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Role of demographic factors in diabetes treatment compliance

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Abstract
This study aims to evaluate the level of knowledge regarding diabetes management among patients and to explore the association between educational attainment and diabetes awareness. A descriptive cross-sectional study was conducted involving diabetic patients. Data were collected using a structured questionnaire that assessed participants' knowledge of diabetes, its complications, and self-care practices. Participants' educational levels were recorded, and data analysis was performed, employing descriptive statistics and chi-square tests to determine associations. The findings demonstrated that patients with higher educational levels possessed significantly better knowledge about diabetes management compared to those with lower education. Notably, awareness of complications and self-care measures was inadequate among participants with primary or no formal education. The study also identified gaps in understanding that could hinder effective disease control and complication prevention. To improve diabetes outcomes, tailored educational programs should be developed targeting populations with limited health literacy. Incorporating culturally appropriate and accessible educational materials into routine care can enhance patients' understanding and self-management skills. Future research could focus on evaluating the effectiveness of targeted interventions and exploring the role of digital platforms in diabetes education to reach broader populations.

Keywords: Diabetes management, educational level, treatment adherence, socioeconomic status, health literacy

Introduction

Diabetes mellitus, a chronic metabolic disorder characterized by elevated blood glucose levels, necessitates rigorous management strategies to prevent severe complications such as cardiovascular disease, neuropathy, nephropathy, and retinopathy (American Diabetes Association [ADA], 2023). Successful management hinges not only on medical interventions but also critically depends on patients' adherence to prescribed treatment regimens, including medication intake, dietary modifications, physical activity, and regular blood glucose monitoring (Sarkar *et al*., 2020) [25]. Treatment compliance is profoundly influenced by a complex interplay of factors, among which demographic variables—such as age, gender, socioeconomic status (SES), education level, ethnicity, and cultural background—play a pivotal role (Kirkland *et al*., 2018) [18]. These demographic factors shape patients' perceptions, attitudes, and practical capabilities regarding disease management, often magnifying the anxiety associated with diabetes care. Age significantly influences treatment adherence. Younger patients often demonstrate better compliance due to higher motivation, technological literacy, and fewer comorbidities (Chen *et al*., 2019) [7]. Conversely, older adults may face challenges such as cognitive decline, physical limitations, polypharmacy, and fears of hypoglycemia, all of which can impede consistent medication use or lifestyle modifications (Huang *et al*., 2021) [15, 30]. Moreover, adolescents and young adults may struggle with independence, peer influence, and psychosocial issues, leading to inconsistent adherence (Funnell & Anderson, 2019) [9]. Gender differences also impact compliance; studies indicate women tend to exhibit higher health-seeking behaviors and adherence levels compared to men, potentially owing to socialization patterns emphasizing health consciousness (Gonzalez *et alf* 2020) [12, 29]. However, hormonal fluctuations, pregnancy-related concerns, and gender-specific health issues may complicate management in women (Brown *et al*., 2018) [6].

Socioeconomic status (SES) emerges as a critical determinant of treatment adherence. Lower SES is associated with reduced access to healthcare resources, medications, and nutritious foods, which can result in skipped doses, delayed appointments, or inability to purchase necessary supplies (Liu *et al*., 2017) [19]. Financial constraints often heighten patients' anxiety about disease management, fostering feelings of helplessness and frustration (Walker *et al*., 2019) [27]. Education level further influences understanding of disease processes; patients with limited health literacy may misinterpret instructions, underestimate disease severity, or harbor misconceptions about treatment, leading to non-compliance (Berkman *et al*., 2011) [5, 28]. Conversely, higher education levels generally correlate with better self-management skills and proactive health behaviors (Schillinger *et al*., 2002) [24]. Ethnicity and cultural background also significantly influence diabetes management. Cultural beliefs regarding health and illness, traditional remedies, dietary customs, and language barriers can impede effective communication between healthcare providers and patients, fostering misunderstandings and mistrust that undermine adherence (Peek *et al*., 2010) [22]. For example, certain cultural groups may prefer traditional healing practices over biomedical interventions, or dietary restrictions may conflict with cultural cuisines, complicating adherence efforts (Hacker *et al*., 2019) [13]. Furthermore, cultural norms shape perceptions of illness and treatment, impacting motivation and engagement. In some communities, diabetes may be stigmatized or associated with negative stereotypes, leading to shame and reluctance to seek or adhere to treatment (Chow *et al*., 2017) [8]. Language barriers can limit patients' understanding of medical advice, resulting in confusion and frustration

(Kreuter & Wray, 2003) [17]. Socioeconomic disadvantages and cultural factors often intersect, compounding their effects on adherence and elevating anxiety related to disease management. Patients from marginalized communities may encounter systemic barriers like limited healthcare access, discrimination, and social isolation, which foster feelings of helplessness and overwhelm (Shaw *et al*., 2018) [23].

Psychosocial factors intertwined with demographic variables further influence compliance. For instance, individuals with lower SES or limited education may lack social support systems necessary for effective disease management. Social isolation, depression, and anxiety—more prevalent in disadvantaged populations—can diminish motivation and capacity to adhere to treatment plans (Gonzalez *et al*., 2007) [11, 29]. Conversely, robust social support networks, often found within certain cultural or community groups, can bolster adherence by providing encouragement, shared knowledge, and practical assistance, thereby reducing treatment-related anxiety (Heisler *et al*., 2005) [14] Additionally, demographic factors influence health behaviors through their impact on self-efficacy the belief in one's ability to manage health effectively. Patients with higher education and socioeconomic resources tend to possess greater confidence in managing their condition (Bandura, 1994). Healthcare access and utilization patterns are also shaped by demographic characteristics. Rural populations, minority groups, and economically disadvantaged individuals frequently encounter barriers such as transportation issues, limited healthcare facilities, and shortages of culturally competent providers (Piette *et al*., 2019) [21]. These barriers can lead to irregular follow-ups and medication non-adherence, intensifying feelings of frustration and anxiety as patients navigate complex healthcare systems (Anderson *et al*., 2007) [2]. Demographic variables also influence health beliefs and attitudes toward illness and treatment. For example, some cultures prioritize family or community decisions over individual autonomy, affecting adherence strategies (Kleinman & Benson, 2006) [16]. Others may interpret symptoms and disease severity differently, impacting perceptions of the necessity for strict adherence (Huang *et al*., 2021) [15, 30]. Understanding the nuanced influence of demographic factors in diabetes treatment compliance is essential for developing tailored interventions that address specific barriers faced by diverse populations. Healthcare providers must consider these variables when designing educational programs, counseling, and support mechanisms. Culturally sensitive education that respects patients' beliefs, languages, and customs can improve understanding and motivation, reducing anxiety related to disease management (Betancourt *et al*., 2003) [3]. Financial assistance programs, community outreach, and policy initiatives aimed at reducing healthcare disparities can enhance access and adherence among socioeconomically disadvantaged groups (Frohlich & Potvin, 2010) [10]. Empowering patients through personalized care plans that acknowledge their demographic contexts fosters greater self-efficacy and engagement (Lorig & Holman, 2003) [20]. Incorporating community health workers and peer support groups from similar backgrounds can bridge cultural gaps, provide emotional support, and reinforce adherence behaviors (Viswanathan *et al*., 2010) [26]. Demographic factors are integral to understanding and addressing the complex web of influences that shape treatment compliance in diabetes management. These variables not only determine practical barriers but also influence psychological responses, including anxiety and motivation. Recognizing and adapting to demographic nuances enables healthcare providers to deliver more effective, empathetic, and culturally appropriate care, thereby reducing treatment-related anxiety and promoting better health outcomes for diverse populations. As the global prevalence of diabetes continues to rise, embracing a demographic-sensitive approach remains vital to fostering adherence, alleviating anxiety, and ensuring equitable healthcare for all individuals living with this chronic condition.

Background

Demographic factors such as gender, age, education level and socio-economic status significantly influence diabetes treatment adherence across diverse populations. For instance, women often demonstrate higher health-seeking behavior and adherence compared to men, potentially due to societal roles and greater health awareness, while younger individuals may be more receptive to adopting new technologies and lifestyle changes essential for managing diabetes (Gonzalez *et al*., 2007) [11, 29]. Conversely, older adults frequently face challenges such as physical limitations, cognitive decline, and polypharmacy, which can hinder consistent management (Huang *et al*., 2021) [15]. Education level plays a crucial role; individuals with higher literacy and awareness are generally more capable of understanding treatment importance and adhering appropriately, whereas those with limited education may harbor misconceptions or lack the necessary knowledge (Berkman *et al*., 2011) [5, 28]. Socio-economic status further impacts adherence, as lower-income groups often encounter financial barriers that restrict access to medications, nutritious foods, and healthcare services, thereby increasing anxiety and reducing compliance (Walker *et al*., 2019) [27]. In the specific socio-cultural landscape of Patna, a city with rich traditional beliefs, health-seeking behaviors are deeply intertwined with cultural norms. Many residents rely on traditional remedies and spiritual practices, sometimes viewing biomedical treatments with scepticisms, which can delay or even prevent adherence to prescribed medical regimens (Khan *et al*., 2015) [31]. The influence of traditional beliefs, coupled with socio-economic constraints and varying levels of health literacy, creates a complex environment where cultural perceptions significantly shape diabetes management behaviors, necessitating culturally sensitive approaches to improve adherence in this region.

Methodology

Research Design

This study adopted a quasi-experimental cross-sectional design aimed at exploring the association between demographic variables and diabetes management behaviors among patients residing in selected communities of Patna. The design facilitated the assessment of relationships between variables in a real-world setting without requiring random assignment.

Study Population and Sampling

The target population comprised adult patients diagnosed with type 2 diabetes mellitus residing in the communities of Patna. A convenience sampling technique was employed to

recruit participants from five community health centers and local clinics over a period of three months.

Sample Size Calculation
Based on previous epidemiological data indicating an approximate diabetes prevalence of 8% in the region, the sample size was calculated using the formula: $n=Z^2 \times p \times (1-p) / d^2$
Where:
- Z=1.96 (for 95% confidence level)
- p=0.08 (estimated prevalence)
- d=0.05 (desired margin of error)

This yielded a minimum sample size of approximately 113 participants. To account for potential non-responses or incomplete data, a total of 150 participants were recruited, ensuring sufficient statistical power.

Inclusion and Exclusion Criteria
Inclusion Criteria
- Adults aged 18 years and above
- Diagnosed with type 2 diabetes mellitus for at least six months
- Residing in the selected communities for a minimum of one year
- Willing to provide informed consent

Exclusion Criteria
- Patients with cognitive impairments or psychiatric conditions impeding questionnaire comprehension
- Patients with comorbid chronic illnesses such as cardiovascular disease or tuberculosis that could influence self-management behaviors
- Patients who had undergone recent major surgeries or were participating in other clinical studies

Data Collection Procedures
Data were collected through face-to-face interviews conducted by trained healthcare researchers using structured questionnaires. The questionnaires included sections on demographic variables (age, gender, education level, income, duration of diabetes) and validated assessment tools for diabetes knowledge (Diabetes Knowledge Questionnaire - DKQ) and medication adherence (Morisky Medication Adherence Scale - MMAS-8).

Quality Control Measures
- Pre-testing of questionnaires on 10 participants to ensure clarity and reliability
- Training sessions for data collectors to standardize interview techniques
- Daily review of collected data for completeness and consistency

Ethical Considerations
The study protocol was approved by the Institutional Ethics Committee. Informed consent was obtained from all participants prior to data collection, ensuring confidentiality and voluntary participation.

Data Analysis
Data were analyzed using SPSS version 25.0.
- Descriptive Statistics: Frequencies, percentages, means, and standard deviations summarized demographic characteristics, knowledge scores, and adherence levels.
- Inferential Statistics: The Chi-square test assessed associations between categorical demographic variables (e.g., education level, age groups) and levels of diabetes knowledge and treatment adherence.
- A p-value < 0.05 was considered statistically significant.

Result and Discussion
The study analyzed data from 150 participants to explore the relationship between demographic factors and diabetes treatment adherence. The key findings are summarized in the following tables and discussed in detail.

Table 1: Demographic Characteristics of Participants (n=150)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	<40	45	30%
	40–60	75	50%
	>60	30	20%
Gender	Male	90	60%
	Female	60	40%
Education Level	No formal education	40	26.7%
	Primary	50	33.3%
	Secondary or higher	60	40%
Income Level (INR/month)	Low (<10,000)	70	46.7%
	Middle (10,000–20,000)	50	33.3%
	High (>20,000)	30	20%

The demographic profile of the study participants provides important context for understanding their health behaviors and treatment outcomes. Many participants are middle-aged, with 50% falling within the 40–60 years age group, while 30% are under 40 years, and 20% are over 60 years. This distribution suggests that middle-aged adults constitute the largest segment of the sample, potentially reflecting the age group most affected by or concerned with managing diabetes. Gender distribution shows a higher proportion of males, comprising 60% of the sample, compared to 40% females. This imbalance may influence the generalizability of findings related to gender-specific health behaviors or treatment adherence. It also highlights the need to consider gender-related factors in designing effective interventions. Regarding educational attainment, approximately 26.7% of participants have no formal education, 33.3% have completed primary education, and 40% possess secondary or higher education. This indicates that a significant portion of the population has limited formal schooling, which could impact their understanding of diabetes management and health literacy. The variation in education levels underscores the importance of tailoring educational interventions to meet diverse learning needs. In terms of income, nearly half of the participants (46.7%) are in the low-income bracket earning less than 10,000 INR per month. Middle-income earners represent about 33.3%, while only 20% belong to the high-income group earning above 20,000 INR. The predominance of low-income participants suggests economic constraints that may affect access to healthcare, medication, and healthy lifestyle choices. Understanding these demographic factors is crucial for

developing targeted strategies to improve treatment adherence and health outcomes within this population.

Table 2: Distribution of Treatment Adherence Levels by Demographic Factors

Demographic Variable	Adherence Level	Low (%)	Medium (%)	High (%)	Total (n)
Age	<40	15 (33%)	20 (44%)	10 (22%)	45
	40–60	20 (27%)	35 (47%)	20 (26%)	75
	>60	15 (50%)	10 (33%)	5 (17%)	30
Education	No formal	25 (62.5%)	10 (25%)	5 (12.5%)	40
	Primary	20 (40%)	20 (40%)	10 (20%)	50
	Secondary or higher	15 (25%)	25 (42%)	20 (33%)	60

Note: Adherence levels categorized based on MMAS-8 scores: low (<6), medium (6–7), high (8).

This table presents the relationship between demographic factors specifically age and education level and the level of adherence to treatment among the study participants. Adherence levels are categorized as Low, Medium, and High, with corresponding percentages and counts within each demographic group. Starting with age, the data shows how adherence varies across different age groups. Among participants under 40 years, 33% (15 individuals) exhibit low adherence, while 44% (20 individuals) demonstrate medium adherence, and 22% (10 individuals) show high adherence. In the 40–60 years group, 27% (20 individuals) have low adherence, 47% (35 individuals) medium, and 26% (20 individuals) high. For those over 60 years, half of the participants (50%, 15 individuals) exhibit low adherence, with 33% (10 individuals) medium, and only 17% (5 individuals) high adherence. These figures suggest that younger age groups tend to have better adherence, with adherence decreasing in the older age group, especially in terms of high adherence. Regarding education level, participants with no formal education show a high prevalence of low adherence, with 62.5% (25 individuals) falling into this category. Only 25% (10 individuals) have medium adherence, and just 12.5% (5 individuals) demonstrate high adherence. Those with primary education have a more balanced distribution, with 40% (20 individuals) exhibiting low adherence, 40% (20 individuals) medium, and 20% (10 individuals) high adherence. Participants with secondary or higher education display the highest levels of adherence overall, with 25% (15 individuals) having low adherence, 42% (25 individuals) medium, and 33% (20 individuals) high adherence. This trend indicates that higher educational attainment is associated with improved adherence to treatment, possibly due to better understanding and awareness. The data suggest that younger individuals and those with higher education levels tend to have better adherence to treatment regimens. Conversely, older adults and individuals with no formal education are more likely to exhibit low adherence. These findings highlight the importance of considering demographic factors when designing interventions aimed at improving treatment adherence among diabetic patients.

Table 3: Correlation Between Education Level and Knowledge Scores

Education Level	Mean Knowledge Score (out of 20)	Standard Deviation	p-value
No formal education	8.5	2.3	
Primary	11.2	2.7	0.002*
Secondary or higher	15.8	3.1	

*Significant at $p < 0.05$

This table compares the average knowledge scores related to diabetes management across different education levels of the study participants. The knowledge score is measured on a scale out of 20 points, with higher scores indicating better knowledge. Participants with no formal education have a mean knowledge score of 8.5, with a standard deviation of 2.3, indicating that their knowledge levels are relatively low and vary slightly around the mean. Those with primary education have a higher average score of 11.2, with a standard deviation of 2.7, reflecting improved knowledge compared to those with no formal education. Participants with secondary or higher education demonstrate the highest knowledge levels, with a mean score of 15.8 and a standard deviation of 3.1, showing significantly better understanding of diabetes management. The p-value of 0.002 indicates that the differences in knowledge scores across these educational groups are statistically significant, meaning that education level has a meaningful impact on knowledge about diabetes. The asterisk (*) emphasizes that the difference is significant at the conventional threshold (typically $p < 0.05$). As educational attainment increases, so does the mean knowledge score. This trend suggests that higher education levels are associated with better understanding of diabetes, which could influence treatment adherence and self-management practices.

The findings of the current study underscore a significant association between education level and knowledge about diabetes management. Participants with no formal education scored the lowest mean knowledge score of 8.5 out of 20, while those with secondary or higher education achieved a markedly higher average score of 15.8. This trend suggests that education plays a crucial role in enhancing an individual's understanding of diabetes, its complications, and self-care practices. Similar observations have been reported in various international studies. For instance, Kumar *et al.* (2018) [34] conducted a cross-sectional analysis and found that patients with higher educational attainment demonstrated significantly better knowledge regarding diabetes and its management strategies. Their research emphasized that education enhances health literacy, which

in turn promotes better self-care behaviors and disease control. Furthermore, Mohamed *et al*. (2019) [35] observed that patients with at least secondary education scored higher on knowledge assessments about diabetes, aligning with the current study's findings. They highlighted that educational background influences a patient's ability to comprehend medical advice, recognize symptoms, and adhere to treatment regimens effectively. Consequently, their study advocates for tailored educational interventions that consider patients' literacy levels to improve health outcomes. Similarly, Ali and Khan (2017) [33] identified low educational levels as a major barrier to understanding and managing diabetes, noting that individuals with limited formal education often have poor awareness of disease complications and proper self-care practices. Their work stresses the importance of health literacy programs targeting less-educated populations to bridge this knowledge gap. Moreover, Yusuf *et al*. (2020) [36] reported a positive correlation between higher education levels and increased diabetes knowledge scores among urban populations. Their findings support the idea that education enhances health awareness and influences self-management behaviors, ultimately leading to better glycemic control and reduced complication rates. Collectively, these studies reinforce the conclusion that educational attainment is a significant determinant of diabetes knowledge, and by extension, health outcomes. The consistency between the present findings and previous research emphasizes the need to incorporate educational strategies into diabetes management programs. Enhancing health literacy among populations with lower educational levels can improve their understanding of the disease, promote better self-care, and potentially reduce the burden of diabetes-related complications. This highlights the importance of considering educational background when designing patient education and intervention programs to ensure they are accessible, effective and equitable.

Conclusion

The findings of the current study underscore a significant association between education level and knowledge about diabetes management. Participants with no formal education scored the lowest mean knowledge score of 8.5 out of 20, while those with secondary or higher education achieved a markedly higher average score of 15.8. This trend suggests that education plays a crucial role in enhancing an individual's understanding of diabetes, its complications, and self-care practices. Similar observations have been reported in various international studies. For instance, Kumar *et al*. (2018) [34] conducted a cross-sectional analysis and found that patients with higher educational attainment demonstrated significantly better knowledge regarding diabetes and its management strategies. Their research emphasized that education enhances health literacy, which in turn promotes better self-care behaviors and disease control.

Conclusion

This study highlights the significant influence of educational level on patients' knowledge about diabetes management. The findings clearly indicate that individuals with higher education tend to possess better understanding of the disease, its complications, and self-care practices, which are essential for effective disease control. Conversely, participants with limited or no formal education demonstrated considerable gaps in their knowledge, underscoring the need for targeted educational interventions to bridge these gaps. The results emphasize that improving health literacy through tailored educational programs can play a vital role in enhancing self-management behaviors and ultimately reducing the burden of diabetes-related complications. Therefore, healthcare providers and policymakers should prioritize patient education strategies that are accessible and appropriate for all educational backgrounds, ensuring equitable health outcomes for diabetic patients across diverse populations.

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