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A Study to Assess Prevalence of Type 2 Diabetes Mellitus and Its Associated Risk Factors in Rural Community of Gwalior District

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Abstract: ***Background**: Type 2 diabetes mellitus is a chronic, debilitating disease characterized by insulin resistance, impaired insulin secretion and hyperglycemia. It represents more than 90% of total prevalence of diabetes in the world and is responsible for 9% of the global mortality corresponding to four million deaths per year. The objective of the study was to assess the prevalence of diabetes mellitus type - 2 in a rural population of age 30 years and above. **Methods**: A community based cross sectional study carried out in population 30 years and above in rural area of Gwalior district in Madhya Pradesh, during the study period from 1st May 2023 to 30th April 2024. A total of 250 sample aged 30 years or more were included in study. **Results**: This study, conducted on 250 individuals, revealed an overall prevalence of diabetes mellitus of 14.8%, with 20% of the population showing impaired fasting glucose. A notable finding was the significant association between family history of diabetes and its prevalence. Individuals with a family history of diabetes had a significantly higher prevalence of diabetes (29.7%) and impaired glucose (14.1%) compared to those without a family history, where the prevalence was 9.7% and 22%, respectively (P < 0.001). **Conclusion**: Focus on Individuals with a Positive Family History: Public health initiatives should prioritize early screening and lifestyle counselling for individuals. Age - Based Interventions: Since diabetes prevalence increases with age, particularly in individuals aged 40 and above, targeted health programs for middle - aged and older adults should be implemented.*

Keywords: Diabetes mellitus, Risk factors, BMI, Hypertension

1. Introduction

Diabetes mellitus, also known as DM, is a chronic metabolic condition distinguished by high levels of sugar in the blood due to problems with insulin secretion, insulin function, or both[1]. This long - standing elevated blood sugar can lead to various complications affecting both small and large blood vessels[2]. The prevalence of diabetes mellitus is widespread globally, with a higher incidence, particularly of type 2 diabetes, observed in both developing and developed nations[3].

The International Diabetes Federation (IDF) anticipates a significant rise in the number of individuals affected by type 2 diabetes mellitus (T2DM) worldwide, with a projected increase to 552 million by the year 2030, more than double the count in 2000. A substantial portion of these new cases, approximately 21%, is expected to arise in India, which currently holds the record for the highest number of diabetes cases among all countries[4].

Presently, India is home to around 61.3 million diabetic individuals, a number that is estimated to surge to 103 million by 2030[5], Various research studies conducted across different regions of India indicate a rising prevalence of type 2 diabetes from 8.2% in urban areas and 2.4% in rural areas during 1992 to 18.6% and 9.2% respectively in 2008[6].

The rapid urbanization and nutritional shifts witnessed in South Asian countries have contributed to an increased occurrence of diabetes in recent times. Moreover, the South Asian phenotype is characterized by a tendency to accumulate fat centrally on a small body frame, often termed as thin - fat or metabolically obese - normal weight[4]. This particular genetic makeup is further exacerbated by the prevalent obesogenic environment[8]. Over 60% of the global diabetic population resides in Asian countries[9].

India exhibiting a growth rate of 12.5% and 20% of the world's inhabitants at a heightened risk of diabetes in urban settings. The prevalence of diabetes in India is forecasted to climb from 8.8% in 2017 to 11.4% by the year 2045. Alarmingly, a significant portion, approximately 60%, of individuals with diabetes remain undiagnosed within the South - East Asian population[10].

The surge in diabetes cases observed in developing nations is closely linked to factors such as industrialization, urbanization, and socioeconomic progress, underscoring the influence of not only genetic components but also environmental aspects like lifestyle and quality of life[11]. A sedentary lifestyle is also recognized as a significant contributor to the development of type 2 diabetes mellitus[12].

2. Aims & Objectives

1) To determine the prevalence of Diabetes Mellitus type - 2 in a rural population.
2) To assess the Socio - demographic profile of study population.
3) To study the association of various risk factors with Diabetes Mellitus type - 2 in the study population.

4) Based on the study to recommend measures for the prevention and control of type 2 Diabetes Mellitus.

3. Material & Methods

The study entitled "A cross - sectional study to assess prevalence of type 2 Diabetes Mellitus and Impaired glucose and it's associated non - modified risk factors in rural community of Gwalior District": A Cross - Sectional Study" was carried out as below:

Place of study: The study was designed in the Department of Community Medicine/PSM, Gajra Raja Medical College, Gwalior. It was carried out in rural area in Gwalior District of Madhya Pradesh.

Period of study: The present study was carried out over a period of 12 months from 1st May 2023 to 30th April 2024.

Sample Calculation: In the present study sampling procedure has been calculated as follow -
By reference document analysis, titled: From the study of S. K. Subramani, Dhananjay Yadav et. al. (2019) [1] Prevalence of type 2 Diabetes and Pre - diabetes in the Gwalior – Chambal Region of Central India was 11.4%.

The formula for calculating sample size:
$\mathbf{N = z^2\alpha_{/2} \times p \times q / d^2}$
where, $z^2_{\alpha/2}$ is constant taken as 1.96 in this calculation,
Z = 1.96 considering (i. e., 1.96 for 95% confidence interval)
'p' = 11.4% (prevalence in the base study)
q is (100 - p) = (100 - 11.4) = 88.6
d is absolute error = 4 %

In our study,
N = $(1.96)^2 \times 11.4 \times 88.6 = 243$
$(4)^2$
The sample size was calculated by formula was around 243. So round off figure sample size of **250.**

Ethical Consideration
The study received ethical clearance from the Institutional Ethical Committee of Gajra Raja Medical College, Gwalior (M. P.).

Inclusion Criteria
1) The study Participants above 30 years of age.
2) Participants constantly residing in last 5 year in rural community.
3) Participants willing to participate in the study after informed consent.

Exclusion Criteria
1) Participants diagnosed with diabetes under 30 years of age.
2) Critically ill.
3) Family not present at the time of visit.
4) Participants not given their consent to participate in the study.

Study Procedure
All the 4 rural blocks of Gwalior Districts were listed and 2 blocks were selected randomly. Five villages were then chosen from each block using the lottery method. In each village, the panchayat center was taken as a reference, and households were surveyed in all four directions (North, South, East, and West). A semi - structured questionnaire was used to assess blood glucose levels. One eligible participant per house was tested. If a house was locked or no eligible participant was available, the next house was surveyed. A total of 25 samples were collected from each village.

Table 1: The WHO recommendations for the diagnostic criteria for diabetes (2019)

Measurement	Diagnostic cut - off value
Fasting venous or capillary* plasma glucose	≥7.0mmol/L (126mg/dL)
2 - hours post - load venous plasma glucose	≥11.1mmol/L (200mg/dL)
2 - hour post - load capillary plasma glucose	≥12.2mmol/L (220mg/dL)
Random plasma glucose	≥11.1mmol/L (200mg/dL)
HbA1c	6.5% (48mmol/mol)

Data Analysis
The completed questionnaire was sorted and entered into Microsoft 2019 excel package and version 2.3.28 of the Jamovi with chai - square test for analysis. Descriptive statistics on the sample characteristics and questionnaire items were computed.

4. Result

In the present study the Socio - demographic characteristics of the 250 respondents to the survey, the overall prevalence of type 2 diabetes in this study was 14.8%. The respondent sample was males 114 (45.6%), and female 136 (54.4%). Diabetes prevalence increased from 40 years, peaking at 18.9% in 51 - 60 years, then declined.

Diabetes prevalence across various educational levels and occupational categories were not statistically significant. However, a significant association was observed between socioeconomic status and diabetes prevalence. The study results Diabetes (29.7%) and impaired glucose (14.1%) were higher in those with a family history (P < 0.001).

Diabetics had co - morbidities (24.3%), including hypertension (16.2%) and high cholesterol (13.5%) (P < 0.001). Studies found a significant link between diabetes

Table 2: Distribution of study participants according to Socio - demographic status (n= 250)

Variables		Frequency (n)	Percentage (%)
Gender	Male	114	45.6
	Female	136	54.4
Age groups	30 - 40 years	21	8.4
	41 - 50 years	46	18.4
	51 - 60 years	90	36
	>60 years	93	37.2
Education	Illiterate	76	30.4
	Primary School	104	41.6
	Middle School	30	12
	High School	21	8.4
	Intermediate	13	5.2
	Graduate/Post Graduate	6	2.4

Occupation	Unemployed	26	10.4
	Farmer/ Labor	78	31.2
	Skilled/ Semi - Skilled Worker/ Government job	36	14.4
	Household worker/Shopkeepers	110	44
Socio-economic status	I Upper Class	11	4.4
	II Upper Middle C lass	19	7.6
	III Middle Class	92	36.8
	IV Lower Middle Class	123	49.2
	V Lower Class	5	2

Table 3: Showing Prevalence of type 2 Diabetes Mellitus in the study population (n=250)

S. no.	Study participants	Frequency	Prevalence (%)
1.	Normal	163	65.2
2.	Pre - Diabetes	50	20
3.	Diabetes	37	14.8
4.	Total	250	100

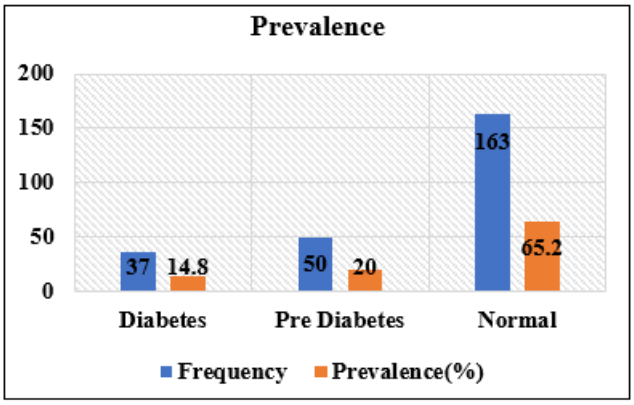

Figure 1: Distribution of study participants according to Prevalence of type 2 Diabetes Mellitus and impaired glucose.

Table 4: Distribution of study participants association with Risk factors and diabetes mellitus and Impaired Glucose

Variable	Sex	Diabetes	Impaired glucose	Normal	Total	P value
Gender	Female	18	29	89	136	0.685
	Male	19	21	74	114	
Age group	30 - 40	2	2	17	21	0.266
	41 - 50	6	13	27	46	
	51 - 60	17	13	60	90	
	>60	12	22	59	93	
Family history	No	18	41	127	186	<0.001*
	Yes	19	9	36	64	
Education	Graduate/post graduate	2	0	4	6	0.851
	Intermediate	2	3	8	13	
	High school	3	5	13	21	
	Middle school	5	3	22	30	
	Primary school	14	21	69	104	
	Illiterate	11	18	47	76	
Occupation	Farmer/ Labor	11	13	54	78	0.567
	Shopkeeper/household worker	14	23	73	110	
	Skilled/ Semi - Skilled Worker/ Government job/ Clerk	9	8	19	36	
	Unemployed	3	6	17	26	
Socio - economic status	Lower class	0	2	3	5	0.024*
	Lower middle class	12	31	80	123	
	Middle class	17	13	62	92	
	Upper class	2	4	5	11	
	Upper middle class	6	0	13	19	
Dietary pattern	Mixed vegetarian	22	18	41	81	**0.001***
	Vegetarian	15	32	122	169	
Amount of Oil Consumption	<2L/M	0	1	6	7	**0.004***
	2 - 3L/M	0	3	16	19	
	3 - 4L/M	28	42	133	203	
	>5L/M	9	4	8	21	
Adequate Sleeping	Yes	27	41	150	218	**0.003***
	No	10	9	13	32	
BMI	Normal	7	24	96	127	**0.001***
	Obese	18	17	24	59	
	Overweight	12	9	43	64	
Waist Circumference	High	16	11	38	65	0.034*
	Normal	21	39	125	185	
Physical Activity	Heavy	1	3	15	19	0.041*
	Moderate	11	27	81	119	
	Sedentary	25	20	67	112	
Duration of physical activity	30 mins	20	19	47	86	**0.087**
	30 - 60 mins	9	23	74	106	
	60 - 90 mins	6	5	28	39	
	>120 mins	2	3	14	19	
Smoking status	No	16	19	132	167	**0.001***

	Yes	21	31	31	83	
Alcohol status	No	20	25	118	163	**0.004***
	Yes	17	25	45	87	
Smokeless tobacco	No	23	30	103	156	**0.920**
	Yes	14	20	60	94	
Co - morbidity	No Abnormality	6	8	68	82	**0.005***
	Arthritis	4	6	25	35	
	COPD/Asthma	7	9	22	38	
	Central nervous system disease	4	5	10	19	
	Metabolic disease	16	22	38	76	

* Statistically significant associations (P<0.05)

5. Discussion

The overall prevalence of type 2 diabetes in this study was 14.8%. **Subramani S. K. et al. (2019)** [1] reported 11.4% in the Gwalior - Chambal region, possibly lower due to a younger age group. **Khan M. S. et al. (2016)** [13] found 15.2% in the urban population (≥30 years) in Bareilly**. M. T. et al. (2023)** [12] reported 11.9% among professional male drivers in Tamil Nadu.

Most participants were aged ≥60 years (37.2%), followed by 51 - 60 years (36%). Diabetes prevalence increased from 40 years, peaking at 18.9% in 51 - 60 years, then declined. The chi - square test showed no significant association. **Khan M. S. et al. (2016)** [13] found peak prevalence in 60 - 69 years (25.5%), followed by 50 - 59 years (20.5%). **Sachan N et al. (2021)** [14] reported most subjects in 50 - 59 years (40.5%), followed by 40 - 49 years.

The study found most participants had primary education (41.6%), followed by illiterate (30.4%) with no significant association (P = 0.851). Similar studies reported varying distributions**: Tripura K et al. (2019)** [17] - primary (30.3%), secondary (31.5%); **M. T. et al. (2023)** [12] secondary (65.3%), primary (11.0%), no education (5.1%).

Most participants were household workers (44%), followed by farmers/laborers (31.2%). **Subramani S. K. et al. (2019)** reported 38.6% household workers, 38.2% laborers, 11.8% office workers. **Syed Jawwad Ali Hashmi et al. (2017)** [16] found housewives (68), laborers (43), unemployed (31). Diabetes showed no significant occupational difference.

The study found most of the Diabetes was highest in the upper middle class (31.6%), with a significant association (P = 0.024)**). Khan M. S. et al. (2016)** [13] reported similar diabetes prevalence in class I (21.0%) and II (21.3%), followed by class III (16.3%) (P = 0.04). **Sachan N et al. (2021)** [14] found 61.4% in lower middle class, followed by middle class.

The study results Diabetes (29.7%) and impaired glucose (14.1%) were higher in those with a family history (P < 0.001). Similar studies found **Hetal K. Rathod, et al. (2014), Tripura K et al. (2019)** [17] revealed a significant association (p value 0.00).

The study found that a sedentary lifestyle showed high diabetes prevalence (22.3%) and fewer non - diabetics (59.8%, P = 0.041). Similar studies found significant associations. **Syed Jawwad Ali Hashmi et al. (2017)** [16]found IGT (53.1%) and diabetes (16.3%) in sedentary individuals. **K. Nithesh et al. (2018)** [15] reported a strong association between physical activity and diabetes.

The study Results showed the Obese individuals had higher diabetes (30.5%) and impaired glucose (28.8%), with a significant BMI association (P < 0.001 **K. Nithesh et al. (2018)** [15] and **Syed Jawwad Ali Hashmi et al. (2017)** [16]also found a significant link (P = 0.001).

The study results showed that High waist individuals had higher diabetes (24.6%) and impaired glucose (16.9%) (P = 0.034). Other studies also found a significant association **M. T. et al. (2023)** [12] (P = 0.004, **Tripura K et al. (2019)** [17] P = 0.60).

The study results showed Among Smokers had diabetes (25.4%), impaired glucose (37.3%), and non - diabetic (37.3%) with a significant difference (P < 0.001). Other studies also found a strong association **M. T. et al. (2023)** [12] (P = 0.002). **Subramani S. K. et al. (2019)** [1] In the rural population, smoking showed a positive association with a high prevalence of diabetes.

The study results showed that alcoholic had higher diabetes (19.5%) and impaired glucose (28.7%) (P = 0.004). **Tripura K et al. (2019)** [17] found 67.6% alcohol use among diabetics was significant association, while **M. T. et al. (2023)** [12] found no significant association (P = 0.360).

The study results showed that smokeless tobacco use showed no significant association (P = 0.920). **Sachan N et al. (2021)** [14] found 43.5% DMC in users with no significance, while **M. T. et al. (2023)** [12] reported a significant link

Diabetics had co - morbidities (24.3%), including hypertension (16.2%) and high cholesterol (13.5%) (P < 0.001). Studies found a significant link between diabetes and blood pressure. Metabolic disease had the highest diabetes (21.1%) and impaired glucose (28.9%). COPD/Asthma, arthritis, and CNS disease also showed higher glucose impairment. Most people (65.2%) had normal glucose

Other studies also found a strong association **K. Nithesh et al. (2018)** [15] and **Syed Jawwad Ali Hashmi et al. (2017)** [16]. **Sachan N et al. (2021)** [14] found diabetes duration linked to rising complications, with significant associations for CAD (P = 0.001), PVD (P = 0.026), and eye problems (P = 0.001). **Vaibhav et al. (2016)** reported hypertension (52.2%), dyslipidemia (47.8%), and complications like retinopathy (37.1%), neuropathy (27.9%), CAD (23.6%), and nephropathy (7.9%).

6. Conclusion

This study on 250 individuals found a 14.8% diabetes prevalence, with 20% having impaired fasting glucose. A significant link was observed between family history and diabetes. Gender difference was not significant (P = 0.685), with males (51.4%) and females (48.6%) among diabetics. Diabetes prevalence increased from age 40, peaking at 18.9% in the 51–60 age group before declining

The present study examined the impact of education, occupation, and socioeconomic status on the development of diabetes mellitus among 250 individuals. differences in diabetes prevalence across various educational levels and occupational categories were not statistically significant. However, a significant association was observed between socioeconomic status and diabetes prevalence.

This study investigated dietary patterns, Oil consumption, Smoking, and alcohol consumption was also found to be significantly associated with diabetes. A statistically significant association was observed between BMI, Waist circumference, Physical activity, sleep duration and diabetes prevalence (P = <0.05).

7. Recommendations

Public health initiatives should prioritize early screening and lifestyle counselling for individuals with a family history of diabetes. Routine Screening: Introduce or strengthen age - based diabetes screening programs, especially for individuals aged 40 years and older.

Health Education: Launch widespread health education initiatives focusing on the modifiable risk factors for diabetes, using multiple platforms such as schools, workplaces, and healthcare centres. Access to Preventive Care: Ensure access to affordable preventive care, including regular check - ups, nutritional counselling, and fitness resources.

Limitation of the study: All population of rural area of Gwalior district is included so the result may not be generalized to all the population. The sample size was not very large.

Conflicts of Interest: The authors no conflict of interest.

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