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A Case Control Study to Assess the Risk Factors Associated with Type 2 Diabetes Mellitus Among Adults Residing in Rural Areas of Bagalkote District

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Abstract **Original Research Article**

Background: Type 2 Diabetes Mellitus (T2DM) is a rapidly increasing public health challenge influenced by multiple medical, lifestyle, psychological, and dietary factors. Identifying these determinants is essential to inform prevention and management strategies, especially in rural populations. ***Objectives:*** The study aimed to (1) assess the risk factors of type 2 diabetes mellitus among case and control group, (2) compare case and control group to assess the risk factors of type 2 diabetes mellitus, and (3) associate type 2 diabetes mellitus with their selected socio demographic variables among case and control group ***Methods:*** A descriptive survey using a cross-sectional case-control design was conducted among 160 adults in Bagalkot district (80 with T2DM, 80 without). Purposive sampling was adopted. Data were collected using a validated and reliable structured questionnaire covering socio-demographic, medical, lifestyle, psychological, and dietary domains. Body Mass Index (BMI) was also assessed. Data were analysed using SPSS 28, applying descriptive statistics, chi-square test, t-test, and odds ratios with 95% confidence intervals. ***Results:*** Mean BMI was higher in cases (26.24 ± 3.67) than controls (24.99 ± 3.19). Major risk factors significantly associated with T2DM included hypertension (81.25% vs. 3.75%), family history of diabetes (80% vs. 20%), tobacco use (67.5% vs. 28.75%), alcohol consumption (57.5% vs. 30%), stress (85% vs. 10%), and high sugar/fat intake (81.25% vs. 23.75%). Odds ratio analysis revealed hypertension (OR = 111.22), stress (OR = 51.00), burnout (OR = 47.67), and high sugar/fat intake (OR > 20) as strong predictors of T2DM. Protective factors included balanced diet (OR = 0.23) and daily exercise (OR = 0.39). Socio-demographic variables significantly associated with T2DM were age (p = 0.0356), education (p = 0.0085), occupation (p = 0.00001), and income (p = 0.0072). ***Conclusion:*** T2DM in rural adults is strongly influenced by modifiable medical, lifestyle, and psychosocial factors, with hypertension, stress, and unhealthy diet as dominant risks. Preventive strategies focusing on lifestyle modification, stress reduction, and dietary regulation are critical in reducing the burden of diabetes.

Keywords: Type 2 Diabetes Mellitus, Risk factors, Case-control study, Rural population, Odds ratio.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by impaired insulin production or action, leading to elevated blood glucose levels. It is a major global health problem, contributing significantly to morbidity and mortality due to its long-term complications rather than its immediate effects. The condition includes multiple types, with Type 2 Diabetes Mellitus accounting for the majority of cases and primarily associated with insulin resistance and relative insulin deficiency. [1,2]

Globally, diabetes is among the leading causes of death and is rapidly increasing in prevalence, driven by urbanization, aging populations, and unhealthy lifestyles. According to the World Health Organization, non-communicable diseases accounted for 74% of deaths worldwide, with diabetes contributing significantly. The number of adults with diabetes has risen dramatically, and projections indicate a continued increase, especially in developing countries like India. [3,4,7]

Type 2 diabetes has become a serious public health concern due to its high prevalence, early onset in younger populations, and impact on quality of life. Factors such as obesity, sedentary lifestyle, unhealthy diet, and genetic predisposition play a crucial role in its development. Additionally, rising childhood obesity and

lifestyle changes have increased the incidence among adolescents and young adults, leading to earlier complications and long-term health burdens. [5,6,8]

The growing burden of diabetes highlights the importance of early detection, prevention, and effective management strategies. Clinical research is essential to understand disease progression, identify biomarkers, and develop targeted interventions for reducing complications. Lifestyle modification, including healthy diet, physical activity, and weight control, remains a key preventive approach. [9,10]

Despite advances in diabetes care, challenges remain in healthcare delivery, early diagnosis, and management, particularly in rural and underserved populations. Variations in healthcare systems, lack of awareness, and limited access to resources contribute to disparities in outcomes. Therefore, there is a need for continuous research, improved healthcare strategies, and strengthened public health interventions to reduce the global burden of diabetes and improve patient care. [11-13]

MATERIAL AND METHODS

Study Design and Participants

Present study was a descriptive case control study conducted between May 2025 to June 2025. A purposive sample of 160 The consists of all adults who are suffering from Type 2 Diabetes mellitus as cases and controls are all adults, who are not suffering with Type 2 Diabetes mellitus. Type 2 Diabetes mellitus clients, who visited to primary health center Shirur and the controls, are all the adults free form diabetes at rural areas of Bagalkote.

Instruments

The tool had three parts: a 10-item semi-structured questionnaire on socio-demographic factors, BMI assessment (height, weight, BMI), and a 26-item structured questionnaire on factors associated with Type 2 diabetes mellitus. All responses were categorical and coded for analysis without numerical scoring

Data Collection Procedure:

The study was conducted among 160 adults (80 cases and 80 controls) from 12 May to 26 June 2025 after obtaining institutional permissions and informed consent. Data were collected in two phases using structured questionnaires, with self-administration for literate participants and interview method for others.

Data Analysis:

Data were analyzed using Microsoft Excel and SPSS. Descriptive statistics included frequency, percentage, mean, median, range, standard deviation, and coefficient of variation. Inferential analysis used regression methods, with adjusted odds ratio and relative risk (95% CI) to assess associations. Results were presented using tables, graphs, and diagrams.

RESULTS

Section 1: Description of Socio demographic variables.

Table No 1: Distribution of cases and controls group according to their socio demographic data

Sl. No	Socio Demographic Factors	Categories	Case N1=80		Control N2=80	
			Frequency	Percentage	Frequency	Percentage
1.	Age	27- 40	29	36.25%	27	33.75%
		41-50	35	43.75%	35	43.75%
		51-85	16	20%	18	22.50%
2.	Gender	Male	41	51.25%	44	55%
		Female	39	48.75%	36	45%
3.	Educational	No formal Education	18	22.50%	23	28.75%
		Primary	26	32.50%	19	23.75%
		High school /PUC	26	32.50%	25	31.25%
		Degree/ Graduation	10	12.50%	13	16.25%
4.	Religion	Hindu	54	67.50%	55	68.75%
		Muslim	19	23.75%	16	20%
		Christians	4	5%	5	6.25%
		others	3	3.75%	4	5%
5.	Marital status	Married	67	83.75%	65	81.25%
		Unmarried	5	6.25%	9	11.25%
		Separated	1	1.25%	4	5%
		Widow	4	5%	1	1.25%
		Divorce	3	3.75%	1	1.25%
6.	Residence	Rural	73	91.25%	59	73.75%
		Urban	7	8.75%	21	26.25%
7.	Occupation status	Government	9	11.25%	17	21.25%
		Private	16	20%	22	27.5%

Sl. No	Socio Demographic Factors	Categories	Case N1=80		Control N2=80	
			Frequency	Percentage	Frequency	Percentage
		Home maker	26	26%	12	15%
		Coolie	24	30%	22	27.5%
		Others	5	6.25%	7	8.75%
8.	Family monthly income	less than 10000	14	17.50%	7	8.75%
		10001-20000	26	32.50%	14	17.5%
		20001-30000	20	25%	21	26.25%
		30001-40000	12	15%	21	26.25%
		More than 40000	8	10%	17	21.25%
9.	Type of family	Nuclear family	42	52.50%	48	60%
		Joint family	35	43.75%	32	40%
		Extended	3	3.75	0	0%
10.	Dietary pattern	Veg	20	25%	23	28.75
		mixed	60	75%	57	71.25%

Most cases and controls were aged 41–50 years, male, married, Hindu, and followed a mixed diet. Cases were more from rural areas and lower income groups, while controls had higher income and more urban representation, with minor differences in education and occupation.

Table No 2: Distribution of cases based on socio-demographic factors N_1= 80

Sl. No.	Variables	Mean	Median	SD	Range	Minimum	Maximum
1	Age	48.83	43.8	0.736	29	31	60
2	Family monthly Income	26000	20001	12,200	30000	<10000	>40000
3	BMI	26.24	26.13	3.67	17.99	18.75	36.74

The mean age of the case group was 48.83 ± 0.736 years (range: 31–60). The mean BMI was 26.24 ± 3.67 (range: 18.75–36.74). The mean family monthly income was ₹6,000 ± 12,200, ranging from <₹10,000 to >₹40,000 per month.

Table No 3: Distribution of control group based on socio-demographic factors N_2= 80

Sl. no	Variable	Mean	Median	SD	Range	Minimum	Maximum
1	Age	48.88	44.71	0.746	29	31	60
2	Family monthly income	33000	29048	12,400	30000	<10000	>40000
3	BMI	24.99	24.57	3.192	15.30	18.025	33.33

The mean age of the control group was 48.88 ± 0.746 years (range: 31–60), and the mean BMI was 24.99 ± 3.19 (range: 18.03–33.33). The mean family monthly income was ₹33,000 ± 12,400, ranging from ₹6,000 to ₹80,000 per month.

Section 2: Description of sample according to assessment of factors associated with type 2 diabetes mellitus

Distribution of samples according to medical factors associated with type 2 diabetes mellitus among adults

A significantly higher proportion of cases reported hypertension (81.25% vs. 3.75%), chronic diseases (45% vs. 3.75%), and family history of diabetes (80% vs. 20%) compared to controls, indicating strong associated risk factors. Additionally, cardiovascular diseases (50%) and long-term GI disorders (32.5%) were present only among cases and absent in controls, suggesting a strong link with the case group.

Distribution of samples according to Life style factors associated with type 2 diabetes mellitus among adults

Cases showed higher prevalence of risk behaviors, including tobacco use (67.5% vs. 28.75%), alcohol use (57.5% vs. 30%), sleep disturbances (86.25% vs. 23.5%), screen addiction (75% vs. 36.25%), and sleeping immediately after meals (68.75% vs. 8.75%) compared to controls. They also reported greater medication use (82.5% vs. 10%) and, interestingly, higher engagement in physical activity (75% vs. 55%) and yoga (82.5% vs. 58.75%), possibly reflecting lifestyle changes after diagnosis.

Distribution of samples according to psychological factors associated with type 2 diabetes mellitus among adults

Cases reported markedly higher psychological distress, including stress (85% vs. 10%), workplace burnout (55% vs. 2.5%), difficulty handling situations (74% vs. 11.25%), and anticipatory anxiety (63.75% vs. 1.25%) compared to controls. Additionally, 56.25% of cases experienced family-related frustration, while none

of the controls did, indicating greater emotional and interpersonal strain in the case group.

Distribution of samples according to Dietary factors associated with type 2 diabetes mellitus among adults

Cases showed higher intake of unhealthy dietary patterns, including high sugar (81.25% vs. 23.75%), saturated/trans fats (86.25% vs. 18.75%), red/processed meat (57.5% vs. 11.25%), sugary drinks (76.25% vs. 28.75%), outside food (68.75% vs. 23.75%), and hurried eating (57.5% vs. 11.25%) compared to controls. Although more cases reported regular mealtimes (62.5% vs. 37.5%) and a balanced diet (57.5% vs. 23.75%), this may reflect post-diagnosis lifestyle changes or perception differences.

Table No 4: Comparison between risk factors of case group and control group based on mean and standard deviation

SL.NO	FACTORS		CASE GROUP	CONTROL GROUP
1	Medical Factors	Mean	2.89	0.275
		SD	1.35	0.50
2	Lifestyle Factors	Mean	5.95	2.5
		SD	1.22	1.62
3	Psychological Factors	Mean	3.33	0.25
		SD	1.52	0.56
4	Dietary factors	Mean	5.47	1.79
		SD	1.50	1.46

The table compares Medical, Lifestyle, Psychological, and Dietary factors between case and control groups using mean and standard deviation (SD). It highlights differences in average levels and variability of these factors between the two groups. The Case Group demonstrated higher mean scores across Medical (2.89 vs. 0.275), Lifestyle (5.95 vs. 2.5), Psychological (3.33 vs. 0.25), and Dietary factors (5.47 vs. 1.79), indicating greater overall risk compared to the Control Group. Standard deviations were generally higher among cases (except Lifestyle), reflecting greater variability, while dietary variability was similar in both groups.

Table No 5: Association between case group with their socio demographic variables

Sl. no	Variables	DF	Chi square	Table value	P Value	Significance
1	Age	2	6.672	5.84	0.0356	Significant
2	Gender	1	2.001	3.84	1.5719	Not Significant
3	Educational status	3	11.609	7.84	0.0085	Significant
4	Religion	3	4.345	7.84	0.226	Not Significant
5	Marital status	4	4.759	11.84	0.3129	Not Significant
6	Residence	1	2.693	3.84	1.0079	Not Significant
7	Occupation	4	31.07	11.84	0.00001	Significant
8	Income	4	14.0	11.84	0.0072	Significant
9	Type of Family	2	5.327	5.84	0.06	Not Significant
10	Dietary pattern	1	0.821	3.84	0.364	Not Significant

Age, educational status, occupation, and income showed statistically significant associations with the dependent variable ($p < 0.05$), indicating that socio-demographic and economic factors play an important role in influencing the outcome. In contrast, gender, religion, marital status, residence, type of family, and dietary pattern were not significantly associated ($p > 0.05$), suggesting they have limited or no influence in this context.

Table No 6: Association between control group with their socio demographic variables

Sl. no	Variables	DF	Chi square	Table value	P Value	Significance
1	Age		5.632	5.84	0.59	Not Significant
2	Gender		0.085	3.84	0.7706	Not Significant
3	Educational status		3.071	7.84	0.38	Not Significant
4	Religion		2.511	7.84	0.473	Not Significant
5	Marital status		5.094	11.84	0.277	Not Significant
6	Residence		8.47	3.84	0.0036	Significant
7	Occupation		0.94	11.84	0.918	Not Significant
8	Income		8.32	11.84	0.80	Not Significant
9	Type of Family		0.0083	5.84	0.99	Not Significant
10	Dietary pattern		3.247	3.84	0.71	Not Significant

Only area of Residence (p = 0.0036) shows the statistically significant at the 0.05 level among control group. And the remaining does not show a statistically significant association among control group those are: Age (p = 0.59), Gender (p = 0.7706), Educational Status (p = 0.38), Religion (p = 0.473), Marital Status (p = 0.277), Occupation (p = 0.918), Income (p = 0.80), Type of Family (p = 0.99), Dietary Pattern (p = 0.71).

Table No 7: Comparison of case & control group to find out the significance level.

Group	Mean	Median	SD	t value	P value	Significance
Case group	17.65	14	3.86	23.46	<0.00001	Significant
Control group	4.825	5	3.01			

An independent samples t-test showed that the case group had a significantly higher mean (17.65 ± 3.86) compared to the control group (4.83 ± 3.01), with a highly significant difference (t = 23.46, p < 0.00001). This indicates that the measured factors are substantially elevated in the case group compared to the control group.

Section II: Estimation of relative risk of modifiable risk factors on Type 2 Diabetic mellitus

The effects of various modifiable risk factors on Type 2 Diabetic mellitus was estimated using the crude odd ratios (c ORs).

Results of relative risk estimation of top risk factors (OR > 20) on Type 2 Diabetic mellitus

Several factors showed extremely strong associations with case status, with ABAF having the highest risk (≈139 times higher odds), followed by hypertension, both indicating powerful contributors despite wide confidence intervals. Chronic stress, burnout, TMR, SIAF, and DFS also emerged as significant risk factors, highlighting the combined influence of psychological, clinical, and possibly condition-specific variables in increasing case likelihood.

Results of relative risk estimation of moderate risk factors (OR 5–15) on Type 2 Diabetic mellitus.

Several factors fall within the moderate-to-high risk range, with one variable exceeding an OR of 20, indicating it could be reclassified as a top risk factor. Family history also emerged as a strong contributor, highlighting genetic or hereditary influence. Other factors—such as social/behavioral variables, dietary habits, occupational or functional aspects, and possible sedentary behaviors—show moderate yet statistically significant associations, suggesting their meaningful but comparatively lower impact on case risk.

Results of relative risk estimation of Protective risk factors (OR < 1) on Type 2 Diabetic mellitus.

Strongest protective factor identified. The odds of being a case are reduced by over 75% in individuals with this factor. May relate to beneficial behaviors or treatments. Possibly a lifestyle, dietary, or therapeutic intervention. Statistically significant.

6.15: Results of relative risk estimation of Additional risk factors (Mixed or Moderate) on Type 2 Diabetic mellitus.

Mild risk factor, OR < 5. May be relevant when combined with others. FWFW, CVD, GID. These factors were observed only in cases, so OR cannot be computed. This suggests a possible strong link, but more balanced data is needed to verify.

DISCUSSION

The present case–control study investigated the risk factors associated with type 2 diabetes mellitus (T2DM) among adults in Bagalkot district, Karnataka. A total of 160 participants were enrolled—80 cases with type 2 diabetes mellitus (T2DM) and 80 age-matched controls without diabetes—allowing for an in-depth comparison of socio-demographic, medical, lifestyle, psychological, and dietary factors. Statistical analysis revealed several strong associations, both modifiable and non-modifiable, that contribute to the risk profile of type 2 diabetes mellitus in this population.

1. Socio-Demographic Determinants and associated risk factors

Socio-demographic factors such as age, education, occupation, and income showed significant associations with Type 2 diabetes mellitus, while gender and other variables were not significant. Medical factors—especially hypertension and family history—had very strong associations, with clustering of chronic conditions among cases [14,15]. Lifestyle risks (tobacco, alcohol, poor sleep) and psychological factors (stress, burnout, anxiety) were markedly higher in cases, highlighting their major role [16,17].

Dietary patterns were significantly unhealthier among cases, with higher intake of sugar, fats, processed foods, and outside food, consistent with global evidence [18,19]. Overall, odds ratio analysis identified several high-risk factors (OR > 20), and the t-test showed a highly significant difference (p < 0.00001), confirming a greater cumulative risk burden among cases.

CONCLUSIONS

This case–control study found that Type 2 diabetes mellitus is influenced by both non-modifiable factors (age, family history) and modifiable factors such as hypertension, stress, unhealthy diet, tobacco and

alcohol use, and sleep disturbances. Psychological factors, especially stress and anxiety, showed strong associations, highlighting the importance of mental health in disease risk.

The study also confirmed a significantly higher overall risk burden among cases, emphasizing the need for early screening and comprehensive interventions. Overall, a multi-dimensional approach focusing on lifestyle modification, stress management, and dietary education is essential for effective prevention and control of T2DM

Recommendations: Highlight early risk screening, integrated care with mental health support, and culturally appropriate diet and lifestyle

Counselling: Public health efforts should focus on awareness, school/workplace programs, healthier food environments, and physical activity.

Policy and research should strengthen national programs, regulate unhealthy foods, improve workplace health, and support culturally relevant studies.

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