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A CROSS-SECTIONAL OBSERVATIONAL STUDY ON EFFECT OF DEMOGRAPHIC FACTORS ON PREVALENCE OF DIABETES MELLITUS IN AYODHYA REGION OF UTTAR PRADESH

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ABSTRACT

This study investigated the effects of age, diet, BMI, economic status, and lipid profile on the prevalence of diabetes, alongside examining the prevalence of mood disorders and cardiovascular health as risk factors associated with diabetes. Conducted as a cross-sectional observational study, it focused on the rural population of Ayodhya district, Uttar Pradesh, selecting 205 diabetic participants (109 males and 96 females) from the outpatient department of a government hospital through a simple random sampling technique. Participants were individually interviewed using a structured questionnaire to assess demographic factors, cardiovascular diseases, mood disorders, and other complications. The study found a statistically significant relationship between vegetarian and non-vegetarian food habits and diabetes status. Dietary habits, specifically a preference for non-vegetarian diets, were more common among diabetic patients. This aligns with the broader understanding that food intake is strongly linked with obesity, not only through the volume consumed but also through the composition and quality of the diet. The overall prevalence of diabetes among the participants was 63.14%, with mood disorders present in 71.15% of diabetic patients. Additionally, 6.1% of diabetic patients had both mood disorders and cardiovascular disease, indicating a statistically significant association between these conditions. Plasma lipid levels were higher in diabetic patients compared to the control group, but age, BMI, and socioeconomic status showed a non-significant effect on diabetes prevalence. These findings underscore a higher prevalence of mood disorders among diabetic patients and highlight the strong association between the incidence of diabetes and lifestyle factors, including dietary habits and economic status. The study emphasized the need for integrated care approaches that address both the physical and mental health aspects of diabetic patients to improve their overall quality of life and health outcomes.

KEYWORDS: Type 2 diabetes, socio-economic, cardiovascular diseases, Body mass Index, diet.

INTRODUCTION

Diabetes mellitus (DM) is a widespread metabolic disorder characterized by elevated blood sugar levels due to either the complete loss or malfunction of insulin-producing pancreatic β-cells. This condition leads to severe complications across various organ systems and is a leading cause of death due to its comorbidities.[1] Recognized as one of the oldest diseases, diabetes was referred to as the "black death" in the fourteenth century due to its severe and often fatal effects.[2]

Diabetes is a complex metabolic disorder with far-reaching implications for an individual's health and well-being. It is intimately linked to an increased risk of cardiovascular disease and a range of mood and cognitive disorders.[3] Type 2 diabetes mellitus (DM), in particular, is driven by a complex interplay of genetic, environmental, and behavioral risk factors.[4]

Symptoms of DM include impaired vision, excessive fatigue, thirst, weight loss, frequent urination, nausea, vomiting, and vaginal itching. Complications are categorized into microvascular and macrovascular types. Microvascular complications involve neuropathy, nephropathy, and retinopathy, while macrovascular complications include peripheral vascular disease, strokes, and cardiovascular disease, with peripheral vascular disease often leading to gangrene and potential amputations.[5]

DM is increasingly prevalent globally, affecting 90% of the diabetic population. Currently, one in eleven people worldwide has diabetes, with the International Diabetes Federation (IDF) reporting 537 million adults (20–79 years old) are diabetic. This figure includes approximately 232 million undiagnosed cases. Projections indicate that the number of adults with diabetes will rise to 643 million by 2030 and 783 million by 2045.[6,7]

India, experiencing rapid development, has seen a significant increase in diabetes cases. According to the IDF 2020, there were 463 million people with diabetes globally, 88 million of whom were in Southeast Asia, with 77 million in India alone. India ranks second only to China in diabetes prevalence, with predictions indicating a rise to 100 million cases by 2030 and 134 million by 2045.[7]

Individuals with type 2 diabetes face a two- to four-fold increased risk of serious cardiovascular complications compared to those without diabetes, even when baseline cardiac risk factors are accounted.[8] Cardiovascular disease is the primary cause of morbidity and mortality among diabetic patients.[9] Epidemiological studies highlight a high prevalence of diabetes, cerebrovascular disease, and cardiovascular disease within Indian communities.[9]

Broad definitions of cardiovascular disease (cardiovascular disease) encompass coronary artery disease (CAD), coronary heart disease (CHD), ischemic heart disease (IHD), congestive heart failure (CHF), and cerebrovascular disease (CBV). Specific conditions of interest include stroke, myocardial infarction (MI), angina pectoris, heart failure, atherosclerosis, and cardiovascular or cardiac death. Strict glycemic control in diabetic individuals has been associated with a reduced risk of macrovascular complications like cardiovascular disease, although evidence supporting this is mixed.[10]

In a current study, 16.43% of diabetics exhibited cardiovascular disease symptoms. Cardiovascular disease is a leading cause of mortality and disability among diabetics, with rising fasting plasma glucose levels increasing cardiovascular disease risk steadily, even before reaching diagnostic thresholds for diabetes.[6,11]

Patients with diabetes are at increased risk for developing anxiety and depression due to the emotional burden of the diagnosis and associated comorbidities.[12] There is a reciprocal relationship between diabetes mellitus and mental health disorders such as depression and anxiety, with patients experiencing anxiety being at higher risk for developing type 2 diabetes and vice-versa.[13] The development of anxiety disorders in diabetes patients can be triggered by stressful life events, personal or familial history of anxiety, substance abuse, and physical illness.[13] Similarly, factors such as clinical conditions, stressful life events, domestic abuse, physical ailments, and personal and family history can lead to depression in these patients.[14,15] Diabetes patients are twice as likely to experience severe anxiety and depression compared to healthy controls, with significant correlations between the patient's sex and symptoms of depression, anxiety, and stress.[3] Understanding both disease-specific and non-specific risk factors for anxiety is crucial for early identification and developing effective treatment plans, given its prevalence among mental disorders.h6

Association with cardiovascular Disease and Mood disorders

The strong association between diabetes and cardiovascular disease is well-established in the literature.[17] The metabolic disturbances characteristic of insulin resistance, including hyperglycemia, dyslipidemia, and hypertension, create an environment conducive to the development of atherosclerosis and its downstream consequences, such as myocardial infarction and stroke.[18] Individuals with diabetes have a two- to six-fold increased risk of developing cardiovascular disease compared to their non-diabetic counterparts, with women bearing an especially high burden.[19] The prognosis for those with diabetes who experience a cardiovascular event is poorer, with lower survival rates compared to non-diabetic individuals.

The links between diabetes and mood/cognitive disorders are equally complex and multifaceted. The chronic stress of managing a lifelong condition, the neurological impacts of hyperglycemia and vascular changes, and the potential for diabetic complications to impair brain function all contribute to an elevated risk of depression, anxiety, and cognitive impairments.[20]

This report's goal is to determine the incidence of diabetes mellitus in Ayodhya's rural population and investigate the relationship between diabetes complications and mood disorders (MD).

MATERIAL AND METHODS

Age, sex, body mass index (BMI), medication, education, cardiovascular disease (cardiovascular disease), 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 were among the variables studied in the patients. A correlation was assessed between the aforementioned variables and the likelihood that the patients would experience a mood disorder.

Duration: The survey was done from January to December 2023.

Setting: A cross-sectional observational study was carried out on a subgroup of patients who were attending the outpatient department at Rajarshi Dasrath

Autonomous State Medical College Ayodhya with permission from the administration. Patients were selected using inclusion and extrusion criteria. Pre-existing blood reports and patient interviews were used to collect data. Well-informed patients supplied the data; no intervention was done. The test participants gave their informed consent. Patients' private and sensitive information was maintained at all times. Diabetes, mood disorders and cardiovascular diseases were assessed in the patients who satisfied the inclusion criteria.

Study Design and Subject distribution

The study involves two groups:

Group 1 (Control) Glycosylated haemoglobin (HbA1c) < 6.5 %**:** 75 patients

Group 2 (Type 2 Diabetics) with HbA1c > 6.5 %**:** 130 patients

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

Inclusion criteria

- 25 to 75 years, both male and female,
- Patients with type 2 diabetes mellitus (HbA1c > 6.5 %),
- Fasting glucose concentration >126 mg/dl
- Post-prandial plasma glucose >200 mg/dl.

Exclusion criteria

- Type I diabetes mellitus,
- Patients with serious illness including Liver, Kidney, Cardiac Problems,
- Patients on history of chronic infections like leprosy, tuberculosis, surgery, recent trauma, skeletal, Muscles injury and HIV infections,
- Cigarette Smokers,
- Pregnancy and lactating womens,

Assessment and Data collection

The patient blood reports were the source of the data. Sociodemographic data, such as age, sex, body mass index (BMI), marital status, level of education attained, employment, and history of alcohol and/or tobacco use, were gathered using a standardised questionnaire. Blood pressure, triglycerides, low-density lipoprotein (LDL) and high-density lipoprotein (HDL), haemoglobin A1c (HbA1c), fasting blood sugar, and post-prandial blood sugar are additional factors.

In addition, information was obtained about the members' type and duration of diabetes, their current pharmaceutical drugs, and whether or not they were receiving treatment for depression. Members were asked to name any medications they took on a regular basis, and the information they submitted was verified by comparing it with their hospital treatment records. Physicians conducted mandatory patient interviews in the diabetes OPD. Age, sex, medication, education, and marital status were among the variables examined in the patients; the relationship between these factors and the likelihood that the patients will experience a mood disorder was assessed.

BMI was interpreted using standard weight status categories applicable to men and women of all body types and ages. BMI was calculated as weight divided by the square of height (kg/m²). According to the 2015 guidelines from the US Centers for Disease Control and Prevention (CDC) and the WHO, a normal BMI range for adults is 18.5 to 24.9. A BMI of 25 kg/m² or higher is considered overweight, and a BMI of 30 kg/m² or higher is classified as obese, with severe obesity defined as a BMI of 40 kg/m² or higher.[21]

All participants were diagnosed with a mood disorder and cardiovascular diseases based on their previous history, questionnaire and interviewed by clinicians as reported by previous method.[22]

Statistical analysis

A descriptive analysis was performed on the data, and sums, averages, medians, and ranges were provided. The estimation of the prevalence rates of cardiovascular illness in DM patients was the main result. SSPS ver. 21.0 was used to examine and verify the collected data. The chi square test was employed to examine the relationship between different variables. The chi square test and other inferential statistical tests were used. At $p<0.05$, the data was considered statistically significant.

RESULTS AND DISCUSSIONS

In comparison to controls, HbA1c values are substantially higher in diabetic patients of all ages. This is a sign of inadequate blood glucose regulation in individuals with diabetes. All age groups with diabetes have higher HbA1c readings, which indicate poor glucose control and need for more effective intervention techniques. Individuals with Hb1Ac levels greater than 6.5 were designated as diabetes cases. The survey comprised 205 patients in total 109 men and 96 women. A overview of the patients' socioeconomic level and demographic information is included in Table no. 1. It displays the fundamental data collected from patients *via*. a questionnaire.

Table 1: Demographic and Socioeconomic data distribution of patients.

Category	Sub category	Cases	Control	Total
Age	25-35	16	9	25
	36-45	27	14	41
	46-55	36	13	49
	56-65	29	21	50

	66-75	22	18	40
Sex	Male	68	41	109
	Female	62	34	96
Education	Primary school	35	25	60
	HSC	29	19	48
	SSC	25	15	40
	Diploma or Graduation	22	9	31
	Post Graduation	19	7	26
Occupation	Unemployed	21	16	37
	Business	17	9	26
	Farmer	37	15	52
	Gov. job	10	4	14
	Pvt. job	19	11	30
	House wife	26	20	46
Income per years	<1 Lakh (I)	25	9	34
	1-4 lakh (II)	36	25	61
	4-7 lakh (III)	33	15	48
	7-10 lakhs (IV)	29	17	46
	>10 lakhs above (V)	7	9	16
Religion	Hindu	81	53	134
	Muslim	49	22	71
Marital status	Married	71	44	115
	Unmarried	59	31	90

1. Age distribution

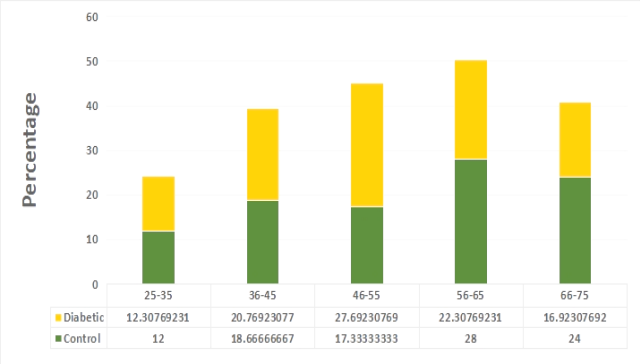

Figure 1: Age Range and Distribution pattern of diabetic (Yellow colour) and Control (Green colour) patients.

The Figure 1 displays the age distribution of the participants under study. It shows that a higher percentage (24.39 %) of the subjects were in the 56-65 age group, while a lower percentage (12.19 %) were in the 25-35 age group. These findings may also be explained by the fact that, in comparison to older patients, younger generations tend to be healthier and have less instances of diabetes. However, Patients who are 36 years (20.7%) of age or older are therefore thought to be more susceptible to developing diabetes. Statistical analysis provided chi-square value (X^2) of 6.1756, with 4 degrees of freedom. The p-value was 0.1873 > 0.05. This analysis indicated that age group does not have a significant association with diabetes disease in the given sample size.

2. Food habit

Table 2: Effect of food habit on prevalence of diabetes mellitus patients.

Food habit	Control	Diabetics	Chi Square test
Veg	31	56	X^2=16.73
Non-veg	44	74	P value = 0.000043
Total	75	130	Df=1

Table 2 shows that in all age groups, there were more non-vegetarian diabetic patients (74 cases) than vegetarians. This may suggest that diet has an impact on the incidence of diabetes. 16.73 is the chi-square value with one degree of freedom. The p-value of 0.000043<0.05 indicates a statistically significant correlation between patients' diabetes condition and their dietary habits, both vegetarian and non-vegetarian.

3. BMI

Table 3: Effect of BMI on diabetes status of patients.

BMI Category	BMI	Total No.	Control		Diabetic		*p value*
			No.	%	No.	%	
Under weight	<18.50	40	14	18.66	26	20	X^2=0.94 P value = 0.918
Normal weight	18.5-24.99	31	10	13.33	18	13.84	
Obese class 1	25-29.99	42	17	22.66	25	19.23	
Obese class 2	30-34.99	54	19	25.33	39	30	
Obese class 3	>=35-39.99	38	15	20	22	16.92	

Figure 3 shows that compared to higher economic groups (IV and V), diabetes prevalence is higher in lower economic classes (I and II). Diabetic patients are more likely to fall into higher BMI categories, such as Obese Class 1 (19.23%) and Class 2 (30%) (Table 3). Furthermore, both the control (group 1) and diabetes (group 2) groups often have a higher number of individuals in the obese category. However, compared to the control group, there are more incidences of diabetes among the obese. The data suggests a robust association between obesity and diabetes, highlighting the significance of weight control in the prevention and management of the disease. In order to conclusively link BMI and diabetes in the study, more comprehensive data is required, even though the found correlation is not statistically significant.

4. Lipid Profile

Table 4: Data of diabetic patients with high values of cholesterol, high density lipoprotein (HDL), and low density lipoproteins (LDL).

Age range	High Cholesterol	%	High LDL	%	High HDL	%
25-35	11	8.46	13	10	10	7.69
36-45	13	10	18	13.84	16	12.30
46-55	16	12.30	14	10.76	15	11.53
56-65	25	19.23	22	16.92	19	14.61
66-75	21	16.15	19	14.61	20	15.38
Total	86		86		80	

Table 6 explains that elevated levels of HDL, LDL, and cholesterol were present in over 86% of diabetic individuals. Furthermore, all of these abnormalities in the increased lipid profile were seen in all age groups, with the 56-65 age group having the highest prevalence) of cholesterol (19.23 %) and LDL (16.92 %) levels. As a result, individuals with diabetes have an increased risk of aberrant lipid profiles, which may exacerbate cardiovascular issues. High Cholesterol: The chi-square values exhibited no statistically significant relationship between age range and high cholesterol, LDL and HDL levels.

5. Socioeconomic Status

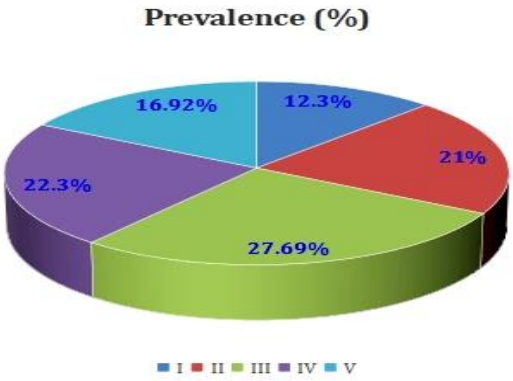

Figure 2: Distribution of diabetic subjects according to their economic class.

Figure 3 shows that compared to higher economic groups (IV and V), diabetes prevalence is higher in lower economic classes (I and II). Additionally, diabetes affects 12.30% of people in class I of the economic group. In class II, the prevalence rises to 20.76%. A further decrease in prevalence is seen in classes III, IV, and V, where it is 2769%, 22:30, and 16.92, respectively. As a result, middle class people were more prevalent than people in the highest and lowest income groups. Thus, at the 0.05 significance level, there is no statistically significant correlation between diabetes and class. According to this analysis, there is no significant

correlation seen in this dataset between the class distribution and diabetes.

6. Mood Disorders

Table 5: Prevalence of mood disorders in diabetics and control patients.

Age range	Control with mood disorder	Percentage (%)	Diabetics With mood disorder	Percentage (%)	Values
25-35	2	2.66	8	6.15	X^2=4.09 P value = 0.393 DF=4
36-45	7	9.33	17	13.07	
46-55	6	8	23	17.69	
56-65	9	12	27	20.76	
66-75	11	14.66	18	13.84	
Total	35	46.65	93	71.51	

The results of assessment of prevalence of mood disorders in both diabetic patients and non-diabetics are reported in Table 5. As one can observe from the table 5, the prevalence of MD increases with age. The age range 56-65 exhibited a prevalence of mood disorders in 12% in non-diabetics and a 20.76% prevalence among diabetics. Further as age progresses the frequency of mood disorders is also increasing. It was discovered that among control or non-diabetic individuals, there were 46.65% cases of mental disorders. The prevalence is higher in diabetic patients-roughly 71.51%.

7. Effect of cardiovascular disease and mood disorder

The data can be arranged in a contingency table for the chi-square test.

Table 6: Correlation data between mood disorder and cardiovascular disease (cardiovascular disease) in diabetic patients.

Case	Mood Disorder	No Mood Disorder	Total	Values
Cardiovascular disease	8 (6.1%)	6 (4.61%)	14 (10.71%)	X^2= 8.938 p value = 0.0028 DF=1
No cardiovascular disease	10 (7.6%)	54 (41%)	64	

The link between mood disorders and cardiovascular disease is seen in Table 6. About 7.6% of all diabetes patients had mood disorders by themselves, 4.61% had cardiovascular disease alone, and 6.1% had both mood disorders and cardiovascular disease. Furthermore, it was noted that 10.71 percent of cases had diabetic cardiovascular disease, highlighting its significance as a primary cause of cardiovascular illnesses. The expected frequencies derived from statistical analysis are as follows: 3.23 for cardiovascular disease with mood disorder, 10.77 for cardiovascular disease without mood disorder, 14.77 for no cardiovascular disease with mood disorder, and 49.23 for no cardiovascular disease with mood disorder. Given that the p-value of 0.0028 is less than 0.05, it may be concluded that there is a statistically significant correlation between mood disorders and cardiovascular disease.

DISCUSSIONS

190 participants in this study had their demographics, lipid profiles, BMIs, diets, mood problems, and cardiovascular health evaluated. It was discovered that 63.14% of the individuals had diabetes overall. Table 1 shows that individuals with diabetes had significantly higher HbA1c levels than non-diabetic controls across all age ranges, suggesting that individuals with diabetes have impaired blood glucose management. This shows that improved glucose management in diabetes patients requires the use of more potent intervention strategies.

Diabetes prevalence may be influenced by dietary practices, with non-vegetarian diets perhaps being more prevalent among individuals with the disease. Obesity has a high correlation with food intake, including the quantity, composition, and quality of the food ingested. The findings show that diabetic patients choose non-vegetarian diets. Diabetes mellitus and insulin resistance are more common in diets heavy in red meat, sweets, and fried foods. On the other hand, there is a negative relationship between the prevalence of DM and vegetable consumption. Because fruits and vegetables are high in nutrients, fibre, and antioxidants that function as protective factors against the disease, eating them can help prevent the development of diabetes mellitus.[23]

The prevalence of mood disorders or cognitive disorder was 71.51 % higher in diabetics as compared to control. Mental health disorders, including depression, anxiety disorders, schizophrenia, eating disorders, and addictive behaviors, manifest through a variety of symptoms affecting emotions, thoughts, and behaviors. These symptoms can sometimes present as physical issues, such as headaches, backaches, and stomachaches.[24,25]

Depression disrupts feelings, thoughts, and behaviors, and in both type 1 and type 2 diabetes, it compounds the risk of micro- and macrovascular complications, high blood sugar, and increased mortality. This comorbidity also indicates an early onset of complications in older

adults.[26] Anxiety and depression are among the most common psychiatric disorders worldwide, frequently co-occurring with chronic conditions like diabetes mellitus, which is rapidly increasing globally.

According to the findings, those with mood problems had a higher risk of cardiovascular illness than people without mood disorders. As the prevalence of diabetes continues to rise, the incidence of associated cardiovascular disease is also expected to increase, driven by both traditional cardiovascular risk factors and the direct effects of diabetes on cardiovascular health. . A significant relation between CVS and mood disorder was observed. The need of keeping an eye on cardiovascular health in individuals with mood disorders is highlighted by this research. Further research endeavours may delve into the causative factors that underlie the correlation between mood disorders and cardiovascular disease.

Oxidative stress, which is caused by an excess of reactive oxygen species (ROS), is intimately associated with the aetiology of diabetes mellitus and other associated diseases. Hyperglycemia and metabolic diseases, including weakened antioxidant capacity, are linked to this overproduction. Chronic inflammation and fibrosis in different tissues are caused by long-term exposure to oxidative stress in DM, which aids in the development and advancement of disease states. Patients with diabetes mellitus have elevated levels of oxidative stress markers, indicating that elevated ROS may be the main cause of diabetic complications.[27]

Large-scale population studies may be necessary to ascertain the nature of the association between mood disorders and cardiovascular disease, including whether mood problems cause cardiovascular disease to develop or *vice-versa*. Approaches to integrated care that address cardiovascular and mental health may be advantageous.

Additionally, a number of research' findings indicate that people with DM need stakeholders like healthcare facilities and clinicians to reinforce DM education, which includes dietary management. Patients may benefit from this reinforcement by learning more about managing their diseases, which may result in greater self-care and an enhanced quality of life.

CONCLUSIONS

The results underscore the complex interplay between mood disorders and cardiovascular illness, underscoring the necessity of integrated care strategies that take mental and physical health into account. Since comprehensive diabetes education greatly improves self-care behaviours and improves the quality of life for individuals with diabetes mellitus, its significance is also clear. Therefore, to stop the rising prevalence and progression of both diabetes and its associated risk factors, appropriate management and treatment of diabetes are crucial, as is aggressive treatment of associated cardiovascular risk factors. For diabetic patients, effective medical care and cardiovascular outcomes require a deeper understanding of the disease processes and how they affect cardiovascular health.

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