Journal of Karnali Academy of Health Sciences
An Official Journal of Karnali Academy of Health Sciences

Assessment of physical activity level in diabetes mellitus patients: A cross-sectional study at the tertiary hospital

Rajendra Mani Giri[1], **Mukesh Joshi**[2], **Rohit Jha**[2], **Pappu Kumar Sah**[2], **Sanjeev Gautam**[1], **Sanjeev Joshi**[1], **Manish Rokaya**[3], **Sandip Kumar Sharma**[4], **Ram Chandra Panthi**[1]

[1] Department of Internal Medicine, Karnali Academy of Health Sciences, Jumla, Nepal
[2] MBBS Student, Karnali Academy of Health Sciences, Jumla, Nepal
[3]MPH student, Karnali Academy of Health Sciences, Jumla, Nepal
[4]Department of Obstetrics and Gynaecology, Institute of Medicine, Maharajgunj, Kathmandu, Nepal

ABSTRACT

Introduction: Diabetes mellitus is a major public health concern globally and in Nepal, with a rising burden in rural and underserved regions such as Karnali Province. Physical activity is a key component of diabetes management, yet data from rural Nepal are limited. This study assessed physical activity levels among patients with diabetes mellitus attending a tertiary center and examined their association with glycemic control indicators.

Methods: This was a cross-sectional study conducted in a tertiary care center of Nepal, among patients aged ≥20 years with diagnosed diabetes mellitus who attended the hospital during the study period of April 2025 to October 2025. Physical activity was assessed using a structured questionnaire adapted from the International Physical Activity Questionnaire. Glycemic control indicators (HbA1c, fasting blood glucose, and 2-hour postprandial blood glucose) were obtained from laboratory records. Following data collection, statistical analysis was conducted using SPSS 22 software. Descriptive statistics and chi-square tests were applied.

Results: Among all participants (N = 145), about two-thirds (66.21%) had poor glycemic control, i.e., HbA1c≥ 6.5%. Nearly 67% reported engaging in more than 600 MET-minutes per week of moderate physical activity, meeting the WHO-recommended levels. Higher physical activity was significantly associated with lower fasting plasma glucose and with lower postprandial blood glucose, although the latter association was not statistically significant.

Conclusion: Inadequate glycemic control remained common among diabetes patients and correlated poorly with glycemic control. Integrating physical activity promotion with routine clinical care and public health interventions is essential.

Keywords: Cross-sectional study, Diabetes mellitus, Glycemic control, Nepal, Physical activity

INTRODUCTION

Diabetes mellitus is a global public health concern characterized by increased blood glucose levels, leading to various complications if not managed effectively.[1] It is one of the fastest-growing diseases worldwide, projected to affect 693 million adults by 2045.[2] Devastating macrovascular complications (such as cardiovascular disease) and microvascular complications (including diabetic kidney disease, diabetic retinopathy, and neuropathy) contribute to increased mortality, blindness, kidney failure, and an overall decreased quality of life among individuals with diabetes mellitus.[3] Lifestyle modifications, particularly maintenance of physical activity, play a crucial role in the management and prevention of diabetes-related complications.[4]

In the context of Nepal and the broader South Asian population, the burden of diabetes is rapidly increasing. South Asia is considered a high-risk region due to rapid urbanization, sedentary lifestyles, and dietary transitions. Recent evidence from Nepal indicates a prevalence of diabetes mellitus of 8.5% (95% CI: 7.8%–9.3%), as reported by Shrestha N et al.[5] A more recent analysis of the Global Burden of Disease Study 2019 estimated approximately 1.4 million prevalent cases of diabetes mellitus in Nepal, representing a substantial and growing national burden.[6] Furthermore, there exists a significant urban–rural disparity: the prevalence of diabetes is as high as 14.6% in urban areas compared to only 2.5% in rural areas, as highlighted by Shrestha N et al.[5] While the lower prevalence in rural areas may seem reassuring, it often reflects underdiagnosis, limited screening, and poor access to healthcare services rather than a truly lower disease burden.

Diabetes patients are particularly vulnerable, especially in low-resource settings, as they may lack adequate knowledge, awareness, and skills to manage their condition effectively, leading to poor health outcomes.[7] In addition to pharmacological treatment, addressing physical activity levels among patients with diabetes mellitus is essential for effective disease control.[4] Early intervention through lifestyle modification can prevent complications, reduce healthcare costs, and significantly improve quality of life.[8]

Conducting this study in rural Nepal, particularly in regions such as Karnali, is critical. Rural populations face unique challenges, including limited healthcare infrastructure, geographic barriers, low health literacy, and reduced access to preventive and curative services. These factors contribute to delayed diagnosis and poor disease management. Moreover, there is a lack of context-specific evidence on lifestyle behaviors, particularly physical activity, among patients with diabetes

Corresponding Author:
Dr. Rajendra Mani Giri
Email: rajendra.mani.giri@gmail.com

Date of Submission:Dec 03, 2025
Date of Acceptance: March 28, 2026
Date of Publication: Apr 01, 2026

DOI: https://doi.org/10.61814/jkahs.v9i1.1125

in these underserved areas.

This study, therefore, aims to focus specifically on the physical activity level of patients with diabetes mellitus and address the critical gap in understanding diabetes management in rural Nepal. By generating localized evidence, the study will support healthcare providers and policymakers in developing targeted, culturally appropriate lifestyle interventions to improve glycemic control. Ultimately, the findings will contribute to improved health outcomes and enhanced quality of life for individuals living with diabetes in rural Nepal.

METHODS

A hospital-based cross-sectional study was conducted at a tertiary care center in Nepal among patients aged ≥20 years with diagnosed diabetes mellitus who attended the hospital during the study period from April 2025 to October 2025. The sample size was calculated based on the prevalence of diabetes mellitus in Nepal (8.7%), as reported by the International Diabetes Federation (IDF) in 2021.[9] Using the formula $n = z^2p(1-p)/E^2$, with a 95% confidence level, 5% margin of error, and accounting for a 15% non-response rate, the calculated sample size was 144 participants. A non-probability consecutive sampling technique was used. All eligible patients with diabetes mellitus attending the study setting during the study period were recruited sequentially until a final sample of 145 participants with complete data was obtained. Patients aged ≥20 years with diagnosed diabetes mellitus were included, while those with severe comorbid conditions affecting dietary patterns, pregnant or lactating mothers, and individuals with incomplete data were excluded.

Data collection was conducted through two primary methods: face-to-face structured interviews and review of laboratory reports. All participants provided written informed consent prior to data collection, and interviews were conducted by the investigator in the participants' preferred language to ensure comprehension and accuracy. Prior to the main study, a pretest was conducted with 10% of the sample to ensure the validity and reliability of the data collection instrument. The calculated Cronbach's alpha from the pre-test was 0.680, indicating acceptable internal consistency. Physical activity levels were reported by participants using a semi-structured questionnaire adapted from the International Physical Activity Questionnaire-Short Form (IPAQ-SF) to align with our study objectives.8 Physical activity was quantified using Metabolic Equivalent of Task (MET) values, which represent the energy cost of physical activities.[10] One Metabolic Equivalent (MET) represents the energy cost of resting metabolism, approximately 3.5 ml of oxygen consumed per minute per kilogram of body weight.[11] In this study, we specifically assessed moderate-intensity physical activity, assigned a standard MET value of 4.0.11 Weekly energy expenditure from moderate-intensity activities was quantified in MET-minutes/week using the calculation: 4.0 × moderate activity minutes per day × number of days per week engaging in moderate activity.[12] These continuous variables were then dichotomized according to World Health Organization (WHO) physical activity guidelines into two categories: insufficient activity (≤600 MET-minutes/week) and sufficient activity (>600 MET-minutes/week).[13] The questionnaire was administered through face-to-face interviews to ensure proper understanding and accurate reporting of physical activity patterns. The IPAQ-SF evaluates physical activity across three domains: walking, moderate-intensity, and vigorous-intensity activity. For the purposes of this study, we specifically focused on calculating moderate-intensity physical activity levels.[14]

The psychometric properties of the IPAQ-SF were evaluated in our study population using Cronbach's alpha. The internal consistency of the IPAQ was assessed using Cronbach's alpha. The overall Cronbach's alpha was 0.742, with a standardized item alpha of 0.776, indicating good internal consistency. The reliability coefficient for moderate-intensity activity was 0.680, indicating acceptable reliability in this domain.

Glycemic control indicators were obtained from participants' most recent laboratory reports available in the hospital records. Three key parameters were collected: glycated hemoglobin (HbA1c), fasting plasma glucose (FPG), and 2-hour postprandial plasma glucose (PPG). These biomarkers were measured using standard laboratory protocols at the hospital laboratory. For analytical purposes, glycemic control was classified into categories based on established clinical thresholds. HbA1c levels were categorized as glycemic control (<6.5%) versus poor glycemic control (≥6.5%). Fasting plasma glucose was classified as adequate control (<125 mg/dL) versus inadequate control (≥125 mg/dL), and postprandial glucose levels were categorized as control (<200 mg/dL) versus poor control (≥200 mg/dL). The independent variables in this study included socio-demographic characteristics (age, gender, education, occupation, and duration of diabetes) and physical activity levels categorized according to WHO recommendations (≤600 MET-minutes/week vs. >600 MET-minutes/week). The dependent variables were the glycemic control indicators: HbA1c, fasting plasma glucose, and postprandial plasma glucose, analyzed both as continuous and categorical variables.

All collected data were entered into Microsoft Excel version 21 spreadsheets and subsequently validated and verified for accuracy and completeness. Records with missing data for key variables were excluded from the analysis. Statistical analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) version 22.0. Descriptive statistics were calculated for all study variables. Continuous variables with normal distribution were presented as mean ± standard deviation, while non-parametric continuous variables were expressed as median with interquartile range. Categorical variables were presented as frequencies and proportions. For inferential statistics, the relationship between categorical variables, including socio-demographic factors and physical activity levels, and categorized glycemic control indicators was assessed using Pearson's chi-square test or Fisher's exact test, where appropriate. The relationship between moderate physical activity level and diabetes control parameters was also assessed using the chi-square test. Differences between continuous variables across groups were tested using the Wilcoxon rank-sum test (Mann-Whitney U test) for non-normally distributed variables and Welch's two-sample t-test for normally distributed variables. The strength of association between continuous variables was evaluated using Pearson's product-moment correlation coefficient. Odds ratios with 95% confidence intervals were calculated to quantify the association between physical activity categories and glycemic control outcomes. A p-value of less than 0.05 was considered statistically significant for all analyses.

Ethical approval for this study was obtained from the Institutional Review Committee. All participants provided written informed consent after receiving detailed information about the study objectives, procedures, potential risks, and benefits. Participants were assured of their right to withdraw from the study at any time without any consequences to their medical care. Confidentiality and anonymity were strictly maintained throughout the study, with all data stored securely and personal identifiers removed during analysis.

RESULTS

The study comprised 145 diabetic patients with a male predominance, i.e., 84(57.9%). Most participants were Chhetri i.e. 78(53.8%), married i.e. 133(91.7%), and resided in rural areas i.e. 129(89%). Illiteracy was the most common educational status (35.2%), and agriculture was the predominant occupation, i.e., 79(54.5%), among participants. Family income was relatively evenly distributed across categories, with 55(37.9%) earning more than NRs. 30,000, and agriculture serving as the main household income source in 90(62.1%) participants. Detailed socio-demographic characteristics are presented in Table 1. No significant associations were observed between socio-demographic variables, diabetes control parameters, or levels of moderate physical activity. (Table 1)

Total of 97(67%) individuals reported engaging in more than 600 MET-minutes per week of moderate physical activity, meeting or exceeding the WHO-recommended levels. In contrast, 48 (33%) participants reported 0–600 MET-minutes per week, indicating insufficient moderate physical activity, as summarized in Table 2. Findings suggest that while the majority of participants meet recommended activity levels, a substantial proportion remains below the threshold for adequate weekly physical activity.(Table 2)

When glycemic parameters were analyzed categorically, the HbA1c

category (< 6.5% vs ≥ 6.5%) did not differ significantly by physical activity level (p = 0.50). In the low physical activity group, 14 (29.2%) participants had HbA1c < 6.5%, compared with 35 (36.1%) in the higher physical activity group. Similarly, the distribution of post-prandial glucose categories (<200 mg/dl vs ≥200 mg/dl) showed a higher proportion of controlled values among participants with higher physical activity, i.e.,44(45.4%), compared with those with lower physical activity (29.2%); however, this association was not statistically significant (p = 0.090).In contrast, fasting plasma glucose categories (<125 mg/dl vs ≥125 mg/dL) differed significantly between physical activity groups (p = 0.036). Controlled fasting glucose was observed in 41 (42.3%) of participants in the higher physical activity group compared with 11 (22.9%) in the low physical activity group (Table 3).

Table 1: Socio-demographic factors (N= 145)

	Variables	Frequency (percentages)
Gender	Male	84 (57.9%)
	Female	61 (42.1%)
Ethnicity	Chhetri	78 (53.8%)
	Brahmin	25 (17.2%)
	Dalit	16 (11.0%)
	Janajati	8 (5.5%)
	Others	10 (6.9%)
Marital status	Single	6 (4.1%)
	Married	133 (91.8%)
	Divorced or widowed	6 (4.1%)
Residence	Rural	129 (89%)
	Urban	16 (11%)
Education level	Illiterate	51 (35.2%)
	Early childhood education	14 (9.7%)
	Basic education (Grades 1-8)	35 (24.1%)
	Secondary Education(Grade 1-12)	28 (19.3%)
	Technical/ vocational education	1 (0.7%)
	Higher education	16 (11%)
Primary occupation	Agriculture	79 (54.5%)
	Business	13 (9.0%)
	Government Service	27 (18.6%)
	Skilled/Unskilled labor	7 (4.8%)
	Unemployed	18 (12.4%)
	Others	1 (0.7%)
Family's monthly income	< NRs. 10,000	40 (27.6%)
	NRs. 10,000- NRs. 30,000	50 (34.5%)
	> NRs. 30, 000	55 (37.9%)
Sources of family income	Agriculture	90 (62.1%)
	Government service	25 (17.2%)
	Non- agricultural	29 (20%)
	Remittance	1(0.7%)

Table 2: WHO MET category of study population (N=145)

WHO-MET of Moderate physical activity /week	Number of participants(%)
0–600 MET/week	**48 (33%)**
> 600 MET/week	**97 (67%)**

Table 3: Glycemic control variables among study population (N=145)

Variables	0–600 MET/ week N = 48	>600 MET/ week N = 97	Total, N=145	p value
HBA1C Categories				
≤6.5%	14.0 (29.2%)	35.0 (36.1%)	49 (33.79%)	0.501
>6.5%	34.0 (70.8%)	62.0 (63.9%)	96 (66.21%)	
Two-hour PP Glucose categories(mg/dl)				
<200	14.0 (29.2%)	44.0 (45.4%)	58 (40%)	0.090
≥200	34.0 (70.8%)	53.0 (54.6%)	87 (60%)	
Fasting glucose categories(mg/dl)				
<125	11.0 (22.9%)	41.0 (42.3%)	52 (35.86%)	0.036
≥125	37.0 (77.1%)	56.0 (57.7%)	93 (64.41)	

Mean HbA1c levels were 7.94 ± 2.68% among participants in the low physical activity group and 7.42 ± 1.66% among those with higher physical activity. Although HbA1c values were numerically higher in the low activity group, the difference was not statistically significant (p = 0.70). Mean fasting plasma glucose was 176.04 ± 81.78 mg/dl in the low physical activity group compared with 159.18 ± 73.06 mg/dl in the higher physical activity group. This difference did not reach statistical significance (p = 0.11). In contrast, mean post-prandial plasma glucose was significantly higher among participants with low physical activity (302.15 ± 170.17 mg/dl) than among those with higher physical activity (235.42 ± 106.31 mg/dl), with a statistically significant difference (p = 0.011), (Table 4). The correlation analysis between moderate physical activity (MET_MPA) and glycemic parameters showed weak negative associations. Specifically, MET_MPA was weakly and negatively correlated with HBA1C (r = -0.044, p = 0.601) and fasting plasma glucose (r = -0.075, p = 0.372), indicating that higher levels of moderate physical activity were minimally associated with lower long-term and fasting glucose levels, though these associations were not statistically significant. Post-prandial glucose showed a slightly stronger negative correlation (r = -0.163, p = 0.051), suggesting that increased moderate physical activity may modestly reduce post-meal glucose levels. Overall, these findings indicate that moderate physical activity alone has a limited effect on glycemic control in this population, with a potential minor benefit for post-prandial glucose regulation.

Table 4: Association of glycemic control variables with MET, N=145.

Variable	0–600 MET/ week(Mean ± SD)	>600 MET/ week (Mean ± SD)	p-value*
HbA1C	7.94 ± 2.68	7.42 ± 1.66	0.701
Fasting Plasma glucose	176.04 ± 81.78	159.18 ± 73.06	0.110
2 hour Post prandial glucose	302.15 ± 170.17	235.42 ± 106.31	0.011

*Wilcoxon rank sum test

DISCUSSION

This cross-sectional study assessed physical activity levels and their association with glycemic control among diabetes mellitus patients attending a tertiary care hospital of rural Nepal. The findings highlight a substantial burden of suboptimal physical activity and inadequate glycemic control in a predominantly rural population, underscoring the need for integrated clinical and public health interventions tailored to underserved settings.

In the present study, 66.21% of the 145 participants had HBA1C > 6.5%, 52.41% had HbA1C > 7%, 64.41% had FBS > 125 mg/dl, and 60%

had PPBS >200 mg/dl. This suggests many had sub-optimal glycemic control.[15] These findings are consistent with studies from other sites in Nepal and in South Asia as well as globally.[5,16,17]

Physical activity is a cornerstone of diabetes management, with strong evidence demonstrating its role in improving insulin sensitivity, reducing cardiovascular risk, and lowering HbA1c level.[4,18] In this study, the majority of participants had moderate or active level of physical activity with 67% of 145 participants having MET more than 600 minutes/week, a significant proportion remained sedentary or low active. The observed levels are higher than those observed in Nepal (51%), South Asia (53%) and Europe (41.7% as per European Health Interview Survey 1).[19,20] This might in part be due to rural location as well as predominant agriculture occupation.[21,22] Comparably, a cross-sectional study from a rural health and training centre in Chennai, India, conducted among 157 diabetic adults using the WHO-GPAQ, reported a physical inactivity prevalence of 36.9%, with the majority achieving only a moderate level of physical activity, findings that mirror the distribution observed in the current study.[6]

The observed association between physical activity level and post prandial blood glucose supports existing evidence that regular physical activity contributes to improved short-term glycemic control. However, weaker association with HbA1c is observed which contrasts with other studies and recommendations which are consistent in showing positive benefits of exercise in long term glycemic control.[23] This might be because other additional factors such as medication adherence, dietary practices, duration of diabetes, and comorbid conditions were not adjusted for, and not fully explored in this study.

Education level emerged as a significant determinant of glycemic control in this study. Participants with higher educational attainment were more likely to achieve better glycemic outcomes, a finding consistent with national and international literature.[24,25] In rural Nepal, where illiteracy remains prevalent, particularly among older adults, this highlights the importance of culturally appropriate and literacy-sensitive diabetes education programs.

Primary occupation was also significantly associated with glycemic control. Participants engaged in agriculture and physically demanding occupations tended to have better glycemic indicators compared to those in sedentary or less physically demanding roles. This aligns with evidence suggesting that occupational physical activity can contribute to metabolic health, although its benefits may differ from structured leisure-time exercise.[26] Nonetheless, reliance on occupational activity alone may be insufficient, particularly as mechanization and lifestyle transitions reduce overall energy expenditure even in rural communities.[27]

From a clinical perspective, the high prevalence of uncontrolled fasting and postprandial blood glucose observed in this study is concerning. Persistent hyperglycemia is associated with an increased risk of microvascular and macrovascular complications, which impose significant morbidity and healthcare costs.[28,29,30] Clinicians working in rural tertiary centers should prioritize individualized physical activity counseling, taking into account patients' age, occupation, comorbidities, and functional limitations. Simple, feasible recommendations such as regular walking, muscle-strengthening exercises, and reduction of prolonged sitting time may be more sustainable than generic exercise advice.[31]

At the public health level, the findings underscore the need for community-based interventions to promote physical activity among people with diabetes in rural Nepal. Integration of non-communicable disease services into primary healthcare, utilization of community health workers, and incorporation of lifestyle counseling into routine follow-up visits could enhance diabetes self-management.[32] Public health campaigns should also address misconceptions regarding physical activity and emphasize its role alongside medication and diet in diabetes control.

Policy implications of this study are particularly relevant for Karnali Province, which faces a disproportionate burden of health inequities. Strengthening health infrastructure, improving access to diagnostic and monitoring facilities, and ensuring continuity of care for chronic diseases are critical steps toward improving diabetes outcomes. Alignment with national strategies such as Nepal's Multi-Sectoral Action Plan for the Prevention and Control of Non-Communicable Diseases can facilitate coordinated efforts across sectors.[33] Moreover, promoting physical activity through supportive environments, such as safe walking paths and community spaces, can have broader benefits beyond diabetes management.[34]

This study has several strengths, including its focus on a rural, underserved population and its use of objective laboratory measures of glycemic control. Nevertheless, the findings should be interpreted in light of certain limitations. The cross-sectional design precludes causal inference, and reliance on self-reported physical activity may introduce recall and social bias. Additionally, other important determinants of glycemic control, such as dietary intake, medication adherence, and duration of diabetes, were not fully assessed.

Despite these limitations, the study provides valuable baseline data on physical activity and glycemic control among patients with diabetes in Karnali Province. The findings contribute to the limited body of evidence from rural Nepal and can inform future longitudinal studies and intervention trials. Addressing physical inactivity through integrated clinical care, community engagement, and supportive policy measures is essential to reducing the growing burden of diabetes-related complications in rural Nepal.

CONCLUSION

Overall, a large proportion of patients with Diabetes Mellitus had poor glycemic control (66.21%), indicating a significant burden of uncontrolled diabetes in the study population. Similarly, a considerable proportion (33%) still engaged in insufficient physical activity, with less than 600 MET-minutes per week of moderate activity, which falls below the WHO's recommended level. The analysis also showed a significant link between physical activity level and fasting plasma glucose. This finding emphasizes that a substantial portion of individuals living with Diabetes Mellitus in the study population remains inadequately active, highlighting the need to strengthen strategies that promote regular physical activity as part of routine diabetes management.

DECLARATION

Acknowledgements

None

Author Contributions

RMG was involved in the concept of research, research design, literature search, data collection, data analysis, and data interpretation. RCP, SJ, MR, SG, MJ, RKJ, PKS, and SKS drafted and reviewed the manuscript for important intellectual content. RCP and MR were involved in the final approval of the version submitted. All authors agreed to be accountable for all aspects of the work.

Ethical Approval

This research was approved by the IRC of Karnali Academy of Health Sciences, Jumla, with the reference number 2025/024 on April 10, 2025.

Consent/Assent

Written consent was obtained from all participants before data collection.

Data Availability Statement

The data supporting the findings of this study are presented within the article. Full data will be available to the editorial team upon request.

Conflict of Interest

RCP is a member of the editorial board of the JKAHS. He has not been involved in any of the editorial processes of the article.

Source of funding

The authors received no external funding for this research.

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