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The Association between Dietary Intake and Lifestyle Patterns of People with Type 2 Diabetes Mellitus in Manipur, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The aim of the study was to examine the association between dietary intake and lifestyle pattern of diabetes patients in Manipur. Tribal and non tribal respondents between 45-64 years of age were randomly selected from the Regional Institute of Medical Sciences (RIMS) Hospital Manipur. Total number of 200 study subjects, 100 tribal and 100 non tribal subjects constituted the study. The information was collected on socio-demographic profile, clinical, anthropometric measurements and dietary intakes of the patients by using interview schedule and 24-hour dietary recall methods. The data were analyzed and tabulated using statistical tools such as frequency, percentage, mean, standard deviation and Pearson's correlation test. The key results indicate that alcohol consumption, elevated triglycerides levels, low energy, oils and sugar intake were notably linked with the prevalence of diabetes. Additionally, low calcium intake, particularly among non tribal individuals, demonstrated a significant correlation with elevated Fasting Blood Glucose (FBG)

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levels, suggesting a potential risk factor for Type 2 diabetes. Moreover, low calcium intake among the non-tribal community was associated with increased Post Prandial (PP) test results, indicating a rise in post-meal glucose levels. Notably, tribal energy intake and non-tribal protein consumption were significantly associated with HbA1c levels, reflecting their impact on glycemic control.

Keywords: Diabetes; tribal; non tribal; demographic profile; lifestyle pattern and clinical parameters.

1. INTRODUCTION

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces WHO, [1]. Its escalating prevalence in emerging nations like India can be attributed to aging populations, urbanized lifestyles, and shifting population structures Ramachandran, [2]. With an estimated 422 million individuals affected globally, the majority residing in low and middle-income countries, diabetes claims approximately 1.5 million lives annually WHO, [1]. Over recent decades, both the number of cases and the incidence of diabetes have shown a steady increase. T2DM and its complications constitute a major public health problem worldwide, affecting almost all populations in both developed and developing countries, with high rates of diabetes-related morbidity and mortality Wu et al., [3]. In India, the National Family Health Survey (NFHS) 2019-21 reports varying proportions of individuals requiring medication or having high blood glucose levels across different religious groups [4]. Genetic predisposition, alongside environmental factors such as family history, older age, obesity, and physical inactivity, significantly contribute to diabetes risk Bakr, [5]. Long-term obesity and a sedentary lifestyle further exacerbate the likelihood of developing type 2 diabetes (T2DM). However, lifestyle modifications, including adopting a healthy diet, regular physical activity, and tobacco avoidance, can delay the onset of T2DM WHO, [6].

Majority of the respondents for both tribal and non tribal consumed refined carbohydrates, saturated fats, and sugars, coupled with low intake of fruits, vegetables, and whole grains, are associated with an increased risk of type 2 diabetes mellitus (T2DM). Furthermore, majority of the respondents were engaged sedentary lifestyle that exacerbates this risk, leading to weight gain, insulin resistance, and eventual beta-cell dysfunction.

Understanding the intricate interplay between diet, physical activity, and T2DM is crucial due to their profound impact on disease onset, progression, and management. Adopting a healthy diet rich in fruits, vegetables, whole grains, and lean proteins, combined with regular physical activity, has been shown to significantly reduce the risk of developing T2DM and its associated complications. Thus, this study aims to delve into the dietary and lifestyle factors contributing to T2DM within the context of Manipur, India, highlighting the importance of addressing these modifiable risk factors to mitigate the burden of diabetes in this population.

2. MATERIALS AND METHODS

2.1 Study Area and Selection of Respondents

This qualitative study design was carried out in the Manipur NCD (Non Communicable Disease) unit of Regional Institute of Medical Sciences (RIMS) Hospital. Patients with diabetes from the non-tribal Meiteis group as well as the tribal Nagas and Kukis group were chosen. The required sample sizes were selected from the hospital randomly. Total 200 study sample were selected purposively. While 100 of them were identified as tribal and the remaining 100 as non-tribal. Fifty from each gender. The chosen age range falls into late middle age (45–64 years old).

2.2 Methods of Data Collection

The main instruments used in the study were pre-tested and pre-designed interview schedules.

The interview schedule utilized in this study was designed to collect data on clinical, socio-demographic, and anthropometric measurements. It comprised structured questions aimed at gathering comprehensive information about participants' health status, demographic characteristics, and physical measurements such as height, weight, and waist-hip ratio. The 24-hour dietary recall method is a dietary assessment technique that involves participants recalling all foods and beverages consumed over the previous 24-hour period. This method provides insight into an individual's dietary intake, allowing gathering detailed information about their eating habits within a specific timeframe.

The formula kg/m^2, where m^2 is the square of a person's height in meters, is used to calculate a person's BMI (Body Mass Index). Utilizing the WHO (BMI) classification, the BMI was evaluated. Measurements of height, weight were obtained using a digital scale. The patients' height was determined using an anthropometer rod. Updated blood glucose monitoring and cholesterol levels records were taken from the patients.

2.3 Instrument Used

Digital weighing machine for weight measurement, anthropometer rod for height measurement, measuring tape for waist-hip ratio, WHO (BMI) classification for BMI calculation and 24 hour recalled was adopted for dietary intake. (24 hour recall method is an oral questionnaire of diet survey, a set of standardized cups suited to local conditions is used. Information on the total cooked amount of each preparation is noted in terms of standardized cups. The cups are used mainly to aid the respondent recall of the quantities prepared and fed to the individual members.) Srilakshmi, [7]

2.4 Statistical Analysis

The data were analysed and tabulated using statistical tools such as frequency, percentage, mean, standard deviation and Pearson's correlation test.

3. RESULTS AND DISCUSSION

Table 1 shows the association between the dietary intake and lifestyle pattern of diabetes patients in Manipur which describe thoroughly about demographic factors like age, occupation, qualification, marital status, total annual income and addiction pattern of tribal and non tribal communities. A majority from both groups falls within the age group of 55-64 years and annual income falls under 2 lakhs per annum. Service was the main occupation for male and majority of females were housewives. Male under service category and female under housewife category in both communities exhibited a higher prevalence of diabetes. Respondents who got higher education had more incidence of diabetes in both tribal and non tribal communities. Probably, the reason behind this is highly paid services because of good education level. More than 90% of the respondents were married. Among the surveyed population, tribal males (68%) exhibited the highest alcohol consumption as compared to others. Tobacco uses was prevalent among tribal males 70% and tribal females at 66%. In comparison non tribal males reported a lower tobacco usage at 50%, while non tribal females had the highest rate at 72%. A similar study conducted by Jayawardena et al., [8] and Wimmer et al., [9] revealed that old aged people and individuals with higher income were more prevalent to diabetes. A study conducted by Begum et al., [10] found that housewives were more diabetic than others. A study by Kim et al., [11] noticed that more than 50% male diabetic patients used tobacco and consumed alcohol. According to Onalan and Gozel [12], smoking cigarettes raises the incidence of diabetes.

Table 2 represents the association of demographic profile, lifestyle pattern and clinical parameters. The mean of tribal and non tribal population were compared height, weight, BMI, increased alcohol intake and higher triglyceride levels showed significance positive correlation among both tribal and non tribal population by using Pearson's correlation test. Additionally, nutrient such as mean energy intake, mean carbohydrate intake and mean protein (high) intake, exhibited significant results for both the communities. The findings reveal that both tribal and non-tribal populations exhibit mean BMI values falling within the overweight or pre obese category, with respective mean values of 25.4 kg/m^2 and 25.43 kg/m^2. Additionally, the waist-hip ratio analysis indicates values of 1.02 for tribal individuals and 1.03 for non-tribal individuals, surpassing the threshold values of 0.85 for females and 0.9 for males, which are indicative of a heightened susceptibility to diabetes and other lifestyle-related disorders. Regarding addiction patterns, the study identifies a notable prevalence of alcohol consumption among 42% of tribal participants and 16% of non-tribal participants, alongside tobacco usage among 68% of tribal individuals and 61% of non-tribal individuals. It is noteworthy that these addiction patterns are observed to decrease post-diagnosis, underscoring the potential influence of health awareness and interventions on lifestyle modifications among diabetes patients. Furthermore, the intake of certain food groups, including cereals and millets, excessive oils, and sugar, exhibited a noteworthy association across both demographic cohorts. This relationship implies that the consumption patterns of these

Table 1. Distribution of study subjects based on socio-demographic details: N= (Tribal=100, Non tribal=100), (Male=50, Female=50)

Demographic Factors	Tribal Frequency (%)		Non Tribal Frequency (%)	
1. Age Group	**Male**	**Female**	**Male**	**Female**
45-54	14 (28)	18 (36)	15 (30)	16 (32)
55-64	36 (72)	32 (64)	35 (70)	34 (68)
2. Occupation				
Housewife	-	22 (44)	-	28 (56)
Farmer	9 (18)	1 (2)	12 (24)	-
Wage earner	1 (2)	3 (6)	4 (8)	2 (4)
Service	29 (58)	13 (26)	22 (44)	11 (22)
Business	11 (22)	11 (22)	12 (24)	9 (18)
3. Qualification				
Illiterate	2 (4)	2 (4)	3 (6)	6 (12)
Can read & write	1 (2)	3 (6)	4 (8)	2 (4)
Middle school	4 (8)	8 (16)	4 (8)	6 (12)
High school	10 (20)	10 (20)	7 (14)	15 (30)
Higher secondary	14 (28)	11 (22)	13 (26)	7 (14)
Under graduate	15 (30)	16 (32)	15 (30)	12 (24)
Post graduate	4 (8)	-	4 (8)	2 (4)
4. Marital Status				
Married	43 (86)	32 (64)	49 (98)	37 (74)
Unmarried	2 (4)	3 (6)	-	1 (2)
Widow	-	15 (30)	-	12 (24)
Widower	5 (10)	-	1 (2)	-
5. Total Annual Income Of Family (In Rupees)				
<50,000	-	-	1 (2)	1 (2)
50,001 – 1,00,000	2 (4)	4 (8)	-	5 (10)
1,00,001 – 1,50,000	1 (2)	2 (4)	5 (10)	5 (10)
1,50,001 – 2,00,000	3 (6)	2 (4)	3 (6)	8 (16)
>2,00,000	44 (88)	42 (84)	41 (82)	31 (62)
6. Addiction Pattern				
Alcohol				
Yes	34 (68)	8 (16)	16 (32)	-
No	16 (32)	42 (84)	34 (68)	50 (100)
Tobacco				
Yes	35 (70)	33 (66)	25 (50)	36 (72)
No	15 (30)	17 (34)	25(50)	14 (28)

particular food categories may contribute significantly to the observed prevalence of diabetes within both demographic groups. In similar findings, high BMI (*p*=.05) Motovu et al., [13] and high triglyceride levels (*p*=.05) Jayakumari *et al.,* (2020) are significantly correlated with the prevalence of diabetes. Likewise, discovered that over consumption of alcohol (*p*=.05) Kim et al., [11], over intake of energy (*p*=.05) Zujko et al., [14] and protein (*p*=.05) Shahar et al., [15] were significantly correlated with the occurrence of diabetes. Similary to the above finding [16] revealed that excess refined cereal intake were significant (*p*=.05) with increased in diabetes. Bowen et al., [17] and Verma et al., [18] stated that excessive consumption of oils (*p*=.05) and sugar (*p*=.05) occurrence rate of diabetes were significant.

Table 3 presents a comprehensive comparison of nutrient intake between the tribal and non-tribal communities, elucidating their relationship with blood glucose monitoring parameters (FBG, PP, and HbA1c). The analysis reveals notable associations between energy, protein, and calcium intake and diabetes-related outcomes. Specifically, lower energy (*p*=.05) and low calcium (*p*=.05) intake consumption among non-tribal individuals are significantly correlated with FBG test results, suggesting a potential link between dietary habits and fasting blood glucose levels. Additionally, among all examined

Table 2. Profiling of study subjects based on demographic, lifestyle, and clinical parameters: N= (Tribal=100, Non tribal=100), (Male=50, Female=50)

Variables	Tribal Diabetic (Mean ± SD)	Non Tribal Diabetic (Mean ± SD)	P-value
Weight (KG)	65.23 ± 8.46	64.3 ± 10.14	0.00*
Height (CM)	159.01 ± 9.14	167.45 ± 7.78	0.02*
BMI (KG/M^2)	25.40 ± 3.58	25.43 ± 4.61	0.03*
WHTR	1.02 ± 0.07	1.03 ± 0.07	0.29
Tobacco Consumption	1.32 ± 0.46	1.39 ± 0.49	0.27
Alcohol Consumption	1.58 ± 0.49	1.84 ± 0.36	0.01*
FBG	181.47 ± 47.26	164.45 ± 31.77	0.58
PP	260.46 ± 77.71	283.63 ± 81.87	0.55
HBA1C	9.39 ± 2.45	8.40 ± 1.86	0.96
Triglyceride (TG)	188.98 ± 74.79	156.24 ± 93.75	0.04*
Total Cholesterol (TC)	221.89 ± 73.43	185.64 ± 48.75	0.55
LDL	102.21 ± 37.32	93.40 ± 34.71	0.65
HDL	43.15 ± 10.65	50.33 ± 17.71	0.98
Energy (KCAL)	2090.39 ± 411.02	2109.52 ± 458.14	0.00*
Carbohydrate (G/D)	262.31 ± 58.68	259.58 ± 73.82	0.00*
Protein (G/D)	95.39 ± 26.90	70.10 ± 18.35	0.04*
Total Fat (G/D)	75.06 ± 25.22	87.13 ± 29.51	0.34
Dietary Fibre (MG/D)	24.32 ± 7.10	23.83 ± 6.88	0.85
Cereals & Millets (G/D)	237.1 ± 64.98	226.7 ± 78.16	0.00*
Pulses & Legumes (G/D)	15.3 ± 18.17	25 ± 23.67	0.86
Fruits and Vegetables (G/D)	435.44 ± 132.86	325.89 ± 114.39	0.85
Dairy Products (G/D)	140.56 ± 93.58	134.3 ± 100.00	0.10
Fish, Egg and Meats (G/D)	278.93 ± 135.26	138.95 ± 87.30	0.32
Oils (ML/D)	43.78 ± 20.98	19.49 ± 24.88	0.03*
Sugar (G/D)	6.17 ± 2.15	6.22 ± 2.64	0.03*

**Significant at the 0.05 level*

BMI=Body Mass Index, WHtR=Waist Hip Ratio, FBG=Fasting Blood Glucose, PP=Post Prandial, HbA1c=Glycated Haemoglobin, LDL=Low Density Lipoprotein and HDL=High Density Lipoprotein

Table 3. Distribution of study subjects by comparing nutrients intake and blood glucose monitoring

Nutrients	FBG (*P*-value)		PP (*P*-value)		HBA1C (*P*-value)	
	Tribal	Non Tribal	Tribal	Non Tribal	Tribal	Non Tribal
Energy (KCAL)	0.76	0.00*	0.63	0.52	0.00*	0.04
Carbohydrate (G/D)	0.86	0.99	0.94	0.75	0.82	0.25
Protein (G/D)	0.31	0.32	0.30	0.19	0.32	0.01*
Fat (G/D)	0.26	0.21	0.30	0.17	0.62	0.12
Iron (MG/D)	0.29	0.71	0.74	0.60	0.07	0.76
Calcium (MG/D)	0.13	0.02*	0.33	0.03*	0.43	0.62
Dietary Fibre (MG/D)	0.23	0.84	0.16	0.60	0.83	0.92

**Significant at the 0.05 level*

nutrients, only calcium intake (*p*=.05) among the non-tribal community demonstrates a significant effect on PP test results, indicating the importance of calcium consumption in postprandial glucose regulation. Moreover, the study highlights a significant relationship between energy intake (*p*=.05) among the tribal community and protein intake (*p*=.05) among the non-tribal community with HbA1c test results, underscoring their potential impact on glycemic control. The statistical analysis utilized Pearson's correlation to ascertain the strength and direction of these associations, providing valuable insights into the dietary factors influencing diabetes outcomes within these populations. A study conducted by Ha et al., [19] and Alami et al., [20] concludes that high energy intake is directly proportionate to increase in FPG test result.

Another study conducted by Takeda et al., [21] and Kang and Kim [22] also reported significant between high HbA1c levels and energy intake. Hajhashemy et al., [23] found that there was an inverse association between calcium intake type 2 diabetes mellitus.

4. CONCLUSION

In conclusion, our study underscores the significant association between demographic parameters, lifestyle patterns, and clinical findings among both tribal and non-tribal communities in Manipur, India. Factors such as age, weight, height, BMI, alcohol consumption, and triglyceride levels emerged as key influencers of diabetes within both groups. Moreover, nutrient intake, including energy, carbohydrate, and protein, as well as specific food consumption habits such as cereals, millets, oils, and sugar, displayed correlations with diabetes prevalence. Notably, increased energy intake and low calcium intake among non-tribal individuals were significantly associated with FBG test results, while low calcium intake among the non-tribal community showed an inverse correlation with PP test outcomes. Furthermore, tribal energy intake and non-tribal protein intake were notably linked with HbA1c test results. These findings underscore the importance of addressing diverse demographic and lifestyle factors to effectively mitigate the burden of diabetes in both tribal and non-tribal populations. Moving forward, further research and targeted public health strategies are warranted to comprehensively address the multifaceted nature of diabetes prevalence and management within these communities.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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