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Diabetes screening and distribution of blood glucose levels in rural far western Darchula District Hospital, Nepal

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Abstract

Introduction: Diabetes mellitus is an emerging public health problem in developing countries like Nepal, where many patients are diagnosed only at a late stage. Rural populations face heightened burdens due to limited screening, low awareness, and poor healthcare access. This study aimed to determine the prevalence of type 2 diabetes mellitus among people attending medical services at Darchula District Hospital, a rural hospital in far western Nepal.

Method: This descriptive cross-sectional study was conducted among 94 adults (≥18 years) attending outpatient services at Darchula District Hospital using non-probability convenience sampling. Random blood glucose (RBS) was measured using a calibrated glucometer. Demographic and behavioral data (alcohol consumption, smoking) were collected through brief structured interviews. Statistical analysis included descriptive statistics and Fisher's exact test for associations.

Result: Among 94 participants (52.1% male, 47.9% female; mean age 52.6 years), the prevalence of RBS ≥200 mg/dL (suggestive of diabetes) was 7.45% (95% CI: 2.4–12.5%). Prediabetes (RBS 140–199 mg/dL) was observed in 19.1% of participants. Smoking was present with elevated RBS, with 13.0% of smokers affected versus none of non-smokers.

Conclusion: The prevalence of type 2 diabetes mellitus in rural setting is notable and comparable to national estimates. Smoking emerged as a significant modifiable risk factor. Early detection through community screening programs, coupled with tobacco cessation interventions, can facilitate timely treatment and help prevent complications.

Keywords: Blood Glucose; Diabetes mellitus; Prevalence; Rural Nepal; Screening; Smoking

INTRODUCTION

Diabetes mellitus stands as a major global public health challenge, with approximately 589 million adults (20-79 years) living with the condition in 2024, marking a prevalence of 11.1%.[1]This number is projected to surge to 853 million by 2050, driven largely by type 2 diabetes mellitus (T2DM), which constitutes over 90% of cases worldwide.[2] The disease led to 3.4 million deaths in 2024—one every nine seconds—and incurred USD 1.015 trillion in global health expenditure, with 81% of affected adults residing in low- and middle-income countries (LMICs).[3]

In South Asia, T2DM prevalence is exacerbated by urbanization, obesity, hypertension, family history, and sedentary lifestyles, contributing to insulin resistance and β-cell dysfunction.[4] Nepal exemplifies this trend, with national T2DM prevalence estimated at 8.5% in 2019 and 7.7% in 2024 among adults, alongside high prediabetes rates of 19.4%.[5] Rural areas face heightened burdens, including undiagnosed cases exceeding 40% nationally and poor control due to limited screening and awareness.[6] Studies indicate prevalence variations from 1.4% to 19%, with rural women showing elevated overweight/obesity and central obesity risks linked to metabolic complications.[7]

Hypertension and abdominal obesity emerge as key hyperglycemia determinants across Nepal's rural and urban populations, doubling T2DM odds alongside elevated triglycerides.[8]In remote districts like Darchula, scarce data underscores geographic disparities, where nutritional transitions amplify non-communicable disease (NCD) risks.[9] Low healthcare access delays diagnosis, with over half of cases unaware or untreated, particularly in provinces with sparse facilities.[10]

Regular rural screening is vital for detecting T2DM and prediabetes, enabling early interventions that avert complications in resource-limited settings.[11] Community-based programs, such as those using HbA1c testing and lifestyle education, demonstrate potential to revert prediabetes and inform policy in Nepal's federal municipalities.[12] Mass efforts provide epidemiological insights, bolstering local planning amid rising burdens.

This study assesses T2DM prevalence and blood glucose distribution in rural Darchula District, Nepal. By generating evidence from this underserved far-western region, it aims to guide targeted prevention, enhance control initiatives, and support nationwide strategies amid escalating NCD threats.

METHOD

A descriptive cross-sectional study was conducted at Darchula District Hospital, a 15-bedded government facility serving rural communities in the far-western region of Nepal. This site was selected due to its role as a primary healthcare hub for underserved populations with limited access to specialized care. Non-probability convenience sampling was employed. The sample size of 94 was determined using the formula for estimating prevalence of 10% in a single proportion with 0.06 margin of error.[13] Adults aged ≥18 years were recruited consecutively from outpatient attendees after obtaining verbal informed consent. A brief structured interview captured demographic data (age, sex), lifestyle factors (alcohol consumption, smoking status), and relevant medical history. Capillary blood glucose was measured immediately using a calibrated glucometer (finger-prick method) under standardized conditions (fasting or random as per presentation). Diabetes and prediabetes classifications followed the latest American Diabetes Association (ADA) 2025 Standards of Care for random plasma glucose (translated to capillary equivalents for glucometer use)[14]: Normal: <140 mg/dL (<7.8 mmol/L), Prediabetes: 140–199 mg/dL (7.8–11.0 mmol/L), Diabetes: ≥200 mg/dL (≥11.1 mmol/L), confirmed where possible by repeat testing or clinical correlation. These criteria align with ADA recommendations for resource-limited settings, emphasizing pragmatic random glucose screening for high-risk adults. Adults aged ≥18 years attending the outpatient department and willing to provide verbal consent and undergo finger-prick glucose testing were included in the study. Known diabetes mellitus (self-reported or on treatment), age <18 years, pregnant women (known or suspected) and acute critical illness precluding safe testing were excluded.

RESULT

Of 94 participants, 49 (52.1%) were male and 45 (47.9%) were female. Mean age was 52.6 years (range: 18–95 years; SD: 18.2) (Figure 1).

Table 1. Age and Gender Distribution

Characteristic	n (%)
Gender	
Male	49 (52.1%)
Female	45 (47.9%)
Age Group	
18–40 years	22 (23.4%)
41–60 years	38 (40.4%)
>60 years	34 (36.2%)

Seven participants (7.45%; 95% CI: 2.4–12.5%) had random blood glucose (RBS) ≥200 mg/dL, indicating diabetes per ADA criteria. Prevalence was higher among males (4/49, 8.16%) than females (3/45, 6.67%) (Figure 2, Table 2).

Table 2. Gender-wise distribution of random blood glucose (RBS)

RBS (mg/dL)	Female (n=45)	Male (n=49)	Total (n=94)
<200	42 (93.3%)	45 (91.8%)	87 (92.6%)
≥200	3 (6.7%)	4 (8.2%)	7 (7.4%)

Prediabetes (RBS 140–199 mg/dL) was observed in 18 participants (19.1%), with normoglycemia (<140 mg/dL) in 69 (73.4%). Alcohol consumption was reported by 35 (37.2%) participants, and tobacco smoking by 54 (57.4%). All 7 hyperglycemia cases occurred among smokers (Table 3, Figure 3). Hyperglycemia prevalence

was 7.45%, predominantly among middle-aged and older adults. Smoking emerged as a significant risk factor in this rural cohort, underscoring the need for targeted tobacco cessation alongside glucose screening.

Table 3. Lifestyle factors and elevated RBS (≥200 mg/dL)

Factor	Category	Total n (%)	Elevated RBS n (%)
Alcohol	Yes	35 (37.2%)	5 (14.3%)
	No	59 (62.8%)	2 (3.4%)
Smoking	Yes	54 (57.4%)	7 (13.0%)
	No	40 (42.6%)	0 (0.0%)

DISCUSSION

This cross-sectional study conducted in a remote rural district hospital in far-western Nepal found a prevalence of probable type 2 diabetes mellitus of 7.45% among adult outpatient attendees, defined by a single random blood glucose (RBS) ≥200 mg/dL. This figure is notable because it indicates that diabetes is no longer confined to urban centers in Nepal, but is increasingly affecting rural populations as well. The observed prevalence in Darchula is comparable to recent national estimates, which report diabetes prevalence of about 8.5% among adults aged 20 years and above, with higher rates in urban and semi-urban areas.[5] A nationwide population-based survey further documented that the burden of diabetes has risen steadily over the past decade, driven by declining nutrition quality, reduced physical activity, and increasing sedentary behaviours.[15] Our finding suggests a convergence of diabetes burden between rural and urban areas, likely due to the diffusion of urban lifestyles, greater consumption of processed foods, and rising exposure to other metabolic risk factors such as obesity and hypertension.[16]

The study also revealed a higher prevalence of elevated RBS among males (8.16%) than females (6.67%). This pattern is consistent with several recent studies from Nepal and other South Asian countries that have reported higher diabetes prevalence in men, particularly in middle-aged and older age groups.[16] The gender difference may arise from a combination of biological factors, such as greater central adiposity in South Asian men at lower body mass index (BMI), and gender-specific lifestyle behaviours. In many Nepali settings, men are more likely to engage in smoking and harmful alcohol use, both of which were strongly associated with hyperglycemia in our sample.[5,17] These behavioural patterns, coupled with occupational and cultural norms, may contribute to a higher diabetes risk in men despite similar or lower overall obesity rates.[5,16]

One of the most striking findings of this study is the strong association between modifiable lifestyle factors—particularly smoking and alcohol use—and elevated blood glucose. All seven participants with RBS ≥200 mg/dL were current smokers, and a significantly higher proportion of smokers (13.0%) had elevated RBS compared with non-smokers (0%). This finding aligns with growing evidence that smoking is an independent risk factor for insulin resistance and the development of type 2 diabetes, mediated through mechanisms such as systemic inflammation, oxidative stress, adverse changes in abdominal fat distribution, and impaired pancreatic β-cell function.[15,18]

Alcohol use also showed a harmful pattern in this cohort. Among alcohol consumers, 14.3% had elevated RBS, compared with 3.4% of non-consumers, although this difference did not reach statistical significance (p=0.095). The relationship between alcohol and diabetes is complex and often described as J- or U-shaped, with light to moderate intake sometimes associated with neutral or modestly protective effects, while heavy or binge drinking increases diabetes risk.[19] In this rural context, alcohol consumption may be linked to poorer overall dietary quality, higher intake of calorie-dense snacks, and other high-risk behaviours, all of which may contribute to hyperglycemia.

From a public health perspective, these findings suggest that in rural Nepal, modifiable behavioural factors are playing an increasingly important role in driving the diabetes epidemic alongside non-modifiable risks such as age, family history, and genetic predisposition.[15,16] This presents both a challenge and an opportunity. The challenge lies in changing deeply entrenched lifestyle habits within the constraints of local culture, socioeconomic conditions, and limited health infrastructure. The opportunity is that smoking, alcohol use, physical inactivity, and poor diet are all amenable to intervention through targeted health education, community-based programs, and policy measures such as tobacco and alcohol regulation, improved food environments, and strengthened primary-care diabetes screening and management.[5,17]

Several limitations should be considered when interpreting these results. First, the use of convenience sampling limits the generalizability of the findings, as participants were drawn from outpatient attendees who may differ systematically from the general community population (selection bias).[5,15]Second, the diagnostic approach relied on a single random capillary blood glucose measurement using a glucometer, which, while practical for screening, is less precise than laboratory-based venous plasma glucose or HbA1c and may be influenced by hematocrit, strip quality, and operator technique.[16]This may lead to some misclassification of glucose status and could overestimate true diabetes prevalence. Confirmatory testing with fasting plasma glucose or HbA1c was not feasible due to resource constraints. Third, assessment of lifestyle factors was based on brief self-reported interviews, which are vulnerable to social desirability bias, particularly for stigmatized behavior such as smoking and alcohol use. Fourth, the cross-sectional design precludes causal inference; we can only describe associations and cannot determine whether smoking or alcohol use preceded hyperglycemia or whether both are linked to unmeasured confounders such as stress, diet, or socioeconomic status. Finally, the sample size (n=94),

although sufficient for descriptive prevalence estimates, reduces the precision of the prevalence measure and the power to detect more subtle associations, especially for subgroup analyses.

Despite these limitations, this study provides locally relevant data from an under-researched rural district and serves as a sentinel signal of a potentially serious public health problem in Darchula. The observed diabetes-range glucose levels, coupled with strong links to smoking and alcohol use, suggest that rural areas may be at an early but accelerating stage of the diabetes epidemic. These findings should be viewed as preliminary and should motivate more robust, community-based studies with larger sample sizes, probability sampling, and standardized diagnostic criteria (including fasting plasma glucose and HbA1c) to obtain a more accurate estimate of diabetes and prediabetes prevalence and to inform tailored prevention and control strategies in rural Nepal.

CONCLUSION

The prevalence of type 2 diabetes mellitus in the rural population was 7.45%, with a substantial burden of prediabetes. Smoking was present with elevated blood glucose levels. Strengthening community-based screening, health education, and tobacco cessation programs may help improve early detection and reduce the burden of diabetes in rural Nepal.

DECLARATIONS

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Conflict of Interest

None declared. There is no financial or institutional conflicts of interest related to this study.

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Ethicial Clearance

Ethical approval was obtained from the Institutional Review Committee (IRC) of Christian Medical college, Vellore and Darchula district hospital.

Consent of Study

Informed written consent in Nepali language was obtained from all participants.

Consent of Publication from Authors

The authors give consent for publication of this study.

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