Original Research Article

Knowledge Regarding Risk Factors, Symptoms, and Complications of Diabetes among Rural Adults in Hassan District, Karnataka: A Cross-Sectional Study

Pavithra P[1], Anjan Sreeranga[2], Bhoomika DN[3]

[1]Assistant Professor, Department of Community Medicine, Hassan Institute of Medical Sciences, Hassan, India.
[2]Assistant Professor, Department of Community Medicine, Hassan Institute of Medical Sciences, Hassan, India.
[3]Senior Resident, Department of Community Medicine, Bangalore Medical College and Research Institute, Bengaluru, India.

Corresponding Author: Dr. Pavithra P

ABSTRACT

Background: Diabetes mellitus is a major global health challenge, with rapidly increasing prevalence, especially in low- and middle-income countries. Despite awareness programs and treatment advances, its burden remains high in India, particularly in rural areas with limited disease awareness.

Objectives:
1. To estimate the prevalence of diabetes among rural adults in Hassan district.
2. To compare the awareness of risk factors, symptoms, and complications of diabetes between diabetic and non-diabetic participants.
3. To assess and compare treatment adherence with the level of knowledge among diabetic participants.

Methods: A community-based cross-sectional study was conducted between September 2023 and June 2024 in selected villages of Hassan district. A total of 328 adults were enrolled. Data were collected using a pre-tested questionnaire and analyzed using SPSS version 29. Proportions with 95 % Confidence Intervals (CI) were calculated, and the Chi-square test was applied.

Results: Diabetes prevalence was 26.5% (95% CI: 21.7–31.3), higher in females (28.6%) than males (23.8%). Awareness of symptoms was 93.1% in diabetics vs 57.3% in non-diabetics, and of complications 87.4% vs 15.5%, respectively. Among diabetics, 43% adhered to treatment, 10% practiced self-monitoring, and 63% incurred out-of-pocket expenses, mainly due to inaccessibility of services. The association between treatment adherence and awareness was not statistically significant.

Conclusion: One in four rural adults was found to have diabetes, with notable gaps in awareness among non-diabetics and inadequate self-monitoring among diabetics. Strengthening community-based health education and routine screening programs is essential for early detection, improved treatment adherence, and the prevention of complications.

Keywords: Diabetes Mellitus; Knowledge; Risk Factors; Treatment Adherence; Rural Adults.

INTRODUCTION

Globally, the burden of diabetes has increased sharply over the past few decades - from around 200 million affected individuals in 1990 to about 830 million in 2022.[1] Currently, an estimated 537 million adults aged 20–79 years, or roughly one in every ten, are living with diabetes. The number is expected to reach 643 million by 2030 and further rise to 783 million by 2045.[2] Approximately 81% of adults with diabetes reside in low- and middle-income countries. In 2024 alone, diabetes accounted for approximately 3.4 million deaths, equating to one life lost every nine seconds.[3]

India has the world's second highest number of diabetics after China. Despite various health programs and initiatives, the prevalence of diabetes in India continues to increase steadily. India had an estimated 77 million people with diabetes in 2019, and this number is projected to rise to over 134 million by 2045. Nearly 57% of people with diabetes remain undiagnosed, posing a major public health concern.[4]

Among adults aged 20–79 years, cases were 74.9 million in 2021, projected to reach 124.9 million by 2045. NFHS-5 (2019–21) reported a diabetes prevalence of 16.1% among those ≥15 years. According to IDF, 1 in 7 diabetic adults globally lives in India, and 1 in 3 households have a diabetic patient.[5]

Major risk factors for Diabetes include unhealthy diet, sedentary lifestyle, physical inactivity, and family history.[6] It is a leading cause of blindness, kidney failure, heart attacks, stroke, and lower limb amputations. According to the International Diabetes Federation, people living with diabetes are up to three times more likely to develop cardiovascular disease. Around one in three are affected by some form of vision loss during their lifetime. Kidney failure occurs about ten times more frequently among those with diabetes, and globally, a lower limb is lost to diabetes every 30 seconds. [7]

According to the Global Burden of Disease 2019 report, ischemic heart disease and stroke were the leading and second-leading causes of the global disease burden, with diabetes recognized as a major precursor for both conditions.[8] Since 2000, diabetes mortality has been rising; in 2021, it caused 1.6 million deaths, nearly half before age 70. It also contributed to 530,000 kidney disease deaths and ~11% of cardiovascular deaths. In 2021, 647,831 deaths were attributed to diabetes, accounting for 2.8% of proportional mortality.[1]

According to NFHS-5, awareness, treatment, and control of diabetes in India remain low, especially in rural areas. Only 17.7% of rural diabetics were aware, 23.9% sought treatment, and 6.3% had control, compared to 33.7%, 27.8%, and 8.3% in urban areas.[5]

Despite the increasing prevalence and significant complications associated with diabetes, awareness regarding its risk factors, early symptoms, and potential complications remains inadequate, especially among rural populations.[5] Limited health literacy, poor access to healthcare services, and misconceptions about the disease contribute to delayed diagnosis and poor glycemic control.[9] Therefore, assessing the knowledge of rural adults about diabetes is crucial for identifying existing gaps and formulating effective community-based health education and prevention strategies.

Objectives

1. To estimate the prevalence of diabetes among rural adults in Hassan district.
2. To compare the awareness of risk factors, symptoms, and complications of diabetes between diabetic and non-diabetic participants.
3. To assess and compare treatment adherence with the level of knowledge among diabetic participants.

MATERIALS & METHODS

A community-based cross-sectional study was conducted in selected villages of

Hassan district, Karnataka. The study was conducted between September 2023 and June 2024. Ethical clearance was obtained from the Institutional Ethics Committee before conducting the study. Informed verbal consent was obtained from all study participants. The sample size was calculated using the formula 4pq/d2. The estimated sample size was 312, considering p = 24.25 % from the Dinesh PV et al. study,[10] q = 75.75% (100 – p), and d = 20% of p. After adding 5% for sample attrition, the final sample size was 328. A multistage sampling technique was employed. Under randomly selected one PHC, 3 villages were selected using simple random sampling. In the third stage, households within the selected villages were chosen using systematic random sampling. From each selected household, 1–2 eligible adults were included until the required sample size of 328 participants was achieved. (Flow Chart 1)
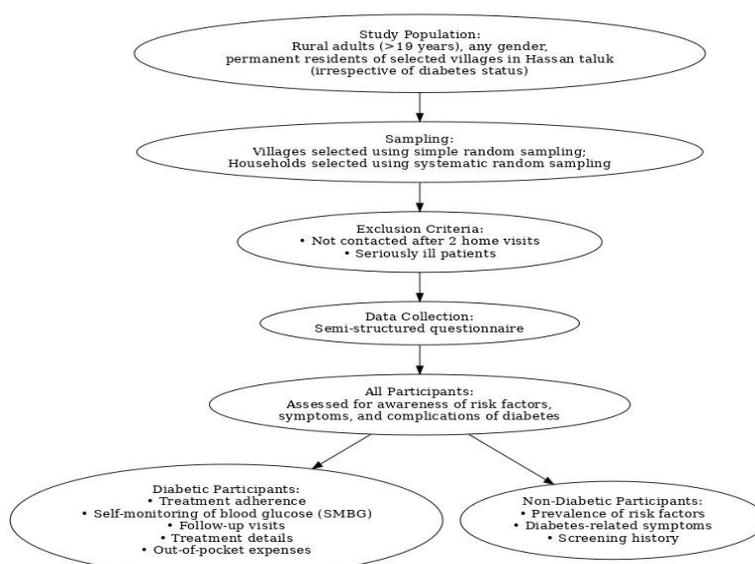

Figure 1: Flow chart of study methodology.

STATISTICAL ANALYSIS
Data were entered in Microsoft Excel and analyzed using SPSS version 29. Results were expressed as proportions and 95 % Confidence Interval (CI). The Chi-square test was applied to determine the association between awareness and treatment adherence among diabetic participants, and to compare awareness levels between diabetic and non-diabetic participants.

RESULT
In the present study (Table 1), prevalence of diabetes was 26.5% (95% CI: 21.7–31.3), The prevalence of diabetes rose steadily with age, starting from 5.9% in the 20–35 years group and increasing to 27.5% in 36–50 years, 38.1% in 51–65 years, and 31.8% in 66–80 years, reaching the highest in the 81–95 years group with 61.5%. Diabetes was seen in 23.8% of males and 28.6% of females. Educational background showed a clear gradient, with the highest prevalence among the illiterate (34.4%) and those with higher primary education (37.5%), while it was much lower among graduates (8.7%) and PUC level (14.3%), with no cases reported among postgraduates. Occupational patterns highlighted particularly high rates among farmers (81%) and the self-employed (100%), followed by the unemployed (40%). In comparison, homemakers (17.6%), skilled workers (9.1%), and business persons (23.1%) had lower proportions of diabetes.

Table 1: Socio-demographic characteristics of study participants.

Variables	Components	Diabetics 87 (%)	Non-Diabetics 241 (%)	Total
Age in years	20-35	05(5.9%)	80 (94.1%)	85
	36- 50	28 (27.5%)	74 (72.5%)	102
	51-65	32 (38.1%)	52 (61.9%)	84
	66-80	14 (31.8%)	30 (68.2%)	44
	81-95	08 (61.5%)	5 (38.5%)	13
Sex	Male	34 (23.8%)	109 (76.2%)	143
	Female	53 (28.6%)	132 (71.4%)	185
Education	Illiterate	33 (34.4%)	63 (65.6%)	96
	Primary	04 (15.4%)	22 (84.6%)	26
	Higher Primary	30(37.5%)	50 (62.5%)	80
	High School	15 (18.3%)	67 (81.7%)	82
	PUC	03 (14.3%)	18 (85.7%)	21
	Graduate	02 (8.7%)	21 (91.3%)	23
	Post Graduate	00 (0.0)	00 (0.0)	00
Occupation	Home maker	27 (17.6%)	126 (82.4%)	153
	Farmer	17 (81.0%)	04 (19.0%)	21
	Business	06 (23.1%)	20 (76.9%)	26
	Skilled workers	03 (9.1%)	30 (90.9%)	33
	Labourer	19 (36.5%)	33 (63.5%)	52
	Govt. Job	03 (37.5%)	05 (62.5%)	08
	Self Employed	00(0.0%)	05 (100.0%)	05
	Unemployed	12 (40.0%)	18 (60.0%)	30

In Table 2: Awareness of modifiable risk factors (sedentary lifestyle, unhealthy diet, central obesity) was higher among diabetics compared to non-diabetics and which was statistically significant. Interestingly, awareness of family history and increasing age as risk factors was similar between both groups but it was not found statistically significant. Notably, non-diabetics (37.3%) reported higher awareness of gestational diabetes than diabetics (11.4%), which may be due to maternal health education programs. These differences were found statistically significant with p value <0.05.

Table 2: Knowledge Regarding Risk Factors for Diabetes among Diabetic and Non-Diabetic Participants (n = 87 and 241)

Risk Factor	Diabetics (%)	95% Confidence Interval	Non-Diabetics (%)	95% Confidence Interval	p-value (χ^2 test)
Sedentary lifestyle	54.0	43.5 – 64.5	16.5	11.8 – 21.2	< 0.001
Unhealthy diet	86.2	78.9 – 93.5	23.6	18.3 – 28.9	< 0.001
Central obesity	86.2	78.9 – 93.5	22.4	17.1 – 27.7	< 0.001
Family history	54.0	43.5 – 64.5	54.0	47.7 – 60.3	0.96
Increasing age	40.0	29.7 – 50.3	40.0	33.8 – 46.2	0.98
Gestational diabetes	11.4	4.7 – 18.1	37.3	31.2 – 43.4	< 0.001

Table 3: About 33.2% of the study participants were unaware of early signs of diabetics. Among Diabetics 93.1% were aware of symptoms like frequent urination, thirst, and fatigue, compared to 57.3% of non-diabetics, which was found statistically significant with p value < 0.05. (Table 2). Awareness of complications was high among diabetics (87.4%) but very low in non-diabetics (15.5%), so only 34.5% of the total population recognized complications, highlighting the need for health education and this was found statistically significant (p value < 0.05).

Table 3: Knowledge regarding Symptoms and Complications of Diabetes among the study population

	Symptoms		Complications		Total
	Yes	No	Yes	No	
Diabetics	81 (93.1%)	06 (6.9%)	76 (87.4%)	11 (12.6%)	87 (100)

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Non diabetics	138 (57.3%)	103 (42.7%)	37 (15.5%)	204 (84.6%)	241(100)
Total	219 (66.8%)	109 (33.2%)	113 (34.5%)	215 (65.5%)	328 (100)

Symptoms: χ² =36.897, df=1, p=<0.0001. Complications: χ² =146.3106, df=1, p=<0.0001

Table 4: Among diabetics, 43% adhered to regular treatment while 58% were irregular, increasing risks of progression and complications. Just 10.3% practiced self-monitoring of blood glucose, with 89.7% relying solely on clinic visits. Most were treated with oral hypoglycemics (92%), while 7% used insulin and 1% managed with diet/exercise alone, indicating limited insulin use. Out-of-pocket expenses were reported by 63%, while 37% received free government care. Monthly costs were <₹500 for 84%, but ~16% spent more, including 4.6% up to ₹5000, reflecting disparities probably linked to complications or advanced treatment.

Table 4: Practice among Diabetics

PRACTICES	No. (%)	95 % CI
Treatment adherence		
Yes	37 (43)	32.4 – 53.6
No	50 (58)	46.4 – 67.6
Self-Monitoring of Blood Glucose		
Yes	09 (10)	4.6 – 17.9
No	78 (90)	82.1 – 95.4
Management		
Insulin	06 (7)	2.8 – 14.7
Oral Hypo Glycaemic (OHA)	80 (92)	85.3 – 97.2
Diet and Physical Activity	01 (1)	0.0 – 5.6
Out of pocket expenditure		
No	32 (37)	26.3 – 48.0
Yes	57 (63)	52.0 – 73.7
Average Cost spent per month for medicines (in Rs)		
<500	73 (89)	80.1 – 94.9
501-1000	08 (09)	4.0 – 16.0
1500-5000	02 (02)	0.2 – 7.0
>5000	04 (05)	1.4 – 12.4

Figure 2: Highlights that the most common reason for out-of-pocket expenditure is inaccessibility of health facilities (40%), followed by lack of belief in free treatment (36.4%), while non-availability of drugs (23.7%) is a comparatively smaller but still important factor.
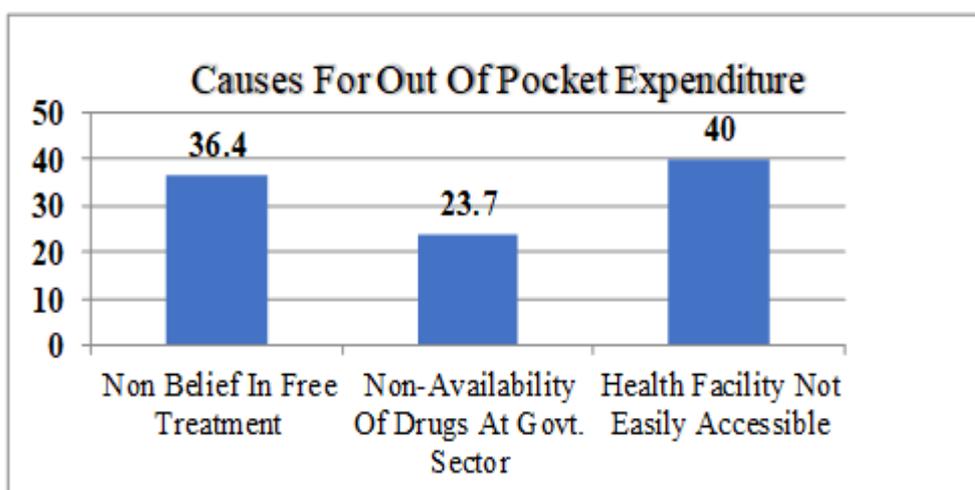
Figure 2: Causes for Out-of-pocket expenses among diabetics.

Table 5. Association between Treatment Adherence and Knowledge on Risk Factors among Diabetic Participants (n = 87)

Treatment adherence	Awareness-Yes		Awareness-No		Total(n)
	No. (%)	95 % Confidence Interval	No. (%)	95 % Confidence Interval	
Regular	34 (91.9)	82.8 – 100	3 (8.1)	0.0 – 17.2	37 (100)
Irregular	42 (84.0)	73.7 – 94.3	8 (16.0)	5.7 – 26.3	50 (100)
Total	76 (87.4)	80.4 – 94.4	11(12.6)	5.6 – 19.6	87 (100)

$\chi^2 = 1.1853$, df = 1, p = 0.27

Table 5: Although participants on regular treatment showed higher awareness (91.9%) compared to those with irregular treatment (84%), this difference was not statistically significant (p > 0.05). The association could be better assessed by analytical studies.

Knowledge regarding screening among non-diabetics

In non-diabetics, only 27.8% were aware of screening for diabetes, while 72.2% were not. This low awareness level in the general population poses a challenge for early detection efforts.

Despite this low awareness, 51.9% of non-diabetics reported having had blood sugar examined at least once, while 48.1% had never been tested. This may indicate opportunistic testing during medical visits, but it also shows that nearly half the population has never been screened

Awareness and Risk Among Non-Diabetics

Regarding awareness, although 51.9% had undergone blood sugar testing at least once, only 27.8% were aware of diabetes screening.

Risk assessment among non-diabetic participants revealed that 56% were obese, making obesity the most significant risk factor. Other notable factors included family history of diabetes (14.5%), hypertension (11.2%), past gestational diabetes (2.9%), sedentary lifestyle (2.1%), and cardiac issues (0.8%), while only 12.4% had no identifiable risk factors.

About one-fourth (24.5%) of non-diabetics reported symptoms suggestive of hyperglycemia, most commonly blurring of vision (11.6%), followed by increased thirst (2.9%) and appetite (2%). The findings indicate that a substantial proportion of non-diabetic individuals may be at risk of developing diabetes or have undiagnosed prediabetes, underscoring the need for systematic community-based screening.

DISCUSSION

In the present study, the prevalence of diabetes was found to be 26.5%. In Haryana, the ICMR–INDIAB study reported a diabetes prevalence of 15.1% in urban areas and 8.1% in rural areas, highlighting a substantial urban–rural disparity in disease burden. This upward trend is largely attributed to changes in lifestyle, improved living standards, increasing migration, and rapid urbanization. [11] According to previous literatures, the prevalence of diabetes in rural India has risen sharply—from just 2.4% in 1972 to approximately 15.0% between 2015 and 2019. [12,13] Recent community-based studies from rural areas of Western Uttar Pradesh have reported a prevalence of type 2 diabetes ranging from 8% to 16.6%, which is higher than earlier estimates. [14,15]

In this study, the prevalence of diabetes has increased with age, 5.9% among those aged 20–35 years to 31.8% in the 66-80 years age group, upholding findings from similar community-based studies that have established age as a key non-modifiable risk factor for type 2 diabetes. This is similar to a study by Sekher TV et al. which showed gradual rise in prevalence of Diabetes with advanced aging.[16]

The prevalence of diabetes was significantly higher among females (28.6%) compared to males (23.8%), in contrast to findings from

other rural studies. This pattern may reflect limited access to early screening and healthcare services for women in rural Indian settings.[17]

Lower educational attainment was associated with higher diabetes prevalence which was 34.4% among illiterates and 37.5% among those with higher primary education, suggesting that education may influence awareness and health behaviours. This is consistent with findings from a study wherein the awareness and health-seeking behaviours improve with increasing education and socioeconomic status.[18]

Occupationally, diabetes prevalence was highest among farmers (81%), followed by the unemployed (40 %) and those in government jobs (37.5 %). A large-scale study in rural South India reported diabetes prevalence of 15.0% among farming individuals compared with 8.7% among non-farming individuals, highlighting the potential role of occupational exposures such as agrochemicals and mechanised agriculture in elevating risk.[19]

Knowledge of Risk Factors for Diabetes Among Diabetic and Non-Diabetic Participants

Diabetics in the present study showed better awareness of modifiable risk factors like unhealthy diet (86.2%) and sedentary lifestyle (54%) compared to non-diabetics (23.6% and 16.5%). However, awareness of non-modifiable factors such as family history and age was similar in both groups, while non-diabetics had statistically significant awareness of gestational diabetes compared to diabetics (37.3% vs. 11.4%). In the survey conducted by Deepa M et al. (ICMR-INDIAB-4), Overall urban residents had higher awareness rates (58.4%) compared to rural residents (36.8%) .Knowledge of specific risk factors remained limited—overweight or obesity (29.2%), family history (13.1%), hypertension (18.1%), and physical inactivity (10.8%) Compared to these national rural estimates, participants in the present study displayed substantially higher

recognition of lifestyle-related risks, suggesting a gradual improvement in diabetes awareness in rural populations, possibly due to expanding community-based health initiatives. The knowledge on risk factors for diabetes was better among the known diabetic subjects [overweight (50.4%), family history of diabetes (28.3%), high blood pressure (35.6%), lack of physical activity (22.9%) and mental stress (23.5%)] similar to present study findings with respect to physical activity.[20]

Knowledge of Symptoms and Complications among Diabetic and Non-Diabetic Participants

In the present study, almost 93.1% of the diabetics had awareness regarding symptoms and could identify signs such as polyuria, fatigue, and polydipsia, while 87.4% were aware of complications such as kidney failure and cardiovascular disease. However, among non-diabetics, awareness was significantly lower—57.3% for symptoms and only 15.5% for complications. Overall, 33.2% of the study population lacked symptom awareness, and 65.5% were unaware of complications. Awareness and self-care practices regarding diabetes remain suboptimal among individuals with type 2 diabetes in rural areas, which is supported by a study conducted in Sullia, Karnataka, where only one-fourth of the study population had a good knowledge toward diabetes and foot care was the most neglected area among the self-care practices.[10] Hence, improving knowledge and self-care practices could potentially enhance early diagnosis and prevention efforts. In a study conducted in rural areas of Anandpur Sahib, Punjab, Kumari and Sidhu (2020) reported that less than half (45%) of the individuals with diabetes were aware of their condition, underscoring the low level of awareness among rural populations.[21]

Practices Among Diabetics

Adherence to regular follow-up was suboptimal, with only 43% of diabetic

participants demonstrating consistent treatment compliance. Self-monitoring of blood glucose was practiced by just 10.3%, indicating heavy dependence on clinic-based testing. Participants on regular treatment showed higher awareness (91.9%) compared to those with irregular treatment (84%), though this difference was not statistically significant. The majority of patients (92%) were managed with oral hypoglycaemic agents, while 7% required insulin therapy.

Pattnaik et al. reported a comparatively higher treatment adherence rate of 90.3%, with the most common reasons for noncompliance being the asymptomatic nature of the disease (60%) and the high cost of treatment (33.3%).[22] Similarly, Padmanabha *et al.* observed that approximately 60% of rural patients adhered to their prescribed therapy.[23]

Economic Burden
Out-of-pocket expenditure was borne by 63.2% of diabetics, despite the availability of free government services. The majority (83.9%) spent less than ₹500/month, reflecting affordable drug regimens, but 4.6% spent as much as ₹5000/month, likely due to complications or insulin therapy. Inaccessibility of health facilities (40%) and disbelief in free treatment (36.4%) were major reasons for private expenditure. Similarly, a study from southern India reported that excess direct costs of diabetes in rural settings (₹15,576) were comparable to those incurred by private clinic attendees (₹19,552), even though the income levels of rural participants were more similar to those attending government clinics.[24]

Limitation: This study was a cross-sectional study based on self-reported awareness and practices, so causal inferences cannot be established. Recall bias and under-reporting may have affected participant responses. Additionally, as the study was conducted among villages under a single Primary Health Centre (PHC), the findings may not be generalizable to the entire Hassan district.

CONCLUSION
The present study demonstrated a considerably high prevalence of diabetes (26.5%) among rural adults in the study area, showing an increasing trend with advancing age, lower education, and certain occupations such as farming. Awareness differed markedly between diabetics and non-diabetics—while most diabetics recognized symptoms and complications, a large proportion of non-diabetics lacked knowledge of risk factors and screening, underscoring the need for strengthened community health education.

Although awareness of modifiable risk factors like unhealthy diet and obesity was relatively good among diabetics, treatment adherence and self-monitoring practices were inadequate. The lack of a significant association between knowledge and adherence indicates that awareness alone is insufficient without behavioural and healthcare support.

High out-of-pocket expenditure further highlights gaps in accessibility and trust in public health services. Strengthening community-based diabetes education, regular screening, and adherence-support programs through primary care can greatly enhance early detection and effective management in rural population.

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