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PREVALENCE OF DIABETES MELLITUS AND ITS ASSOCIATION WITH SOCIO-ECONOMIC STATUS, MOOD DISORDERS, AND NEPHROPATHY IN PRAYAGRAJ, UTTAR PRADESH (2021-2022)"

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ABSTRACT

This cross-sectional observational study aimed to evaluate the prevalence of mood disorder, socioeconomic status, and nephropathy among diabetic patients in the rural population of Prayagraj, Uttar Pradesh, India, and to examine the correlation between above mentioned factors and diabetes. A total of 190 diabetic participants (106 males and 84 females) were selected from the outpatient department of a government hospital using a simple random sampling technique. Patients were individually interviewed using a structured questionnaire to assess lifestyle factors, mood disorders and other complications. The prevalence of mood disorder among diabetic patients was 65.6%, which was higher than control 47.69 %. About 16% cases reported diabetic nephropathy and 9.6% patients reported nephropathy along with some mood disorder. Also, preference for non-veg diet was observed in diabetic patients. Additionally, plasma lipid levels were found to be higher in diabetic patients compared to the control group. Conclusively, prevalence of mood disorders is higher and incidence of diabetes is strongly associated with lifestyle and economic status of individuals.

KEYWORDS: Diabetes mellitus, Nephropathy, Lipid profile, Diet, Hb1Ac.

INTRODUCTION

Diabetes Mellitus (DM) prevalence is nowdays on the rise globally and it is expected that about 422 million people are reported to have the condition in 2022.[1] India is also known as the second-largest country after China having largest number of DM Patients (Age group of 20-79 years). Around 75 percent adults with diabetes are from under developed or un developed areas I.e. low-and middle-income countries. Further, it is stated that patients with type 2 diabetes can have a far lower quality life, disability and even death ahead, and the diabetic nephropathy, after age and sex, have a role in the rate of depression.[2]

The major impacts of high blood glucose (Sugar) levels includes weight loss, polydipsia (Increased thirst), polyphagia (Increased hunger), and polyuria (Frequent urination).[3] Diabetes is generally associated with several complications like nephropathy dysfunction, cardiovascular disease, neuropathy, retinopathy and stroke, and there is evidence that about 1.5 million deaths per year, worldwide, have been directly associated with diabetes.[4] Type 2 diabetes mellitus (T2DM) and cognitive impairment are most common prevalent diseases worldwide. in addition it is associated with an increased risk of cognitive disorders such as depression, anxiety, dementia and Alzheimer's disease, but awareness of the link between the two diseases is low andthere are very few recommendations are made to physicians on how to manage cognitive impairment in diabetic patients.[5,6] The prevalence of diabetes with mood disorders increasing as in 2013, there were 40 million people living with dementia worldwide and and it is speculated to cross 110 million in 2050.[7]

Several studies demonstrated association between T2DM, insulin resistance and cognitive decline. Moreover, T2DM is associated with moderate impairments in cognitive function, particularly verbal memory, information processing speed, and executive function. These connections between diabetes and cognitive function are well established in various large grouptrials. In 2013, a study on 89,708 patients deduced that there are 56% more risk of Alzheimer's disease in diabetic patients as compared to non-diabetic patients.[8] In another meta-analysis in 2015, on diabetic (6184) and non-diabetic (38530), the aggregative relative risk for cognitive disorder for daibetic patients was 1.5.[9] The

role of mitochondrial dysfunction also enhances the production of inflammatory cytokines causing mitochondrial damage due to over production of nitric oxide.[10]

Any chronic disease can be very debilitating and costly, and it can cause many problems for the patient for years that affect the patient's daily life and mood. These mood disorders, such as depression, can reveal itself more in patients who have complications. Depression is a mood disorder that reveals itself with symptoms such as low mood, loss of pleasure and interest, weight loss, insomnia, exhaustion, emptiness, guilty, and inability to concentrate and death-related thoughts.[11]

Thus, considering complications of mood disorders and nephropathy, following study was performed to study the factors affecting the prevalence of diabetes mellitus.

Aim of the study

The objective of present study was to determine the prevalence of diabetes mellitus and its correlation with conditions like mood disorders and nephropathy in rural population of Prayagraj.

MATERIAL AND METHODS

The studied variables in patients included age, sex, body mass index (BMI), medication, education nephropathy, marital status, hemoglobin A1c (HbA1c), triglyceride, low-density lipoprotein (LDL) and high-density lipoprotein (HDL), blood pressure, fasting blood sugar and post-prandial blood sugar, which the correlation between the above variables and the probability of mood disorder in patients was evaluated.

Duration: The survey was done during the post-covid period of December 2021 to December 2022.

Setting: The cross-sectional observational study was performed on selected patients visting the out-patient department of government hospital Prayagraj with permission from the administration. Patients were selected on the basis of inclusion and extrusion criteria. The information were collected by interviewing patients and from their blood exixting reports. No intervention was performed only data was collected from well informed patients. Informed consent was obtained from the participants forthe test. Confidentiality regarding the patients and theirpersonal details were strictly maintained. The patients who satisfied the inclusion criteria were assessed fordepression and diabetes distre.

Study Design and Subject distribution

The study involves two groups

- **Group 1 (Control Group)** Glycosylated haemoglobin (HbA1c) < 6.5 %**:** 65 subjects.
- **Group 2 (Type 2 Diabetic Patients) with** HbA1c > 6.5 %**:** 125 subjects.

This provides a substantial dataset to analyze various factors influencing diabetic patients compared to non-diabetic controls.

Inclusion criteria

- Age: 25 to 75 years, both male and female
- Newly diagnosed type 2 diabetes mellitus patients.
- Fasting plasma glucose >126 mg/dl (7.0 mmol/L).
- Post-prandial plasma sugar >200 mg/dl (11.1 mmol/L).

Exclusion criteria

- Individual with Type I diabetes.
- Patients with serious illness including cardiac issues, tuberculosis, rheumatoid arthritis, skeletal muscle injury and HIV infection.
- Smokers/ alcoholics.
- Pregnant women

Assessments and Data collection

The data were collected from the already existing blood reports of patients. No any intervention was performed on the patients. A organized survey was utilized to gather socio-demographic data, counting age, sex, conjugal status, instruction level, occupation, and history of current smoking and/or liquor utilize. Also, information were assembled on the type and term of diabetes, current pharmacological medicines, and whether the members were experiencing treatment for depression. Members were inquired to list all medicines they used on a chronic basis, and the data given was confirmed against their hospital therapeutic records. Interviews were conducted by clinicians on obligation within the diabetes out-patient department. BMI was interpreted using standard weight status categories. These categories are the same for men and women of all body types and ages. BMI was recorded as weight divided by square of height (kg/m2).[12] For adults, current guidelines from the US Centers for Disease Control and Prevention (CDC) and the WHO in 2015 defined a normal BMI range as 18.5 to 24.9, whereas a BMI $\geq$ 25 kg/m2 is considered to be overweight, and a BMI $\geq$ 30 kg/m2 is classified as obese, with severe obesity defined as a BMI $\geq$ 40 kg/m2.[13]

Economic status of patients were studied and classified as given in Table 1.[14]

All participants were diagnosed with a mood disorder based on their previous history, questionnaire and interviewed by clinicians as suggested by Manning et al., 1999.[15]

Statistical analysis

Collected data was analysed and checked using SSPS ver. 21.0 software. Chi square test was used to study the correlation between various variables. Inferential statistical tests like chi square test, Pearson's correlation was applied. Data was interpreted statistically significant at $p<0.05$.

RESULTS

Diabetic patients show significantly higher HbA1c levels across all age ranges compared to controls. This is indicative of poor blood glucose control in diabetic patients. Higher HbA1c levels in diabetic patients across all age groups suggest inadequate glucose management, requiring better intervention strategies. Diabetic patients with Hb1Ac > 6.5, were selected as diabetic cases. A total of 190 patients (106 male and 84 females) were included in the survey. Table no 1 illustrates summary of patients demographic and socioeconomic status data of patients. It represents basic information gathered from patients from questionnaire form.

Table 1: Demographic and Socioeconomic data distribution of patients.

Category	Sub category	Cases	Control	Total	P value
Age	25-35	16	8	24	0.618
	36-45	25	12	37	
	46-55	37	11	48	
	56-65	28	18	46	
	66-75	19	16	35	
Sex	Male	66	40	106	0.249
	Female	59	25	84	
Education	Primary school	32	22	54	0.529
	HSC	27	17	44	
	SSC	26	12	38	
	Diploma or Graduation	23	8	31	
	Post Graduation	17	6	23	
Occupation	Unemployed	19	12	31	0.853
	Business	16	7	23	
	Farmer	35	15	50	
	Gov. job	11	5	16	
	Pvt. job	20	9	29	
	House wife	9	17	26	
Income per years	<1 Lakh (I)	20	6	26	0.546
	1-4 lakh (II)	37	23	60	
	4-7 lakh (III)	35	15	50	
	7-10 lakhs (IV)	27	16	11	
	>10 lakhs above (V)	6	5	26	
Religion	Hindu	91	47	138	0.942
	Muslim	34	18	52	
Marital status	Married	69	38	107	0.667
	Unmarried	56	27	83	

1. Age distribution of patients participated in the study

Age distribution of total subjects patients from age of 25-75 were selected for the study and were divided into 5 groups as shown in the Figure 1.

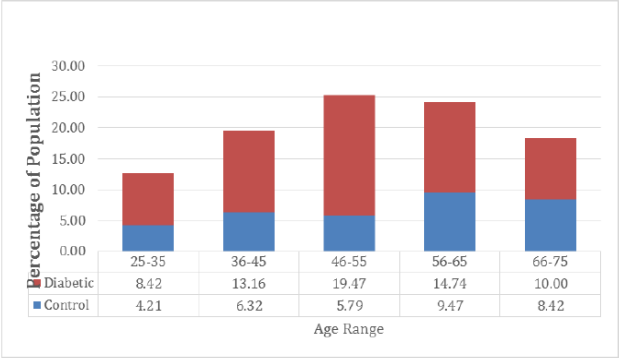

Figure 1: Bar graphs showing age group distribution of subjects included in the study.

Age distribution as shown in the Fig. 1, demonstrates higher percentage (25 %) of the subjects studied were falling in the age group of 46-55, and lowest percentage (12.63%) in the younger age group of 25-35 years old. These results can also be correlated with the fact that younger generations are relatively healthy and frequency of diabetic cases are less as compared to the older patients. Therefore, the patients above 46 plus age group are considered at more risk for development of diabetes.

2. Effect of Age on HbA1c Levels

Table 2: Data showing control and diabetic patients.

Age range	Control	Patients with > 6.5 HbA1c	Prevalence (%)
25-35	8	16	12.8
36-45	12	25	20
46-55	11	37	29.6
56-65	18	28	22.4
66-75	16	19	15.2
Total	65	125	

Diabetic patients showed significantly higher HbA1c levels across all age ranges compared to controls. This is indicative of poor blood glucose control in diabetic patients. Higher HbA1c levels in diabetic patients across all age groups suggest inadequate glucose management, requiring better intervention strategies.

3. Socioeconomic Status

Table 3: Prevalence of diabetes based on economic status of diabetic patients

Classes	Diabetics	Prevalence (%)
I	20	16
II	37	29.6
III	35	28
IV	27	21.6
V	6	4.8

Table 3 demonstrates diabetes prevalence is higher in lower economic classes (I and II) compared to higher classes (IV and V). Further, the prevalence of diabetes is 16 % in class I of economic classification. The prevalence increases to 29.6 % in class II. There is further decline in prevalence to 28 % in class III, 21.6 in class IV and 4.8 in class V. Thus, middle class individuals showed highest prevalence as compared to lowest and highest income group (16).

4. Effect of food habits

Table 4: Effect of diet on diabetes status of patients.

Food habit	Control	Diabetics	Chi Square test
Veg	26	54	X2=0.179
Non-veg	39	71	P value= 0.67
Total	65	125	Df=1

At a glance on the table 4 it can be observed that non-veg diet preference is there in case of diabetic patients. The number of non-vegetarian diabetic patients (71 cases) was higher than vegetarians in all age groups. This could imply a dietary influence on the prevalence of diabetes. Dietary habits could play a role in diabetes prevalence, with non-vegetarian diets possibly being more common among diabetic patients. However, chi-square test indicates there is non-significant effect of diet on the cases of diabetic mellitus.

5. Correlation of BMI with diabetes

Table 5: The distribution of control and diabetic patients based on their BMI value.

BMI Category	BMI	Total No.	Control		Diabetic		p value
			No.	%	No.	%	
Under weight	<18.50	35	11	16.9	24	19.2	
Normal weight	18.5-24.99	28	9	13.8	18	14.4	X^2=0.61
Obese class 1	25-29.99	38	15	23.07	24	19.2	P value= 0.96
Obese class 2	30-34.99	52	17	26.1	36	28.8	Df = 4
Obese class 3	>=35-39.99	37	13	20	23	18.4	

Higher BMI categories Obese Class 2 (28.8%) and class 3 (18.4%) shows greater prevalence among diabetic patients (Table 5). The control group has more individuals in the normal weight BMI and underweight categories. Thus, Obesity is strongly correlated with diabetes, highlightingthe need for weight management in diabetes prevention and control. Though a non-significant correlation is there, more extensive data is required to derive statically significant relation between BMI and diabetes in the study.

6. Effect of Diabetes and Lipid Profile

Table 6: Data of diabetic patients with high values of cholesterol, high density lipoprotein (HDL), and low density lipoproteins (LDL).

Age range	High Cholesterol	Prevalence (%)	High LDL	Prevalence (%)	High HDL	Prevalence (%)
25-35	12	9.6	14	11.2	11	8.8
36-45	17	13.6	19	15.2	14	11.2
46-55	19	15.2	17	13.6	21	16.8
56-65	25	20	23	18.4	24	19.2
66-75	15	12	16	12.8	18	14.4
Total	88	70.4	89	71.2	88	70.4

Table 6, elaborates that about more than 70% diabetic patients had high cholesterol, LDL, and HDL levels. Moreover, all these higher lipid profile abnormalities were present across all age ranges, with high prevalence among 56-65 age group (20 % cases). Therefore, Diabetic patients are at a higher risk for lipid profile abnormalities, which could contribute to cardiovascular complications.

7. Effect of Age on Mood Disorders (MD) of diabetics

The prevalence of mood disorder was studies on diabetics patients and non-diabetics was calculated. It can be seen from the table that as the age progresses the prevalence of MD increasing. As in case of 56-75 age group there were 17.6 % prevalence of MD in case of diabetics and 12.3 % in case of non-diabetics.

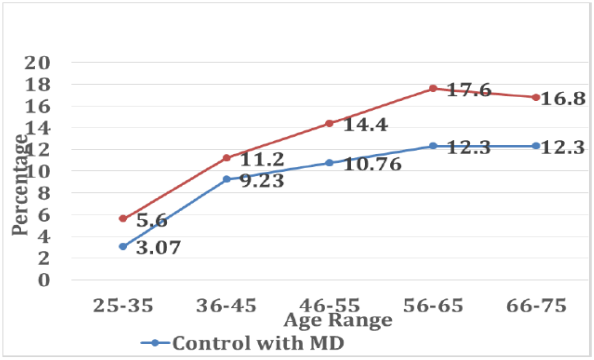

Figure 2: Percentage prevalence of control with mood Disorder and Patients with mood disorder.

The prevalence of mood disorders increases with age in both groups. It was found that there were 47.69% cases of mood disorder in control or non-diabetic patients. The prevalence is higher about 65.6 % in diabetic patients.

8. Correlation effect of nephropathy and mood disorder

Table 7: provides insight into the correlation between diabetic Nephropathy and Mood disorders in diabetic patients.

Condition	Mood Disorder	No Mood Disorder	Total	Chi square test
Nephropathy	12 (9.6%)	8 (6.4%)	20 (16%)	$X^2 = 0.3308$
No Nephropathy	70 (56%)	35 (28%)	105	Df = 1
Total	82	43	125	P value = 0.565

Table 7 demonstrates correction of nephropathy and mood disorder. Out of total diabetic patients 56% individuals had mood disorders alone, 6.4 % Individuals had nephropathy alone, 9.6% individuals had both nephropathy and mood disorders. Also, diabetic nephropathy was observed in 16 % of cases, underscoring its role as a leading cause of end-stage renal disease. The results suggest that patients with diabetic nephropathy are more likely to develop mood disorders and *vice-versa*.

DISCUSSION

This study included 190 participants, assessing their fasting blood sugar levels and evaluating diabetic cases for nephropathy and mood disorders. The overall prevalence of diabetes was found to be 65.78%. The

study observed a direct correlation between BMI and diabetes risk, particularly in men, with a greater risk increment between overweight and obese individuals compared to those of normal weight and overweight. Additionally, the prevalence of mood disorders among diabetics was 20.54%. This finding aligns with other research suggesting that diabetes can significantly impact mental health, potentially due to the chronic nature of the disease, lifestyle changes, and the stress associated with long-term condition management. Abnormalities in insulin signaling and receptor sensitivity in neurons and dendritic processes may contribute to this impact. Several studies have demonstrated a relationship between diabetes and decreased cognitive abilities.[17] It was also noted that elderly non-diabetics with metabolic syndrome and elevated inflammatory markers have an increased risk of mood disorders.[18]

Diabetes is a major risk factor for the onset of neurodegenerative diseases. Glycated proteins produce significantly more reactive oxygen species than non-glycated proteins, and inhibitors of advanced glycosylated end products, antioxidants, and anti-inflammatory substances are used to reduce glycol-oxidation in cases of dementia. These mechanisms indicate a connection between diabetes and elevated inflammatory processes throughout the body.[19]

The significant correlation between nephropathy and mood disorders highlights the compounded risk faced by diabetic patients with complications. Nephropathy, a serious diabetic complication, may worsen mental health issues due to the additional stress and health management challenges it presents.

The results showed that fatigue, insomnia, and anxiety were the most common symptoms among the participants. Medical professionals should adopt an integrated care approach, combining diabetes management with mental health support. Regular mental health screenings should be part of routine care for diabetic patients, especially those with complications like nephropathy. Increasing patient awareness about the potential mental health impacts of diabetes and encouraging proactive mental health care can improve overall outcomes. Further lifestyle management, including diet and weight control, will help manage diabetes and its associated complications.

CONCLUSION

The analysis of the provided data indicated there are increasing prevalence and its associated complications like mood disorder and nephropathy in Prayagraj region of Uttar Pradesh India. Also there were strong association between diabetes and BMI, socio-economic status, food habits, mood disorders and nephropathy which is exacerbated with advancing age. These outcomes clearly reveal that diabetes has ended up as bigger public health issue, therefore strategies aiming anticipation and treatment of diabetes are the need of hour.

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