < 0.0001**
	Self-employed	78 (74.3%)	27 (25.7%)	105	
	Employed	115 (89.8%)	13 (10.2%)	128	
	Retired	28 (32.2%)	59 (67.8%)	87	
Duration of DM	≤4 years	203 (97.1%)	6 (2.9%)	209	$\chi^2 = 175.1$, p-value< 0.0001**
	>4 years	49 (31.8%)	105(68.2%)	154	
median = 4years, IQR = 2.5					
Glycemic control	Yes (HBA ₁ C < 7%)	57 (77.1%)	17 (22.9%)	74	$\chi^2 = 2.533$, p-value = 0.112
	No (HBA ₁ C ≥7%)	195 (67.5%)	94 (32.5%)	289	
* Significant at p< 0.05, ** very high significance					

* Significant at p< 0.05, ** very high significance

A chi-square test of independence was conducted to examine the association between different parameters and hypertension status.

Table 2: Mean values of biological and diabetes related factors of study participants (n=363)

Categories	Mean	SD	Minimum	Maximum
Age (years)	54.43	11.86	35	89
Age at onset	48.78	9.39	16	80
Duration of DM	5.6	4.35	1	20
BMI(Kg/m ²)	31.3848	4.26	21.60	41.80
SBP(mmHg)	137.75	15.58	110.00	172.00
DBP (mmHg)	90.1818	12.08	70.00	122.00
FBG (mg/dl)	172.23	74.50	100.00	590.00
PPBG(mg/dl)	217.42	93.46	33	925
HBA1c (percent)	8.240	1.97	5.0	15.5
MET-min/ week	1940	12344.28	260	15000

Table 3: BMI and physical activity in relation to hypertension status (n=363)

WHO BMI categories	Non- hypertensive	Hypertensive	Total	Chi-square test
Normal	21 (75%)	7 (25%)	28	$\chi^2 = 12.565$, p-value = 0.006**
Overweight	84 (77.8%)	24 (22.25%)	108	
Obese Class I	101 (70.6%)	42 (29.4%)	143	
Obese Class II and III	46 (54.8%)	38 (45.2%)	84	
Physical activity (MET-min/week)				
Low	31 (72.1%)	13 (27.9%)	43	$\chi^2 = 3.77$, p-value = 0.152
Moderate	183 (67%)	90 (33%)	273	
High	38 (80.8%)	9 (19.2%)	47	

Table 4: Association between BMI and physical activities (n=363)

Physical activity level	WHO BMI Categories				Total
	Normal	Overweight	Obese class I	Obese class II and III	
Low	3 (7.0%)	14 (32.5%)	14 (32.5%)	12 (28.0%)	43
Moderate	23 (8.4%)	81 (29.6%)	110 (40.4%)	59 (21.6%)	273
High	2 (4.3%)	13 (27.6%)	19 (40.5%)	13 (27.6%)	47
$\chi^2 = 2.93$, p-value = 0.817					

Table 5: Logistic regression analysis for predictors of hypertension status

Variables	Reference category	S.E	Wald.	df	Sig.	COR	AOR	95.0%C.I.for EXP(B)	
								Lower	Upper
Smoking	Smoker/Non-smoker	0.25	50.83	1	.000	5.87	4.36	3.61	9.55
Duration of DM	>4/≤4 years	0.48	84.49	1	.000	85.65	76.94	33.16	221.21
Glycemic control	No (HBA _{1c} ≥7%)/ Yes (HBA _{1c} < 7%)	0.30	2.50	1	.114	1.62	1.59	0.89	2.93
Marital status	Married/ Unmarried	0.36	4.24	1	.039	2.08	1.75	1.04	4.19
Age group	> 53/≤ 53 years	0.32	72.70	1	.000	15.92	15.46	8.42	30.06
Ethnicity	Bramhin/Chhetri	0.23	2.02	1	.156	0.72	0.91	0.45	1.13
COR = Original odds, AOR = Adjusted odds									

activity among patients with T2DM. The analysis revealed no statistically significant association between BMI and physical activity levels ($\chi^2 = 2.93$, $p = 0.817$).

Across all physical activity categories, the majority of participants were classified as overweight or obese. Among those with low physical activity, 32.5% were overweight, 32.5% were obese class I, and 28.0% were obese class II and III. A similar pattern was observed in the moderate activity group, where 29.6%

were overweight, 40.4% were obese class I, and 21.6% were obese class II and III. In the high physical activity group, Obese Class I remained the most prevalent category (40.5%), followed by equal proportions of overweight and obese class II and III (27.6% each).

The proportion of participants with normal BMI was consistently low across all activity levels, ranging from 4.3% in the high activity group to 8.4% in the moderate activity group.

Table 6: Simple logistic regression analysis for predictors of hypertension status

Physical activity	Reference category	S.E	Wald.	df	Sig.	AOR	95.0%C.I.for EXP(B)	
							Lower	Upper
Moderate	Low	0.50	0.954	1	.329	1.634	0.610	4.380
High		0.39	3.467	1	.063	2.077	0.386	4.481
Employment status	Reference category							
Self-employed	Unemployed	0.41	17.06	1	0.000	0.18	0.082	0.410
Employed		0.32	31.82	1	0.000	0.16	0.088	0.308
Retired		0.37	61.88	1	0.000	0.05	0.026	0.111

Table 5 presents the results of binary logistic regression analysis identifying independent predictors of hypertension among patients with T2DM. Both crude odds ratios (COR) and adjusted odds ratios (AOR) were estimated.

After adjusting for duration of DM and glycemic control, smoking was a strong and statistically significant predictor of hypertension ($p < 0.001$). Smokers had 4.36 times higher odds of being hypertensive compared to non-smokers (AOR = 4.36; 95% CI: 3.61–9.55), indicating a robust independent association.

Duration of diabetes showed the strongest association with hypertension ($p < 0.001$). Participants with a duration of >4 years had markedly increased odds of hypertension (AOR = 76.94; 95% CI: 33.16–221.21), suggesting a substantial impact of prolonged disease exposure.

After adjusting for socio-demographic factors, age was also a highly significant predictor ($p < 0.001$), with individuals aged >53 years having 15.46 times higher odds of hypertension compared to younger participants (AOR = 15.46; 95% CI: 8.42–30.06).

Marital status demonstrated a significant association ($p = 0.039$), with married individuals having 1.75 times higher odds of hypertension than unmarried participants (AOR = 1.75; 95% CI: 1.04–4.19).

Table 6 presents the results of simple logistic regression analysis examining the association of physical activity levels and employment status with hypertension among patients with T2DM.

Physical activity was not found to be a statistically significant predictor of hypertension. Compared to participants with low physical activity, those with moderate activity had higher odds of hypertension (AOR =

1.63; 95% CI: 0.61–4.38), but this association was not statistically significant ($p = 0.329$). Similarly, participants with high physical activity showed increased odds (AOR = 2.08; 95% CI: 0.386–4.48), approaching but not reaching statistical significance ($p = 0.063$). The wide confidence intervals further indicate variability and lack of precision in these estimates.

In contrast, employment status demonstrated a strong and statistically significant association with hypertension ($p < 0.001$). Using unemployed individuals as the reference category, all other employment groups had significantly lower odds of hypertension. Retired individuals had 82% lower odds (AOR = 0.18; 95% CI: 0.082–0.410), self-employed individuals had 84% lower odds (AOR = 0.16; 95% CI: 0.088–0.308), and employed participants had the lowest odds, with a 95% reduction (AOR = 0.05; 95% CI: 0.026–0.111).

DISCUSSION

This study examined the association between physical activity levels and hypertension among patients with T2DM in a tertiary care setting in Kathmandu. A high prevalence of hypertension was observed, with significant associations identified for age, duration of diabetes, smoking, marital status, and BMI, whereas physical activity and glycemic control were not statistically significant predictors.

The substantial burden of hypertension in this study population is consistent with the rising prevalence of cardiovascular diseases (CVDs) in Nepal, where over 1.2 million individuals are affected.¹ The coexistence of diabetes and hypertension observed in this study reinforces their well-established bidirectional relationship, underpinned by shared pathophysiological mechanisms such as endothelial dysfunction, oxidative stress, vascular inflammation, and accumulation of

advanced glycation end-products (AGEs).^{13,19} These mechanisms collectively accelerate vascular injury and increase susceptibility to hypertension among individuals with diabetes.

The prevalence observed in this study is lower than that reported in Europe and Asia,³⁷ and in studies from Ethiopia (55.0%),³⁶ Afghanistan (70.5%),³⁵ and Bangladesh (67.2%),³⁴ but higher than that reported in Mysore, India (25.6%).³³ These variations may reflect differences in population characteristics, healthcare access, and lifestyle factors.

Advancing age and longer duration of diabetes emerged as strong independent predictors of hypertension. Age-related vascular changes, including arterial stiffness and impaired endothelial function, are known to increase blood pressure.¹³ Similarly, prolonged exposure to hyperglycemia contributes to cumulative vascular damage through oxidative stress and AGE formation, explaining the strong association with longer disease duration.¹⁹ Smoking was also identified as a significant determinant, consistent with evidence linking tobacco use to sympathetic overactivity, endothelial dysfunction, and increased arterial stiffness.

The associations observed with marital status and occupation, particularly the higher prevalence among retired individuals, likely reflect underlying demographic and lifestyle factors, including age, reduced physical activity, and increased comorbidity burden. BMI showed a significant positive association with hypertension, with prevalence increasing across higher BMI categories. This aligns with global evidence identifying obesity as a major modifiable risk factor, mediated through insulin resistance, activation of the renin–angiotensin–aldosterone system, and sympathetic nervous system stimulation.²⁰⁻²²

Despite strong evidence supporting the role of physical activity in reducing cardiovascular risk, this study did not demonstrate a statistically significant association between physical activity levels and hypertension. Nevertheless, a lower prevalence among highly active individuals suggests a potential protective effect. This finding is partially consistent with previous studies demonstrating that regular physical activity improves endothelial function, reduces blood pressure, and enhances metabolic health.^{20,21} The lack of statistical significance may be attributable to methodological limitations, including reliance

on self-reported physical activity using the Global Physical Activity Questionnaire (GPAQ), variability in activity intensity, and recall bias.¹⁸ It may also be because of awareness of patients with Type 2 diabetes to do physical exercises regularly to minimize the occurrence of complications due to type 2 diabetes.

Furthermore, no significant association was observed between physical activity and BMI, indicating that physical activity alone may not sufficiently influence weight status in this population. This observation is supported by prior studies highlighting the multifactorial determinants of physical inactivity, including socioeconomic, behavioral, and clinical factors.²⁴⁻²⁵ Evidence from Nepal and other settings also suggests that awareness of health benefits does not necessarily translate into adequate physical activity, emphasizing the need for structured and culturally appropriate interventions.^{22,23}

Glycemic control was not independently associated with hypertension, although a higher proportion of hypertensive individuals had poor glycemic status. This suggests that cumulative metabolic burden and disease duration may exert a stronger influence on hypertension risk than short-term glycemic control.^{13,19,27,33-35}

Overall, these findings underscore the multifactorial nature of hypertension among patients with T2DM, with traditional risk factors such as age, duration of diabetes, smoking, and obesity playing a dominant role.²⁷⁻²⁹ Although physical activity did not reach statistical significance, its potential protective effect remains clinically relevant.

Limitation: Limitation of our study is that it is a cross-sectional study. Patients with T2DM who had high BMI had high physical activity levels and hence they had low prevalence of hypertension.

In conclusion, hypertension is highly prevalent among patients with T2DM in this tertiary care setting. These findings highlight the importance of early screening, comprehensive risk assessment, and targeted interventions focusing on modifiable risk factors, particularly smoking cessation and weight management. Promotion of regular physical activity should remain a central component of preventive strategies. Future longitudinal studies incorporating objective measures of physical activity are warranted to better elucidate its role in this population.

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