



Prevalence and Risk Factors of Type 2 Diabetes Mellitus in India: A Focus on Demographics, Lifestyle, and Treatment Patterns

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ABSTRACT

Diabetes mellitus, a prevalent metabolic disorder, results from insufficient insulin or insulin resistance, primarily manifesting as Type 2 diabetes in India. This study surveyed patients across Assam, India, assessing age, BMI, diet, exercise, and medication use. Results showed a higher prevalence in individuals over 50 and those with obesity, linking diabetes risk to family history, poor lifestyle, and socio-economic factors. Findings align with existing literature, highlighting the rising trend of diabetes in India driven by age, genetics, and lifestyle. The study emphasizes the need for targeted prevention and management strategies to mitigate diabetes-related complications. Keywords: BMI, Glucose, Hyperglycemia, Lifestyle, Metformin, Stress.

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INTRODUCTION

Diabetes mellitus is one of the most common diseases in the world. It is a metabolic disease which is controlled by the hormone Insulin (Alam *et al.*, 2014). It is caused either when our body lacks production of enough insulin or when our body cells do not respond normally to the hormone insulin. Due to both the above causes in the body, sugar (Glucose) level increases in the blood which is known as Hyperglycemia (World Health Organization, 2024). The hormone insulin is produced by the beta cells of the gland Pancreas (Kulkarni, 2004).

Generally, there are two types of Diabetes mellitus

i) **Type 1 diabetes mellitus** – It is also known as insulin-dependent diabetes mellitus (IDDM). It is caused when our body lacks to produce enough insulin. When beta cells of pancreas get injured it lacks insulin secretion and leads to type 1 diabetes mellitus (Roep *et al.*, 2021). This type of diabetes usually begins at 14 years of age and that is why it is known as juvenile diabetes mellitus (Alam *et al.*, 2014).

ii) **Type 2 diabetes mellitus** – It is also known as non- insulin-dependent diabetes mellitus (NIDDM) or insulin-independent diabetes mellitus. It is caused when body cells and tissues do not respond to the metabolic effect

of insulin which is called insulin resistance. It is the most common type of diabetes mellitus. About 90% of the total diabetes mellitus cases are type 2 diabetes mellitus (T2DM). This type of diabetes mellitus begins at 30 years of age and usually occurs between the age of 50 and 60 years. Hence it is known as adult-onset diabetes mellitus (Chen *et al.*, 2018; Saaristo *et al.*, 2008). Obesity, excess growth hormones, excess glucocorticoids, Polycystic ovary diseases (PCOD), and some mutations are some of the causes of T2DM (Hall and Hall, 2020).

Apart from type 1 and type 2 Diabetes mellitus, there are also another 2 types of diabetes mellitus:

i) Gestational Diabetes, occurs in pregnant women without a prior diabetes diagnosis and typically resolves after childbirth, but it raises the risk of developing type 2 diabetes later in life (Kim *et al.*, 2007). Pregnancy becomes complicated due to Gestational diabetes mellitus and possesses adverse outcomes both in mother and her offspring (Mohan *et al.*, 2024). ii) Prediabetes, some individuals have blood sugar levels that are elevated but not high enough to be diagnosed with type 2 diabetes mellitus. This condition raises their risk of developing type 2 diabetes, as well as stroke and heart disease (Catalano, 2014; Grundy, 2012).

Stress hormones increase or decreases blood sugar level unpredictably. Thus, taking more stress is a problem for diabetic patients. Diabetic patients suffer from depression and anxiety (Lloyd *et al.*, 2005). Symptoms of depression that can be seen in those patients are: losing interest in various activities, concentration problems and trouble in decision making, not being able to sleep, feeling irritable, hopeless etc (Centers for Disease Control and Prevention, 2024). Diabetes mellitus leads to hyperglycemia, glycosuria, polyuria, ketosis and ketoacidosis, cardiovascular disorders, infection, renal failure, blindness, diabetic microangiopathy and diabetic macroangiopathy (Alam *et al.*, 2014; Blair, 2016). Another prevalent complication of Diabetes mellitus is Erectile dysfunction (Sureshkumar *et al.*, 2024). Diabetic foot ulcer is also a main complication of diabetes and can lead to physical problems. To prevent these complications self-care and patient awareness are of particular importance (Lahni *et al.*, 2024). Symptoms of type 1 and type 2 diabetes mellitus are blurring of vision, unexplained weight loss, fatigue, restlessness and body pain,

hyperglycemia, dry mouth, polyuria, polydipsia, polyphagia etc (Ramachandran, 2014).

Many people have alliances between Diabetes and other diseases like Tuberculosis and Hypertension. Several factors increase the chances of having TB-DM (Tuberculosis - Diabetes mellitus) co-morbidity (Singh *et al.*, 2024). Quality of life deteriorates in individuals with both Diabetes mellitus and hypertension (Senthilkumar *et al.*, 2024).

For measuring diabetes FBS (Fasting Blood Sugar) and PPBS (Postprandial Blood Sugar) test is done. FBS test is the test in which value of blood sugar level is measured before eating anything or in empty stomach. And PPBS test is the test in which value of blood sugar level is measured after 2 hours of eating. Apart from FBS and PPBS test there is also another test known as Random Blood Sugar (RBS) test. This test is conducted at any time regardless of before or after eating (Centers for Disease Control and Prevention, 2024).

FBS	PPBS
Normal - ≤ 99	Normal - ≤ 140
Pre-diabetes - 100-125	Pre-diabetes - 140-199
Diabetes - ≥ 126	Diabetes - More than 199

The study focuses on identification of the characters of those who have been diagnosed as type 2 diabetes mellitus and are taking treatment, and to access the effects of important factors affecting type 2 diabetes mellitus. The factors are: BMI (Body Mass Index), Unhealthy food taking, age and lack of exercise and Identification of the most used medicine from the survey.

MATERIALS AND METHODS

Sources of Review

This systematic review followed the PRISMA guidelines, utilizing databases of research papers, scholarly articles, books, and websites such as PubMed, Google Scholar, ResearchGate, and Scopus. Only studies published in the past 25 years were included to ensure relevance. The systemic literature search was focused on factors influencing type 2 diabetes in India, including Body Mass Index (BMI), unhealthy eating habits, stress, lack of exercise, and commonly used medications. Boolean operators (AND, OR) were used to refine the search in the selected databases.

Studies were included in the review based on: (1) studies published in the last 25 years; (2) matching keywords; (3) studies with full-text availability; (4) publications from reputable journals and databases like PubMed, Google Scholar, ResearchGate, and Scopus; (5) studies mainly focused on Indian subcontinent; and (6) studies presenting clear methodologies and relevant results. Exclusion criteria were: (1) studies with incomplete data or insufficient methodological details; (2) abstracts or conference papers without full-text access; (3) studies not related to type 2 diabetes or the identified factors of interest; (4) publications from non-reputable sources or

journals; and (5) studies with a high risk of bias or those lacking proper result reporting and analysis.

The quality of included studies was assessed using standard tools for evaluating both observational and interventional studies. Criteria such as research question clarity, study design, sample size, statistical analysis, and result reporting were considered. Studies were rated on a scale from low to high quality. The review adhered to PRISMA guidelines, reporting the study selection process, eligibility criteria, data extraction methods, and synthesis of findings. A PRISMA flow diagram was used to visualize the selection process.

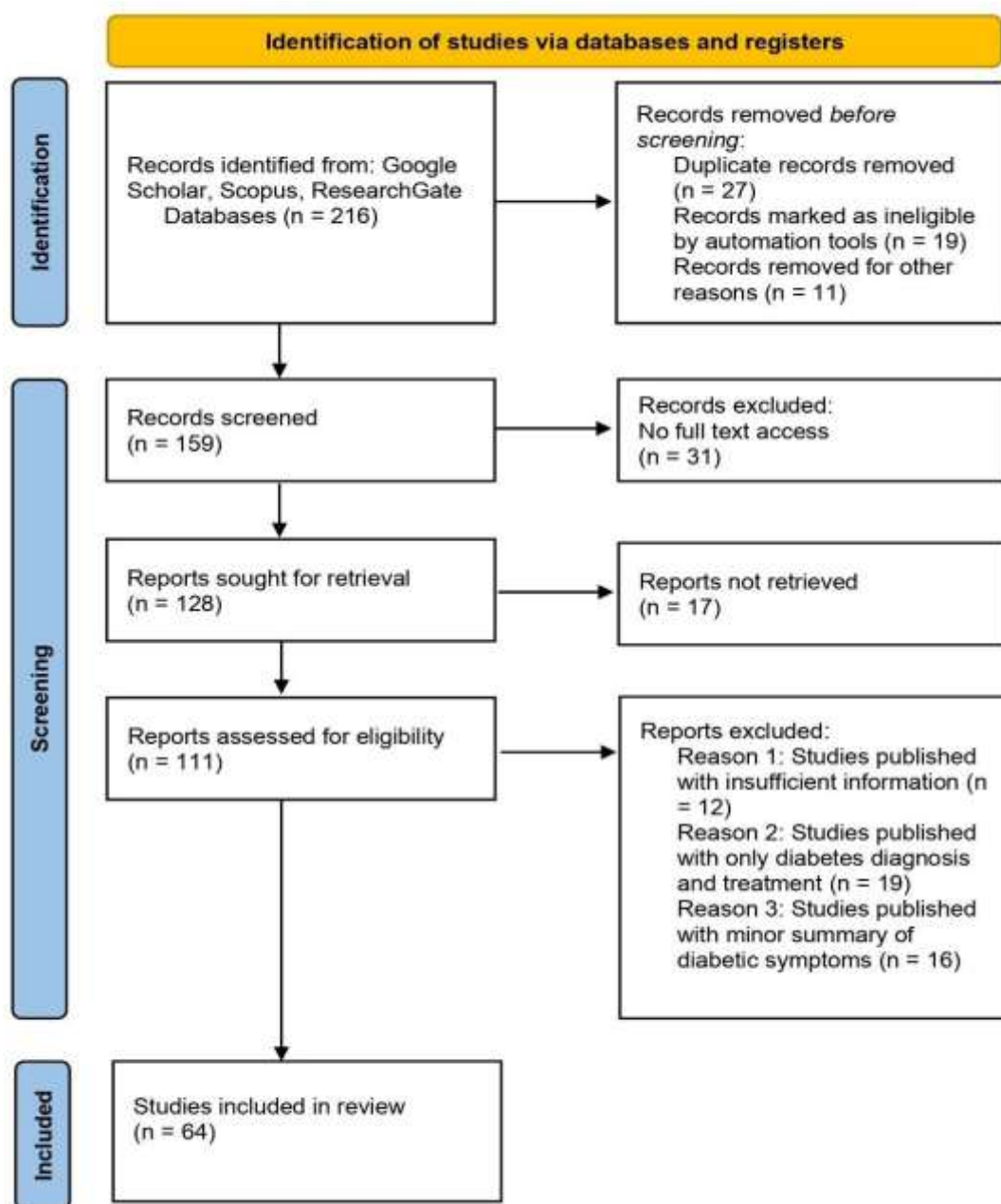


Fig.1 PRISMA Flow chart to visualize the systematic review process

2.2 Survey Design

A study on the prevalence, observed symptoms, influencing factors, and the most commonly used medications for diabetes mellitus in Assam, India comparing survey data with existing literature from across India. On a local scale a survey was conducted to find out the symptoms of patients with diabetes mellitus and the medicines used by them. The survey was conducted randomly, selecting patients from various regions within the same state, with the number of participants differing by location. Areas were chosen based on convenience and patient availability. Patients were interviewed about their age, height, weight, diet, blood sugar levels, medications, and physical activity. The survey also aimed to identify factors influencing diabetes mellitus, such as BMI, diet, exercise, stress, and age. The data collected from the survey, which includes height and weight, is used to calculate the BMI of diabetic patients. BMI is determined by dividing an individual's weight in kilograms by the square of their height in meters (Nuttall, 2015). The relationship between BMI and

blood sugar levels is then analyzed and examined. All survey participants were asked to provide the names of the medications they take. The most commonly used medication was identified, and the compositions of these medicines were noted.

3. RESULTS AND DISCUSSIONS

3.1. Survey Analysis:

On the basis of the survey, the list of the individuals with type 2 diabetes mellitus are listed in Table 1. The table presents data on diabetic patients, including their age, fasting blood sugar (FBS), post-prandial blood sugar (PPBS), medications, and body mass index (BMI). There are 27 individuals in total, with ages ranging from 38 to 75 years. The FBS values vary significantly, with the lowest recorded at 76 mg/dL and the highest at 302 mg/dL. Similarly, the PPBS values also show considerable variation, with a minimum of 109 mg/dL and a maximum of 323 mg/dL.

Table 1: Surveyed individuals with type II diabetes mellitus with their FBS, PPBS and prescribed medicine intake

Sl. No.	AGE	FBS	PPBS	COMPOSITION OF MEDICINE USED	BMI
1	54	141	109	Metformin hydrochloride	24.1
2	52	220	234	Metformin hydrochloride	25.6
3	50	238	260	Metformin hydrochloride	25.9
4	56	185	205	Glimepiride, Metformin and Voglibose	25.1
5	38	216	232	Metformin hydrochloride	25.3
6	52	195	220	Metformin hydrochloride	25.9
7	50	302	320	Metformin hydrochloride	26.3
8	52	136	156	Metformin hydrochloride	28.2
9	60	209	273	Metformin hydrochloride	26.2
10	59	194	323	Glimepiride and Metformin	25.1
11	62	110	160	Metformin hydrochloride, Glimepiride, Sitagliptin, Vildagliptin	23.1
12	62	160	212	Sitagliptin, Metformin, Dapagliflozin, and Voglibose	26.8
13	60	76	142	Dapagliflozin, Metformin hydrochloride and Vildagliptin	22.6
14	55	137	268	Metformin hydrochloride	28.8
15	50	110	184	Metformin hydrochloride	19.5
16	62	123	153	Gliclazide and Metformin	22.14
17	75	107	265	Metformin hydrochloride	25.0
18	60	102	190	Metformin hydrochloride	25.1
19	60	129	212	Metformin hydrochloride	24.2
20	65	165	246	Linagliptin and Metformin	32.8
21	74	145	236	Gliclazide extended release	26.0
22	70	136	166	Metformin hydrochloride	22.4
23	41	118	228	Metformin hydrochloride	24.1
24	55	116	140	Metformin hydrochloride and Teneligliptin	25.8
25	56	158	312	Vildagliptin, Metformin and Gliclazide	25.2
26	53	125	150	Glimepiride, Pioglitazone hydrochloride, Linagliptin and Empagliflozin	26.9
27	53	141	160	Metformin hydrochloride	24.14

The patients are prescribed various medications, predominantly Metformin hydrochloride, available in different formulations like Glycomet®, Glycicon®, and others. Other medications include Amaryl® and Diamicon®, indicating a diverse approach to diabetes management. The survey indicates that Metformin hydrochloride tablets are the most commonly used medication among diabetic patients. These tablets are available in doses of 500 mg, 850 mg, or 1000 mg of metformin hydrochloride (Brar *et al.*, 2024; Corcoran and Jacobs, 2018). The extended-release version of Metformin hydrochloride tablets includes inactive ingredients such as hypromellose, magnesium stearate, and polyvinyl pyrrolidone (Chandira *et al.*, 2010; Klepser and Kelly, 1997).

The BMI of the patients ranges from 19.5 to 32.8, suggesting a spectrum of body weight statuses among the individuals. Overall, the table provides a comprehensive overview of the relationship between blood sugar levels, medication use, and BMI in this group of diabetic patients

Typically, the Post Prandial Blood Sugar (PPBS) value is higher than the Fasting Blood Sugar (FBS) value. FBS measures blood sugar levels before eating, while PPBS measures blood sugar levels two hours after a meal

(Chandra Sekhar *et al.*, 2020). However, there are instances where the PPBS value can be lower than the FBS value. In the survey mentioned above, one individual was found to have a PPBS value that was lower than their FBS value.

3.2. BMI and Diabetes Mellitus

The survey (Table 1) reveals that most individuals with diabetes mellitus have a higher BMI, classifying them as overweight or obese. Additionally, those with elevated BMIs tend to show significantly increased blood sugar levels. BMI values help determine if a person is overweight or obese: a BMI between 18.5 and 24.9 is considered healthy, 25 to 29.9 indicates overweight, and a BMI of 30 or more indicates obesity (Nuttall, 2015).

The correlation between BMI and PPBS is 0.403 (Fig. 3), and between BMI and FBS, it is 0.3198 (Fig. 2). This suggests that, while individuals with higher BMI generally have higher FBS and PPBS values, there are exceptions due to various other factors influencing diabetes mellitus. The pattern in Fig. 4 indicates a strong association between the moderate overweight category (BMI 24.9–29.9) and the prevalence of diabetes mellitus.

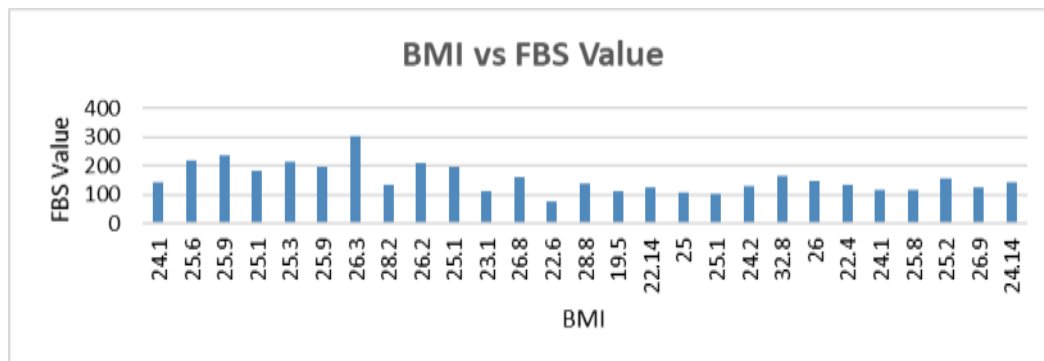


Fig 2: Graph showing BMI vs FBS value of the above survey

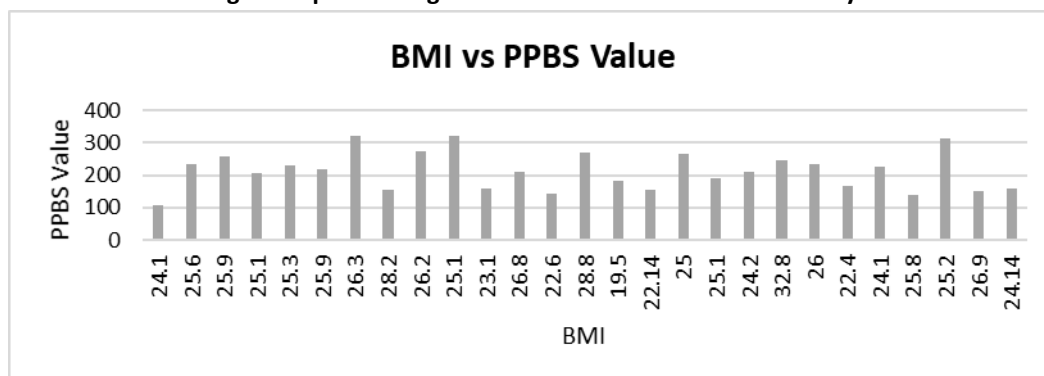


Fig.3: Graph showing BMI vs PPBS value of the above survey

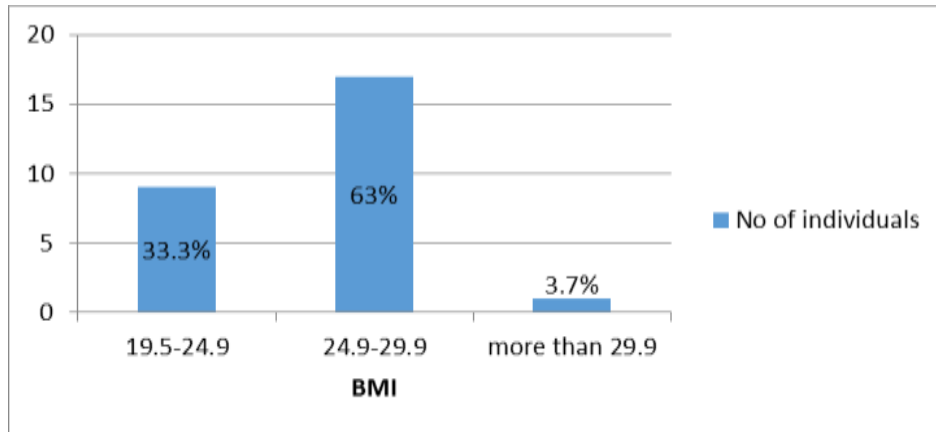


Fig.4 Number of individuals with diabetes mellitus at a particular range of BMI

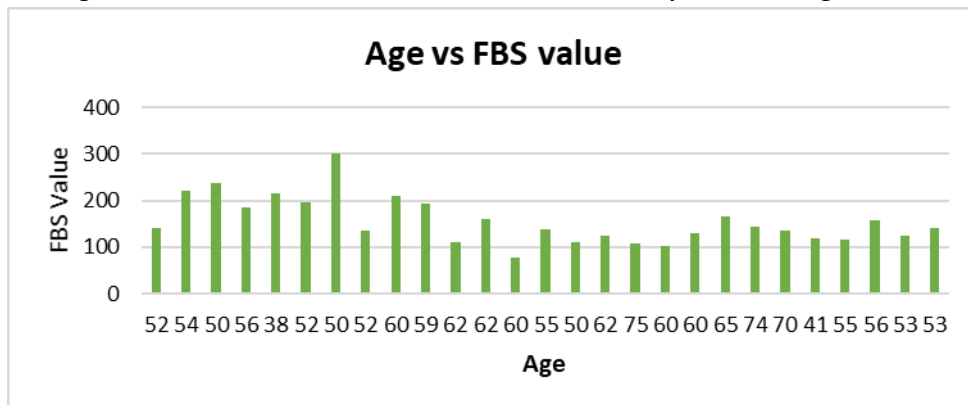


Fig.5 Graph showing Age vs FBS value of the above survey

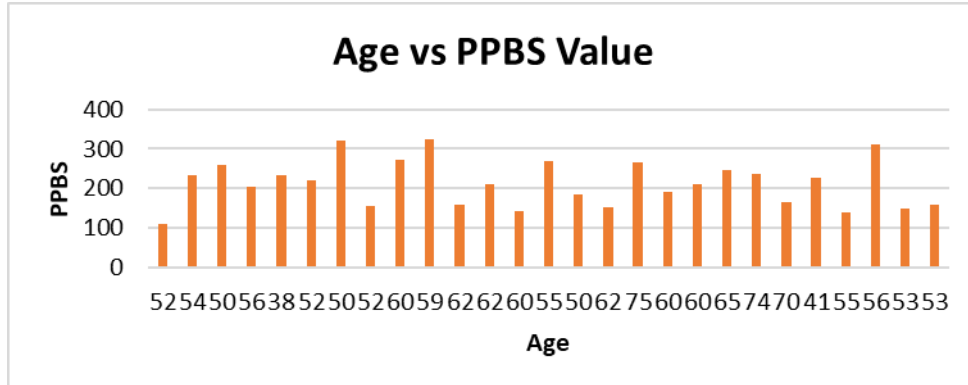


Fig.6 Graph showing Age vs PPBS value of the above survey

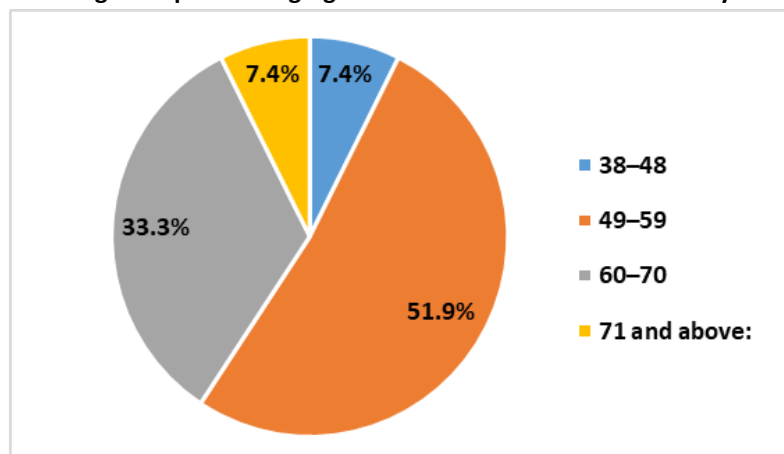


Fig 7: Number of diabetic individuals at the particular age range

3.3. Age and Diabetes mellitus

The survey reveals that individuals aged 50 and above have a higher incidence of diabetes mellitus compared to those under 50 (Table 1 and Fig.5). Among the 27 individuals surveyed, only 2 are below 50 years old. The correlation between Age and Fasting Blood Sugar (FBS) is -0.33 (Fig.5), while the correlation between Age and Postprandial Blood Sugar (PPBS) is 0.013 (Fig.6). The negative correlation between Age and FBS suggests that FBS levels may decrease with age; however, this trend is not consistent. Typically, type 2 diabetes is more prevalent in individuals aged 40 and above (Fig.7). FBS and PPBS values can vary independently of age due to various other influencing factors (Akhtar and Dhillon, 2017).

3.4. Unhealthy lifestyle increases the risk of diabetes mellitus

The survey indicates that individuals with the disease tend to lead an unhealthy lifestyle, characterized by poor diet, lack of physical activity, and high stress levels. Additionally, some consume alcohol, and some smoke cigarettes. These factors collectively increase the risk of developing diabetes (Bagheri *et al.*, 2016; Rimm *et al.*, 1995). Junk food contributes to higher calorie and sugar levels in the body. Stress is a significant factor in the development of diabetes, and the stresses of modern life have made the disease more prevalent than in the past (Mozzillo *et al.*, 2017). Diabetic patients report that maintaining a healthy diet and engaging in regular exercise are effective in managing blood sugar level.

3.5. Prevalence of Type 2 Diabetes mellitus in India

Type 2 Diabetes mellitus is increasing day by day in all over India. In India, since 1990, accelerating from the year 2000. Prevalence rose from 7.1% in 2009 to 8.9% in 2019 (Pradeepa & Mohan, 2017; Mehta *et al.*, 2009). After China, India ranks second in the global diabetes epidemic with 77 million people with diabetes (Pradeepa & Mohan, 2021). According to The India State-Level Disease Burden Initiative, prevalence increased from 5.5% in 1990 to 7.7% in 2016, with Tamil Nadu, Kerala, and Delhi having the highest prevalence (Tandon *et al.*, 2018).

In the year 2000 national survey in six major cities showed a prevalence of diabetes in 12.1% in urban Indian adults (Ramachandran *et al.*, 2001). The National Family Health Survey found the highest prevalence in south India (9.39%), followed by eastern

(6.81%) and western India (6.58%). The lowest prevalence of diabetes (4.90%) and pre diabetes (4.86%) was in Northern India (Chandrupatla *et al.*, 2020). The ICMR-INDIAB study reported an overall prevalence of 7.3%, ranging from 4.3% in Bihar to 10.0% in Punjab, and was higher in urban areas and mainland states compared to the northeast. As per this study, States with higher per-capita GDP seemed to have a higher prevalence of diabetes (Anjana *et al.*, 2017).

A community-based cross-sectional study reported a 9.5% prevalence for both men and women, highest in the Western region (16.6%) and lowest in the Northeast (5.5%) (Meshram *et al.*, 2016). A study in rural Northeastern states found married participants had a higher prevalence of diabetes than widowed ones, with no significant gender difference (Medhi *et al.*, 2021). Another survey found married (11.6%) and separated (11.0%) individuals were at higher risk than unmarried ones (Nagarathna *et al.*, 2020).

3.6. Factors affecting Diabetes mellitus in India

Evidence from large-scale surveys in India showed that obese individuals had two times higher risk for “newly diagnosed” and 1.5 for “self-reported only” diabetes compared to persons with normal BMI (Akhtar & Dhillon, 2017). An analysis in North Eastern India using a seemingly unrelated probit model found that overweight or obese individuals have a 3.5% higher chance of having diabetes compared to those who are not overweight. This analysis further showed that among overweight and obese individuals, a 10% increase in overweight and obesity causes an increment of 4.7% in diabetes (Marbaniang, *et al.*, 2021). A study using data from the Indian Demographic Health Survey showed a non-linear effect of Body Mass Index (BMI) on diabetes, where the risk was lower for individuals with BMI values of 20 to 25 but significantly higher for BMI values of 50 and more (Marbaniang *et al.*, 2022). A population-based, cross-sectional study found that as BMI levels increased, the prevalence of diabetes increased, with the lowest prevalence (2.4%) among underweight individuals and the highest (30.4%) among obese individuals (Medhi *et al.*, 2021). A cross-sectional analysis in India reported that the prevalence of diabetes is higher among obese men (11.46%) than obese women (9.19%) (Sujata & Thakur, 2021). As per a review, despite a lower BMI, the existence of high insulin resistance in Asian Indians could be explained

by upper body adiposity. Central obesity, indicated by the deposition of large quantities of abdominal visceral fat, increases the risk of diabetes by favoring insulin resistance (Mehta, Kashyap, & Das, 2009). According to a study using the National Family Health Survey (2015-16), average self-reported diabetes prevalence is three times higher among overweight or obese individuals compared to non-overweight individuals. When BMI increases by one unit, the probability of having diabetes increases by 1.5% among obese and overweight individuals, compared to 0.5% among normal individuals (Gupta & Bansal, 2020).

According to the results from a STEPS survey in Punjab, Diabetes mellitus was found to be most prevalent (18%) among those aged 45-69 years (Tripathy *et al.*, 2017). The National NCD Monitoring Survey (NNMS) stated that the mean Fasting Blood Glucose was higher in the older age group of 50-69 years (107.47 mg/dl) compared to the overall mean of 96.7 mg/dl for ages 18-69 (Mathur, Leburu, & Kulothungan, 2022). A cross-sectional study resulted in the highest number of diabetic patients being from the age group 60-69 years (26.7%) (Sarkar, Ojah, & Sharma, 2022). According to data from the fifth round of the National Family Health Survey of India, the prevalence of diabetes among people aged 15 years and older was 16.1% and was found to increase with age (Maiti *et al.*, 2023). Evidence from large-scale surveys confirmed a positive association, showing the risk for both newly diagnosed and self-reported diabetes is higher in people aged 60 and above compared to the youngest age group (Akhtar & Dhillon, 2017). Another study comprising 132 type 2 diabetes patients found that the prevalence is highest in the age group 41-50 years (28%), followed by 51-60 (24%) (Borah & Goswami, 2017).

A cross-sectional analysis in India reported that among different genders, the prevalence of diabetes is higher in men (2.63%) than in women (2.35%). According to Sujata and Thakur (2021), women in urban areas are more affected (3.53%) than their male counterparts, while men in rural areas are more affected (2.30%) than rural women. A population-based cross-sectional study conducted from April 2009 to March 2010 in Yingkion, Upper Siang district of Arunachal Pradesh, revealed that diabetes prevalence was higher in females (39.07%) than males (32.10%), and the magnitude of impaired glucose tolerance (IGT) was

12.04%, with 10.51% in males and 13.58% in females (Zaman & Borang, 2014).

A review study in Northeast India found that urban women in Tripura had the highest blood glucose level (5.8%), while rural women in Meghalaya had the lowest (1.6%). Among men, urban males in Sikkim had the highest blood glucose level (6.4%), followed by those in Nagaland (5.7%) and Tripura (5.4%), with rural males in Sikkim showing the lowest levels. Overall, urban residents of both genders had higher blood glucose levels than their rural counterparts (Devi, Meitei, & Singh, 2023).

Das, *et al.* (2012) highlighted that individuals with both parents affected by diabetes had significantly higher blood glucose levels than those without a family history of type 2 diabetes mellitus (T2DM). In Kancheepuram district, Tamil Nadu, a cross-sectional study at an urban health training center reported that 68.8% of T2DM patients had a family history of diabetes, with 25.1% having a diabetic mother and 15.3% a diabetic father (Gopalakrishnan & Geetha, 2017). Similarly, research from Trivandrum District in Kerala found that 78.7% of patients cited family history as the most common risk factor (Sathish *et al.*, 2023).

Unhealthy lifestyles are also significant risk factors for diabetes mellitus. Sujata and Thakur (2021) found that diabetes prevalence is higher among alcohol consumers than non-consumers, with alcohol contributing to chronic pancreatic inflammation and impaired insulin secretion. Changes in eating habits and sedentary occupations, especially in urban adults, are major contributors. Fast food rich in calories and fats, along with 'sedentarism', are key drivers of diabetes. Mohan, Shanthirani, and Deepa (2003) observed that diabetes prevalence was three times higher among individuals engaged in light physical work compared to those in heavy physical work. A cross-sectional study using the 2015-16 Demographic and Health Survey found that participants in high physical activity occupations had a lower diabetes prevalence (6.87%) than those in low physical activity jobs (10.11%) (Chandrupatla *et al.*, 2020).

In the Rani Development Block of Kamrup District, Assam, diabetes prevalence was higher among alcohol users (11.3%) and tobacco users (12.8%) compared to non-users (8.6% and 8.5%, respectively). Among

users, those consuming alcohol for more than five years had a prevalence of 13.5%, and tobacco users for 1–5 years had a prevalence of 15% (Sarkar, Ojah, & Sharma, 2022). Basu *et al.* (2024) reported that among diabetes mellitus patients, the majority of smoking tobacco users (95.7%), dual users (99.75%), smokeless tobacco users (64.31%), and alcohol consumers (91.88%) were males.

Das and Kar (2023), using data from the Longitudinal Ageing Study in India (2017–18), found that wealthier individuals are at higher risk of diabetes due to lifestyle factors, smoking, and tobacco consumption. However, the impact of lifestyle behavioral factors on diabetes prevalence was less significant compared to other determinants.

According to a survey study, among patients of diabetes mellitus prevalence of high/very high stress was 35%. As per the study, the factors significantly associated with stress are age 30–40 years, working in professional jobs, and lack of physical activity. The reasons behind stress are family-related issues, job-related issues, financial problems, and disease-related problems Sendhilkumar *et al.*, (2017) As per a study it was found that majority of the diabetic patients whether male or female were having stress due to different reasons. The percentage of females is higher than males, prevalence of stress being found among 84.75% females and 58.54% males (Kaur and R. Kochar, 2017). A cross-sectional, case-control study showed that type 2 diabetic patients had higher stress scores as compared to individuals with normal glucose tolerance (NGT). As compared to individuals with NGT, the prevalence of stress was almost three-fold higher in individuals with T2DM (Vidyulatha *et al.*, 2022).

CONCLUSION AND FUTURE PROSPECTS

Diabetes mellitus is a significant global health issue, with India being one of the most affected countries. This study identified various factors contributing to the development of type 2 diabetes mellitus through a survey analysis. It was observed that BMI, unhealthy lifestyle choices, such as physical inactivity, poor diet, excessive alcohol consumption, and smoking, are key risk factors. In addition, age and genetics also play a role in increasing susceptibility to the disease. From the survey it can be asserted that the correlation of these factors with type 2 DM may not be always

positive as the latter doesn't only depend on one factor.

To address this issue, future efforts in India should prioritize preventive strategies. Public health campaigns that promote healthy lifestyles, including balanced diets and regular exercise, are vital. Furthermore, educational programs should raise awareness about the risks of smoking and excessive alcohol consumption.

Given the genetic predisposition involved, implementing genetic screening programs could help identify individuals at higher risk, enabling early intervention and potentially preventing or delaying the onset of diabetes.

In addition, continued investment in research is essential to better understand the intricate relationship between genetics, lifestyle, and environmental factors, ultimately leading to more effective treatment options. Telemedicine can also play a crucial role by offering remote consultations, medication management, and ongoing support for patients, especially in rural or isolated regions. By adopting these multifaceted approaches, India can effectively combat the diabetes epidemic and improve the quality of life for millions.

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Conflict of Interest

The authors affirm that they do not possess any known competing financial interests or personal relationships that might have appeared to influence the work reported in this paper.

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