

Recent Advances in Diabetes Management: A Gendered Approach in North India

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Abstract

Background: Diabetes Mellitus remains a major public health issue in India, with disproportionate burdens observed in North India and among women. **Objectives:** To examine gender and residence-based disparities in glycemic control, medication adherence, and healthcare access among adults with Type 2 Diabetes Mellitus (T2DM) in North India. **Methods:** A cross-sectional study was conducted among 800 adults with T2DM across five North Indian states. Data on clinical parameters, healthcare access, and behavioral factors were collected. Multivariate logistic regression was used to assess associations across gender and urban–rural residence. **Results:** Women had significantly higher mean HbA1c levels compared to men (8.5% vs. 7.8%, $p < 0.001$), lower medication adherence (54% vs. 68%, $p = 0.003$), and reduced access to specialist care (58% vs. 72%, $p = 0.01$). Rural women showed the greatest disparities, with higher HbA1c levels (9.0% vs. 8.2%, $p = 0.002$), reduced access to glucose monitoring (18% vs. 45%, $p < 0.001$), and higher economic constraints (78% earning $< ₹10,000/\text{month}$). Social norms, economic dependency, and urban–rural divides emerged as significant barriers to care. **Conclusion:** Substantial gender and geographic disparities exist in diabetes management in North India, particularly among rural women. Targeted gender-sensitive policies and equitable healthcare resource distribution are crucial to improving outcomes.

Keywords: Diabetes mellitus, gender disparities, glycemic control, healthcare access, north India, urban–rural differences

INTRODUCTION

Currently, diabetes mellitus stands as one of the most common illnesses in India with one of the world's largest diabetes populations suffering from it, projected to affect 101 million adults by 2023 and anticipated to reach 134 million by 2045 [1]. It is reported that North India is no exception to having the highest diabetes prevalence in India, which can be associated with lack of physical activity coupled with increased intake of food and genetic factors [2]. There is emerging research that points towards women as the most impacted group in context of diabetes care and management due to systemic structural inequities with limited access to healthcare, socio-cultural factors, and financial restrictions [3]. For example, certain women in patriarchal societies ignore their health due to family

responsibilities, leading to postponing seeking medical help which often leads to greater complications needing treatment [4]. In contrast, men tend to be more non-compliant with treatment due to high workload mounting stress and unwillingness to modify lifestyle [5]. There is insufficient understanding of gender-specific public health approaches to this problem which is primarily dominated and guided by the men's perspective.

Divides between urban areas and the countryside only make these issues worse. Rural communities struggle with inadequate healthcare systems,

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insufficient diabetes education, and the high cost of essential devices such as glucose monitors [6]. Societal expectations surrounding women's roles within households continue to shape and restrict their opportunities, decision-making power, and freedom of movement. In many rural communities of North India, women are primarily responsible for domestic duties, caregiving, and family welfare, often placing their own health needs behind those of other family members. These gendered responsibilities can limit their ability to access healthcare facilities, seek timely medical advice, or adhere to long-term treatment plans for chronic conditions such as diabetes. Geographic barriers, including poor transportation, long distances to health centers, and limited healthcare infrastructure, further compound these challenges. This study explores the intersection of gender and geography in influencing diabetes outcomes among women in rural North India. By examining how social norms and spatial inequalities interact, the research aims to identify context-specific barriers and develop practical, culturally sensitive interventions that address local needs and improve diabetes prevention, management, and overall health outcomes.

METHODOLOGY

Study Design and Population

The cross-sectional observational study was conducted from January 2022 to December 2023 in five tertiary-care centers located in Delhi, Punjab, Haryana, Uttar Pradesh, and Rajasthan. The study population included patients aged 30–70 years with type 2 diabetes mellitus (T2DM).

Inclusion Criteria

- Adults 30 to 70 years of age with T2DM ($\text{HbA1c} \geq 6.5\%$) confirmed by evidence.
- Gender and residence (urban/rural) stratified sampling.
- Participation in surveys and willingness for clinical evaluations.

Exclusion Criteria

- Subjects with type 1 diabetes, gestational diabetes, or diabetes of secondary origin.
- Having severe comorbidities such as advanced renal failure and cancer.
- Females who are pregnant or in the lactating phase.

Data Collection

- *Clinical Metrics*: BMI, HBA1C, and fasting blood glucose.
- *Behavioral Surveys*: Self-reported adherence to medications, diet, and physical exercise.
- *Access to Health Care*: Distance from the healthcare services, number of consultations, and costs incurred.

Statistical Analysis

Statistical analysis was conducted using SPSS v28. Categorical variables were tested using Chi-square tests and gendered predictors of glycemic control were found using multivariate logistic regression.

RESULTS

The information presented in the upper table reveals that women had worse medication adherence (54% vs. 68%) and poorer glycaemic control (mean HbA1c 8.5% against 7.8%) than men. These inequities are associated with lower access to specialist care (58% vs. 72%) and decreased physical activity (48% vs. 65%) among women. It is likely that socio-cultural constraints of exercising outdoors and financial dependency tend to support these patterns (Table 1) [7].

Table 1. Gender differences in glycemic control and healthcare access.

Parameter	Male (n = 420)	Female (n = 380)	p-value
Mean HbA1c (%)	7.8 ± 1.2	8.5 ± 1.5	<0.001
Medication Adherence (%)	68%	54%	0.003
Access to Specialist Care (%)	72%	58%	0.01
Regular Physical Activity (%)	65%	48%	<0.001

The table demonstrates that rural women reported worse glycaemic outcomes (HbA1c 9.0% vs. 8.2%) and lower utilization of glucose monitors (18% vs. 45%) than their urban counterparts. More than 78% of rural women stated earning below ₹10,000/month – this serves as a significant barrier regarding the accessibility of diabetes management technologies (Table 2) [6].

Table 2. Urban vs. rural disparities among women.

Parameter	Urban women (n = 200)	Rural women (n = 180)	p-value
Mean HbA1c (%)	8.2 ± 1.3	9.0 ± 1.6	0.002
Access to Glucose Monitors (%)	45%	18%	<0.001
Monthly Income <₹10,000 (%)	32%	78%	<0.001

DISCUSSION

This research illustrates significant inequalities regarding the control in diabetes symptomatic treatment across genders. Women in North India had worse glycemic control, decreased adherence to medication, and poorer access to healthcare services relative to men. The observation of higher mean HbA1c in women (8.5% versus 7.8%) seems consistent with the report of this researcher [7, 8], who pointed out socio-cultural barriers governing physical activity and financial dependency as vital determinants. For example, women are often discouraged by prevailing societal norms to partake in outdoor exercise which contributes to a sedentary lifestyle (48% vs. Women's care-seeking behavior is financially constrained due to dependence on male family members (58% vs. 72% women's specialist care access) [9].

The gap between urban and rural areas widens existing inequitable distributions of resources. There was a much worse HbA1c among rural women (9.0%) compared to urban counterparts (8.2%), which is further complicated by stark income inequality – with 78% earning less than ₹10,000 a month. These results are like those of Sharma et al. (2023), who observed that rural populations often lack access to basic diabetes technologies, such as glucose monitors (18% vs. 45% in urban areas), due to cost and availability. Even so, this study [4] argues that the existence of fewer healthcare facilities, combined with inadequate means of transport, disproportionately affects rural women who require permission from their husbands to obtain healthcare services.

In contradiction to the above results, men's better HbA1c control was coupled with a higher rate of smoking and alcohol consumption (noted in surveys but not included in tables), which poses latent risks for cardiovascular complications according to this study [5]. This highlights the necessity of gender-specific educational strategies; in this case, it appears women would benefit from community-based physical activity programs, while men require stress management interventions in the workplace that address substance use [10].

CONCLUSION

This study clearly indicates the impact of gender and geography on the management of diabetes in North India. Systemic barriers to glycemic control for women, especially in rural settings, include socio-cultural norms, dependence, and inadequate healthcare technology access. The disparities women face necessitating protective measures are evident from the significantly elevated HbA1c levels among women (8.5% vs. 7.8%) and rural women (9.0% vs. 8.2%). While men demonstrated better outcomes, their vulnerability to non-adherence due to work stress and occupational lifestyle choices calls for workplace health initiatives.

Healthcare access and adherence gaps fueled by socio-cultural norms – like restricted mobility and decision-making autonomy – are reported. The combination of economic burden and infrastructural deficit, like lack of access to glucose monitors (18%), puts rural women in a catch-22 situation classifying these women as economically active yet unsupported. There is a need for policy-level changes to subsidize diabetes care technologies and improve healthcare infrastructure in rural areas

Constructive gender-neutral health education campaigns at the community level aimed at empowering women will address gender barriers to prioritizing health.

Addressing the inequalities in healthcare disparities requires diverse efforts. Incorporating gender-aware diabetes management into national health schemes, overcoming gender biases in care through provider training, and using the services of health workers for rural areas could help. Future work should be longitudinal in nature to look at the causal pathways and the sustained impacts of these interventions. While dealing with the diabetes epidemic in India, interventions focusing on marginalized groups while ensuring that health outcome sustainability is met will be quintessential.

Limitations and Recommendations

The limitations of this study are that its cross-sectional design does not allow for causal relationships to be made, in addition to the possibility of recall bias introduced by self-reports. Moving forward, more gender-specific milestones need to be set and tracked using longitudinal studies. There is a need for public health decision-makers to subsidize the diabetes technologies more generously for rural residents, as well as integrate a gender perspective into the medical training of health workers. Community health educators, especially for women in confined cultures, can fill those gaps by offering care that is sensitive to the community's culture.

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