

Literature Analysis on The Prevalence of Type 2 Diabetes Mellitus in Adolescents and Young Adults. A review study

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ABSTRACT

Background: Diabetes is a significant global health concern characterized by persistent hyperglycemia that leads to severe complications with time, including damaging cardiovascular system, kidneys, nerves, and eyes. Among its major types—Type 1, Type 2, and gestational—Type 2 Diabetes Mellitus (T2DM) is increasingly affecting adolescents and young adults due to lifestyle-related factors. **Objectives:** This study investigates the prevalence of Type 2 Diabetes Mellitus (T2DM) among adolescents and young adults, focusing on the relationship between obesity and T2DM, specifically concerning sedentary behavior, unhealthy dietary practices, and inadequate physical activity. **Methods:** A thorough literature search was performed utilizing the PubMed (MEDLINE) and EMBASE databases. The keywords used were “Diabetic,” “Prevalence,” “Indian Population,” “Young Population,” and “Adolescents.” Articles published between 2010, and March 2024 were considered for review. **Results:** An upward trend in early-onset Type 2 Diabetes Mellitus (T2DM) has been noted, especially in India, where the estimated number of diabetic individuals was 77 million in 2019. Projections indicate an increase to 101 million by 2030 and 134 million by 2045. Among the population studied, 46.6% were overweight and 22.9% were obese. The rise in T2DM is paralleled by an increase in obesity, especially in regions like Pacific Island nations and parts of Europe. **Conclusion:** There is a growing need for large-scale, focused research on the rising incidence of T2DM among the youth. Early preventive strategies including awareness campaigns, healthy lifestyle promotion, and physical activity encouragement are essential to mitigate the global burden of diabetes in young populations.

KEYWORDS: Diabetic, Prevalence, Obesity, Young Population, Adolescents.

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INTRODUCTION

The global health problem with diabetes is very important. The disease is defined by high glucose levels in the blood, which are long term and steadily increasing. It is also known to be a complex disease with different age-related causes that are affecting individual patients. Diabetes, according to the World Health Organization, is a chronic metabolic condition marked by high blood glucose or blood sugar levels that, over time, cause major harm to the heart, blood vessels, eyes, kidneys, and nerves. Type 1 diabetes, type 2 diabetes, and gestational diabetes mellitus are the three main types of diabetes [1].

Just 5–10% of people with type1 diabetes, formerly known as juvenile onset or insulin-dependent diabetes. Insufficiency of insulin at any age. Type 2 diabetes, which affects 90% to 95% of adults, was previously called non-insulin dependent or adult-onset diabetes [2].

Most subjects with this form of diabetes are obese, and obesity adds to insulin resistance since hyperglycemia develops slowly and is often not severe enough for the patient to notice. This kind of diabetes is rarely treated for years. Worldwide, 36.9% of men, 38% of women, 23.8% of boys, and 22.6% of girls are overweight or obese [3]. Another risk factor for type 2 diabetes in children is family history. Offspring of a parent with T2DM are more likely to get the condition, and the risk increases if both parents have it [4]. Inactive youth are more likely to develop type 2 diabetes, insulin resistance, and metabolic syndrome. In rich societies, especially urban populations, socioeconomic hardship is a major risk factor for obesity and type 2 diabetes [5].

This study highlights the rising incidence of type 2 diabetes mellitus (T2DM) among young adults and adolescents, illustrating

its strong correlation with obesity resulting from sedentary lifestyles, insufficient physical exercise, and poor food habits. These findings underscore the imperative to tackle modifiable lifestyle risk factors early in life, since they substantially influence the start, progression, and consequences of T2DM. Identifying these variables is essential for developing focused prevention initiatives, enhancing community-based interventions, and guiding clinical guidelines for early detection and therapy. This study highlights the increasing prevalence of T2DM among younger populations, emphasizing the necessity of incorporating lifestyle change programs, regular screening, and health education into public health strategies. Such initiatives are crucial to alter the course of T2DM and to alleviate enduring health and socioeconomic repercussions.

MATERIALS AND METHODS

We have conducted a search of PubMed (MEDLINE) and EMBASE for all pertinent articles published using the specified keywords: Diabetic, Prevalence, Obesity, Young Population & Adolescents. The literature search was conducted within a defined time frame, covering articles published from 2010 to March 2024.

2.1 Diabetes Mellitus

Diabetes is a chronic condition resulting from inadequate insulin production or hereditary deficiencies and causes an increase in blood sugar, affecting blood vessels and nerves [6]. Diabetes mellitus (DM), the predominant cause of endocrine problems, impacts approximately 100 million individuals globally, or 6% of the total population. The reason is irregular blood sugar values resulting from insufficient or ineffective synthesis of insulin by the pancreas. It has been shown to damage the heart, blood vessels, kidneys, eyes, nerves and other body systems [7]. Pre-diabetics have fasting plasma glucose levels of 100–125 mg/dL (5.6–6.9 mmol/L), 2-hour plasma glucose levels of 7.8–11.0 mmol/L on an oral glucose tolerance test, or HbA1c values of 5.7–6.4%. These people are at increased risk for type 2 diabetes and cardiovascular disease [8].

2.2 Sign and Symptoms

Hyperglycemia, weight loss, polyuria, polydipsia, and blurred vision are diabetes symptoms. Growth retardation and infection susceptibility are indications of prolonged hyperglycemia [9].

2.3 Types of Diabetes Mellitus

Type 1 diabetes, previously referred to as insulin-dependent diabetes. The immune system attacks beta cells, inhibiting the pancreas from making insulin, which is vital for survival. This type is more prevalent in children and teenagers, but as people age, it becomes more apparent. Type 1 diabetes can be fatal and frequently develop suddenly [10]. Type 2 diabetes, formerly known as noninsulin-dependent diabetes, is caused by insulin resistance. Around 90% of diabetes cases worldwide are type 2 diabetes. Although it is more common in adults, teenagers are also starting to experience it on a regular basis. Although some may also have abdominal adiposity, these individuals usually have obesity [10].

Pathophysiology. Regarding the pathophysiology of the condition, abnormally elevated blood glucose values result from a failure of the reactions between insulin action and insulin secretion [11]. Reduced insulin synthesis in β -cell malfunction hinders glucose maintenance. In contrast, insulin resistance (IR) increases liver glucose production and lowers liver, muscle, and adipose glucose uptake. β -cell dysfunction is normally more severe than IR, yet both contribute to disease development early in the pathogenesis. Combined β -cell loss and IR lead to worsening hyperglycemia and T2DM progression [12,13].

Assessment of β -cell function in individuals at risk for diabetes was of interest, as β -cell function is reduced by approximately 75% in fasting hyperglycemia. As fasting glucose levels rise, β -cell activity gradually decreases, although glucose levels are still within the normal range. According to the preexisting risk concept, individuals at increased risk of eventually developing diabetes show signs of β -cell dysfunction even before their glucose tolerance is considered impaired. Genetically predisposed to type 2 diabetes and first-degree relatives also have reduced beta-cell activity, although their glucose tolerance may still be normal [14,15].

This flowchart illustrates the underlying mechanisms that lead to the development of Type 2 Diabetes Mellitus. The process begins with genetic and lifestyle risk factors, advances via resistance to insulin and β -cell malfunction and culminates in chronic hyperglycemia and clinical diagnosis.

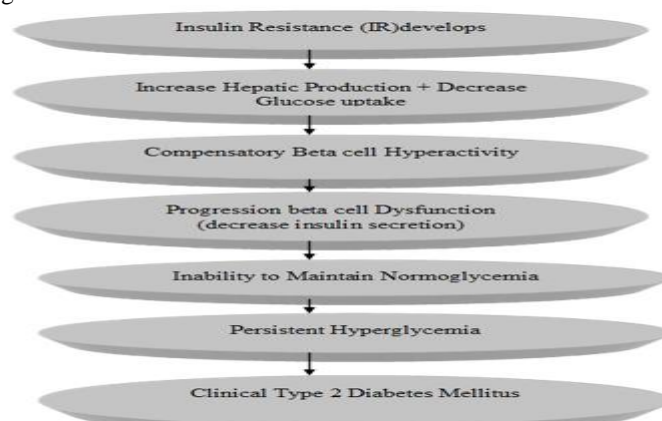


Figure 1. Flowchart of the pathogenesis of Type 2 Diabetes Mellitus (T2DM) from risk factors to clinical manifestation.



Figure 2. Composite Picture of DM and its Symptoms and Complications Results

2.4 Complications

Like adults, young people with type 2 diabetes are prone to micro- and macrovascular complications associated with the disease. There is prior evidence of microvascular effects. Young people with type 2 diabetes who were under the age of thirty-three were the subjects of a Canadian study. Of the fifty-one individuals, one had a toe removed, six percent were on dialysis, and nine percent had died [16]. A follow-up study conducted in Japan looked at the likelihood of the onset of nephropathy in individuals with type 1 and type 2 diabetes diagnosed at or before the age of thirty [17].

Krakoff et al. [18], In Pima Indians diagnosed with type 2 diabetes at ~20 years (youth), 20-39 years (young adults), and 40-59 years (elderly) had higher rates of retinopathy and nephropathy. Nephropathy was prevalent in all age groups and was not connected with type 2 diabetes diagnosis age (after five years, 13/1,000 teenagers, 8/1,000 young adults). Older adults: 7/1,000. But retinopathy did not appear in juvenile diabetes for at least five years, as opposed to people with adult-onset diabetes who had it in such a short time. At all durations of diabetes, retinopathy occurred less frequently in young patients than in adults. In SEARCH, adolescents and young adults with T2DM exhibited a markedly greater prevalence of microvascular complications and comorbidities (diabetic kidney disease, retinopathy, and peripheral neuropathy) compared to their counterparts with T1DM [19]. Comparing patients with T2DM and T1DM showed that the latter had much higher levels of microalbuminuria, which was associated with a faster development of macroalbuminuria [20]. In a multinational, long-term observational cohort study, the incidence of diabetic peripheral neuropathy was threefold higher in young adults with T1DM and similar in older adults with age-diagnosed T2DM [20].

The rates of progression of retinopathy in young Japanese with type 1 and type 2 diabetes are comparable; however, nephropathy occurs approximately twice as often in type 2 diabetics than in type 1 patients [21]. After 20 years of diabetes, 128 Japanese subjects under 35 years of age with proliferative retinopathy, of which 23% received dialysis. Of the 1,065 people with type 2 diabetes requiring dialysis, 50 had onset before age 30, and the average age at diagnosis was 20. Another important finding is the finding that primary and acquired kidney disease unrelated to diabetes appears to be more common in people with highly prevalent of type 2 diabetes in young people [22,23]. In a British study, despite having less time with diabetes and similarly poor glycemic control, patients with T2DM had retinopathy at all stages (age of onset) [24].

This diagram outlines the complications associated with Type 2 Diabetes Mellitus in young individuals. It includes microvascular and macrovascular complications as well as other observed effects such as dialysis and early mortality, with specific focus on illness progression and organ system damage.

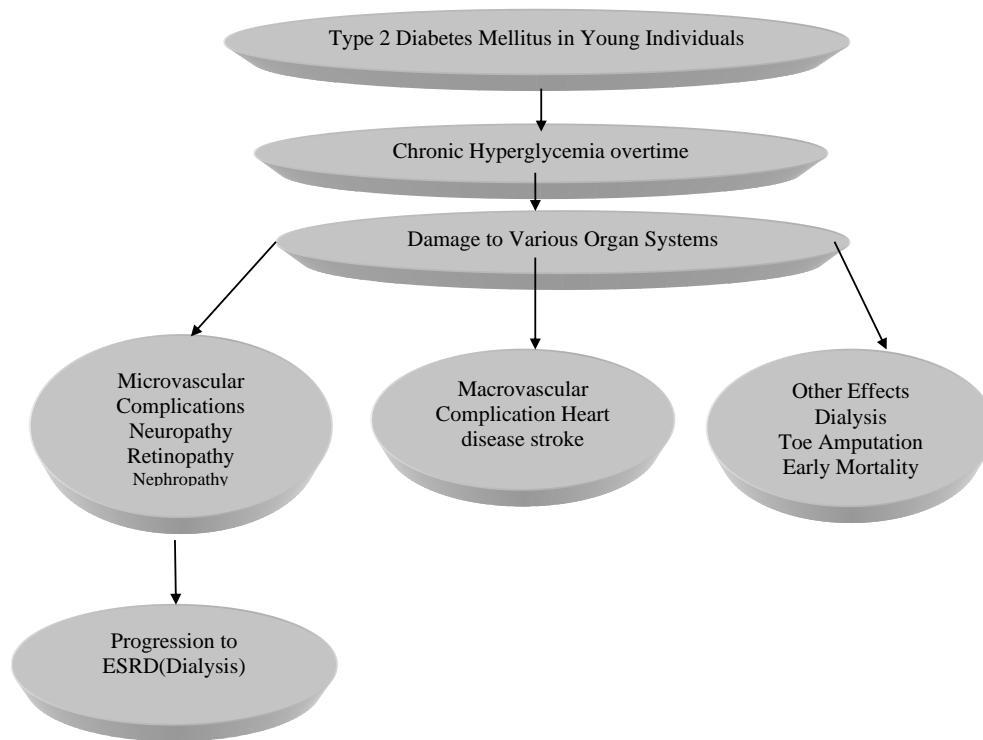


Figure 3: Complications associated with Type 2 Diabetes Mellitus (T2DM) in youth.

2.5 Worldwide Prevalence Rate of Type 2 Diabetes Mellitus

A significant worldwide health burden that has grown over the previous 20 years is type 2 diabetes. The occurrence of type 2 diabetes in children, adolescents & young adults has increased recently, especially since the 2000s. This is a public health concern, as indicated by the nearly threefold increase in the standardized incidence of disease among people under 40 years of age [25]. In 2021, about 537 million adults (aged 20-79) lived there with illness. By 2045, that number is expected to increase to 783 million [25,26]. T2DM will impact 8.5% of the world's population (642 million) by 2040, up from 4.7% in 1980, according to the WHO. By 2030, 552 million would have diabetes, up from 366 million in 2011. Every country has rising type 2 diabetes rates, and 80% of those affected live in low- and middle-income countries [27]. Asia is a significant region impacted by the swiftly escalating global epidemic of Type 2 Diabetes Mellitus (T2DM). In 2011, it was estimated that 366 million individuals would have diabetes; by 2030, this figure is expected to rise to 552 million.

The prevalence of type 2 diabetes is rising globally, with 80 percent of individuals affected residing in low- and middle-income nations [27]. Globally, adult diabetes prevalence is anticipated to rise from 5.2% to 6.2%. 328 million instances from 2003-2025. In developing countries, prevalence is expected to increase from 4.2 percent to 5.6 percent, the largest percentage and absolute increase. The number of diabetics in China is projected to more than double to 46 million by 2025, and to 73 million in India. Young people are increasingly showing significant evidence of type 2 diabetes, which has increased most in the middle-aged and elderly. By 2000, 2.4 and 6.2 percent of Australians aged 35–44 and 45–54 had diabetes, up from 1.7% and 2.4% in 1981. According to Chinese data, 3.2 percent of people aged 35 to 44 had diabetes in 2000, up from 1.7 percent in 1994. According to these facts, diabetes begins to appear at a younger age [28]. The International Diabetes Federation estimates that by 2045, there will be 700 million diabetics globally, up from 463 million in 2019. In the age groups 20-70 years, the prevalence of diabetes was 8.3% in 2019; by 2045 it should rise to 9.6%. In 2019, 59 million adults with diabetes were identified in Europe. By 2045, the number of patients is predicted to be 68 million. In Europe, the prevalence of diabetes among 20–79-year-olds was 6.3% in 2019; by 2045, that number is expected to rise to 7.8 percent. According to the Croatian National Diabetes Registry, 315,298 people were diagnosed with diabetes in Croatia in 2019, and the number of patients is increasing every year. Based on previous studies, only 60% of patients in Croatia have been diagnosed. Therefore, the total number of patients is about 500,000 adults [29]. In US youth aged 10–19 years, prevalence estimates show a 30–5% increase in T2DM between 2001 and 2009, giving a prevalence of 0.48 per 1000 in this age group. According to SEARCH, the annual incidence of type 2 diabetes among Americans aged 10-19 increased by 7.1% (from 9 per 100,000 in 2002-2003 to 12.5 per 100,000 in 2011-2012), and the relative increase was significant across all etiology.

The International Diabetes Federation estimates that approximately 23 million young people worldwide had type 2 diabetes (T2DM) in 2000, representing 13% of the 177 million adults with diabetes. The ages of these adults ranged from 20 to 39 years. By 2013, that number had increased to about 63 million, or 16 percent of the world's 382 million people with type 2 diabetes. The most significant increases occurred in Africa, Southeast Asia, and the Western Pacific. Type 2 diabetes is becoming more prevalent among children, adolescents, and young adults globally. Individuals of South Asian, African, and Afro-Caribbean heritage are reported to be more prevalent in the UK than those of white European descent. Individuals born in the year 2000 in

the United States, the chance of developing diabetes before age 40 is about 2.5 percent for men and 5 percent for women. Black and Hispanic estimations are twice as high, indicating that certain ethnic groups are disproportionately impacted [30].

It's interesting to note that other regions, like the Pacific Island nations, have the highest disease prevalence. Among them are American Samoa (18,312), Fiji (20,277 per 100,000), Kiribati (17,432), and Mauritius (18,545). Southeast Asia has developed during the last 20 years, including Vietnam, Malaysia, Thailand, and Indonesia. Among the world's most populous countries, the ones with the highest numbers of people diagnosed with type 2 diabetes are the US (28.9 million), India (65.9 million), and China (88.5 million) [31].

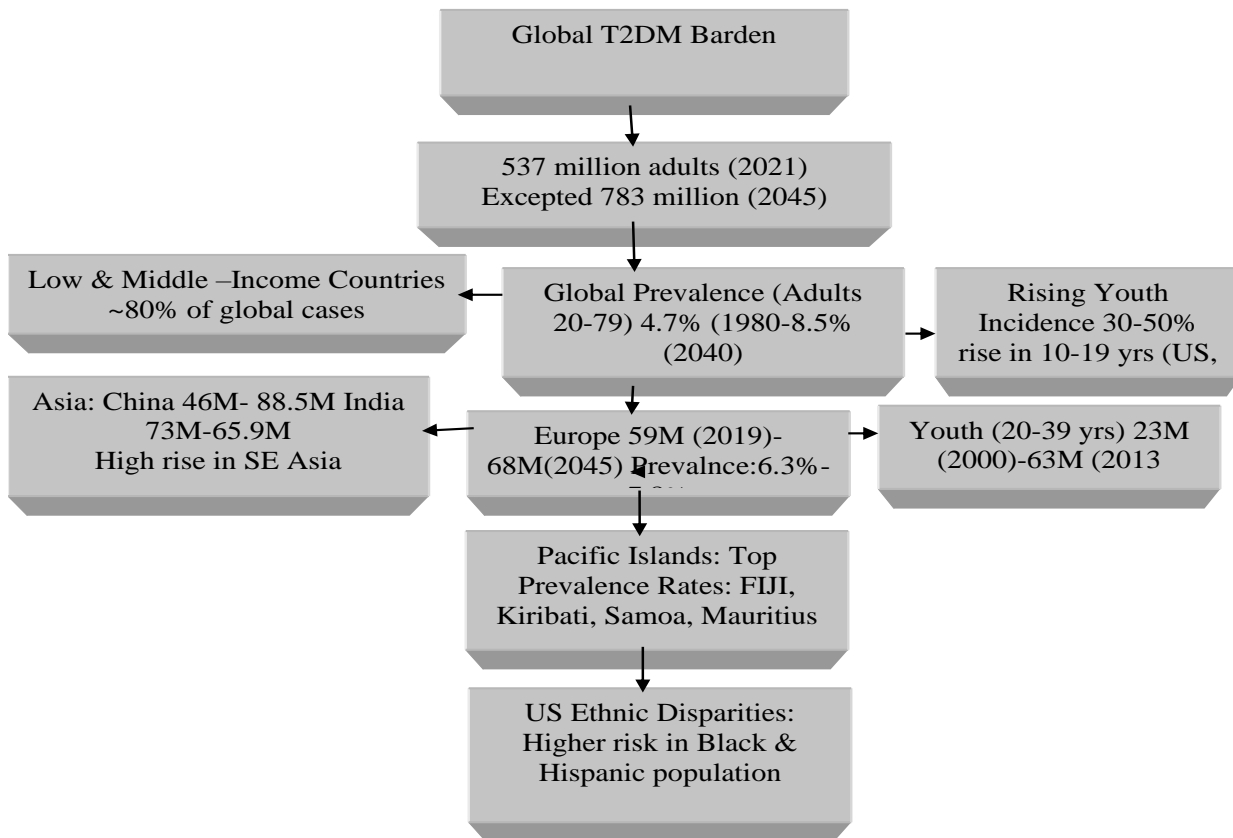


Figure 4: Global overview of the rising prevalence of Type 2 Diabetes Mellitus (T2DM) across different regions and age groups.

2.6 In India, the Prevalence Rate of Type-2 Diabetes Mellitus

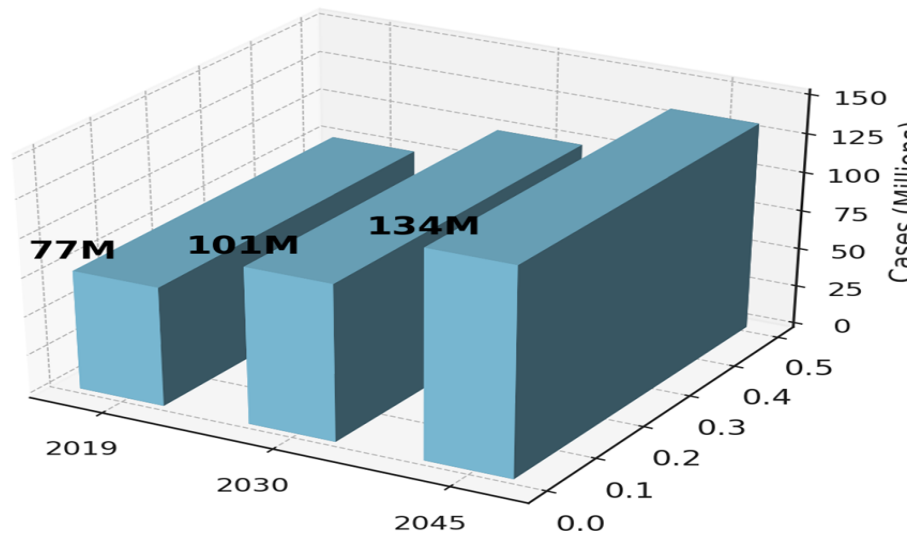
Type- 2 diabetes is on the rise in urban India. Compared to Western populations, Indians experience the onset of diabetes at a younger age, usually a decade or two earlier. Among all socioeconomic categories, NCDs, including diabetes, account for a higher percentage of premature deaths only in India [32]. India had an estimated 77 million diabetics in 2019, with that number anticipated to rise to 101 million by 2030 and 134 million by 2045 [33]. With a median age of 37.0 (33.0-39.0) years, 22,921 individuals were enrolled in the latter study. There were more men (61.6%) than women (38.4%) of the population. Overweight patients accounted for 46.6% of the total, followed by obese (22.9%), normal weight (28.1%) and underweight (1.5%). Only T2DM patients accounted for 46.9% of patients.

Patients diagnosed with T2DM alone were significantly more common in the youngest age group (≥ 18 to ≤ 25 years, 62.1%), while patients with T2DM and hypertension were significantly more common in those > 35 years. for the ≤ 45 -year-old age group (67.8%) ($p < 0.001$). From the age group ≥ 18 – ≤ 25 to the age group > 35 – ≤ 45 , the frequency of risk factors increased. all age groups - 61.1% of 18–25-year-olds; 66.7% among 25–35-year-olds; and 69.2% of those aged 35–45 years - more than 60% of patients had a family history of T2DM [34]. According to a study by the Indian Council of Medical Research (India Diabetes) (ICMR-INDIAB), about 51% of adults in 15 Indian states (average age 35.8-43.9 years) have diabetes or pre-diabetes. This study also showed that the age group of 25-34 years was the peak of diabetes in rural and urban India, suggesting an early onset of the disease [35].

T2DM is more common in girls than boys in children and adolescents, as well as in adult women more than in adult men.[36]. The prevalence of T2DM among Pima Indians aged 15-19 years increased significantly between 1967 and 1976, from 2.4% in males and 2.7% in females to 3.8% and 5.3% in women between 1987 and 1996. Among Navajo Indians in the United States, 3 and 13% of girls and boys aged 12–19 years had either diabetes or impaired glucose tolerance (IGT) [28]. The proportion of

Indians aged 15-19 diagnosed with diabetes increased from 0.32 to 0.54% between 1990 and 1998. Men had a greater relative increase in type 2 diabetes during this period (0.23–0.41% vs. 0.42–0.68% in women), although type 2 diabetes was more common in women [37].

3D Bar Graph: Projected T2DM Cases in India



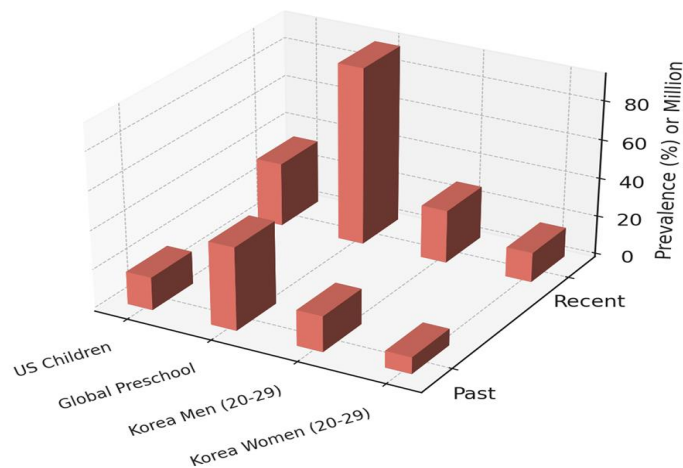
Graph 1: 3D bar graph showing projected increase in Type 2 Diabetes Mellitus cases in India for the years 2019, 2030, and 2045.

2.7 Prevalence of Obesity in Type 2 Diabetes Mellitus

According to the National Health and Nutrition Examination Survey, 17% of children in the US are considered obese, and a third of those kids are overweight. Approximately 43 million preschool-aged children are overweight or obese, with an additional 92 million at risk for developing this condition. The prevalence of overweight and obese children is disproportionately high among youngsters of African American and Hispanic descent. Trends in obesity and type 2 diabetes have both been on the rise in recent years, with the former accounting for 25–45 percent of all diabetes diagnoses in young adults.

A study conducted in Ohio and published in California found that type 2 diabetes (T2D) in youngsters increased dramatically in the late 1990s, making up 33–45% of all new cases of diabetes in both regions. Most of these kids were overweight, belonged to a minority group, and had a direct lineage of the illness. Diabetes mellitus (T2D) has been found to be more common among younger populations in both India and the United Kingdom, according to similar studies [38]. Between 1979 and 2002, the prevalence of childhood and adolescent obesity increased ninefold among women and men in Korea. In addition, the National School of Health Survey after the 2000s showed that the prevalence of obesity among Korean children aged 6-18 increased from 8.7% in 2007 to 15.0% in 2017. In all age groups, the prevalence of obesity increased in adults, although the increase was greatest in those in their 20s and 30s. Among men aged 20-29, the prevalence of obesity rose from 18.5 percent in 2009 to 27.5 percent in 2018. The prevalence of obesity among women aged 20-29 increased from 8.6% in 2009 to 15.4% in 2018 [39].

3D Bar Graph: Obesity in Type 2 Diabetes Context



Graph 2: 3D bar graph showing obesity and overweight trends in populations vulnerable to Type 2 Diabetes, including US children, global preschoolers, and young Korean adults (2009–2018).

2.8 Factors Influencing the Prevalence Rate

The prevalence of type 2 diabetes is influenced by a complex interplay of metabolic, genetic, and environmental variables. Epidemiological studies show that improving the main modifiable risk factors (obesity, low physical activity, and an unhealthy diet) can prevent many cases of T2DM, even though ethnicity and family history/genetic predisposition are strongly genetic. Other main factors are ethnicity, family history, obesity, insufficient physical activity, improper food, socioeconomic factors, gender, and polycystic syndrome. [40].

RESULTS

The prevalence and risk factors of Type 2 Diabetes Mellitus (T2DM) in adolescents and young adults are the subject of this analysis, which synthesizes data from several national and international surveys, epidemiological studies, and reviews published between 2010 and 2024.

3.1 Prevalence in India

According to recent estimates from the International Diabetes Federation (IDF), the prevalence of diabetes in India was 8.3% in 2021, Figure 5. [IDF, 2020]. Literature reviews indicated a consistent increase in prevalence, rising from 7.1% in 2009 to 8.9% in 2019 [Pradeepa et al., 2021]. Recent nationwide surveys, including the National NCD Monitoring Survey, indicated prevalence rates of 9.3% for diabetes and 24.5% for impaired glucose tolerance (IGT) among adults aged 18–69 years [Mathur et al., 2022]. The ICMR-INDIAB 2023 study estimated that more than 101 million Indians are currently affected by diabetes, with a weighted prevalence rate of 11.4% [Marín-Peñalver et al., 2023; Ranjit et al., 2023] Table 1.

3.2 International Overview

The global prevalence of T2DM in adolescents and young adults has increased nearly threefold over the past two decades. In 2019, the International Diabetes Federation estimated that 463 million individuals were affected, with projections suggesting an increase to 700 million by 2045, Figure 4. The burden is significantly greater in low- and middle-income countries, particularly in South Asia, Southeast Asia, and the Pacific Islands, which have reported the most substantial increases.

3.3 Obesity and Lifestyle Factors

Obesity has become a significant contributor to Type 2 Diabetes Mellitus in younger demographics. Data from the National Health and Nutrition Examination Survey (NHANES) indicate that 17% of children in the United States are classified as obese, with an additional 43 million preschool-aged children worldwide categorized as overweight or obese Graph 2. Surveys in India indicated that 46.6% of individuals were classified as overweight, while 22.9% were categorized as obese, highlighting the significant association between obesity and early-onset diabetes Graph 1.

3.4 Complications Associated with Young-Onset Type 2 Diabetes Mellitus

Research indicates that adolescents and young adults with Type 2 diabetes mellitus (T2DM) face an increased risk of both microvascular and macrovascular complications compared to their counterparts with Type 1 diabetes. Research involving Pima Indians, Japanese populations, and SEARCH data from the U.S. demonstrates the early onset of retinopathy, nephropathy, and neuropathy in younger patients with type 2 diabetes mellitus Figure 3.

3.5 Overview of Key Findings

Table 1 presents a summary of significant epidemiological studies regarding diabetes prevalence in India from 2019 to 2024. The evidence indicates a significant increase in the prevalence of T2DM among adolescents and young adults, strongly associated with obesity, sedentary behavior, and inadequate dietary habits.

Table 1. Key epidemiological studies reporting prevalence of Type 2 Diabetes Mellitus in India (2019–2024).

S.No	Author	Year	Type of Study	Result	References
1.	The International Diabetes Federation	2020	Survey	Prevalence rate of t2dm in 2021 is 8.3* as per idf India.	https://idf.org/our-network/regions-and-members/south-east-asia/members/india/
2.	Rajendra Pradeepa et al.	2021	Review of Literature	As per idf the prevalence of diabetes in India has risen from 7.1% in 2009 to 8.9% in 2019.	Pradeepa R, Mohan V. Epidemiology Of Type 2 Diabetes In India. Indian J Ophthalmol. 2021 Nov;69(11):2932-2938. Doi: 10.4103/Ijo.Ijo_1627_21. Pmid: 34708726; Pmcid: Pmc8725109.

3.	Mathur P et al	2022	Survey	The prevalence of diabetes in 2022 and impaired glucose tolerance has been estimated to be 9.3% and 24.5%, respectively based on the nationally representative sample of adults aged 18–69-years in the national NCD monitoring survey	Mathur P, Leburu S, Kulothungan V. Prevalence, Awareness, Treatment and Control of Diabetes in India From the Countrywide National NCD Monitoring Survey. Front Public Health. 2022 Mar 14;10:748157. doi: 10.3389/fpubh.2022.748157. PMID: 35359772; PMCID: PMC8964146.
4.	Juan José Marín-Peñalver et al	2023	Survey	As per icmr (INDIAB) study, the prevalence of diabetes is 10.1 crores in 2023.	Marín-Peñalver JJ, Martín-Timón I, Sevillano-Collantes C, Del Cañizo-Gómez FJ. Update on the treatment of type 2 diabetes mellitus. World J Diabetes. 2016 Sep 15;7(17):354-95. doi: 10.4239/wjd.v7.i17.354. PMID: 27660695; PMCID: PMC5027002.
5.	Ranjit M et al	2023	Survey	The overall weighted prevalence of diabetes was 11.4% in 2023.	Ranjit M Et Al. Metabolic Non-Communicable Disease Health Report Of India: The Icmr-Indiab National Cross-Sectional Study (Icmr-Indiab-17). Volume 11, Issue 7, P474-489, July 2023

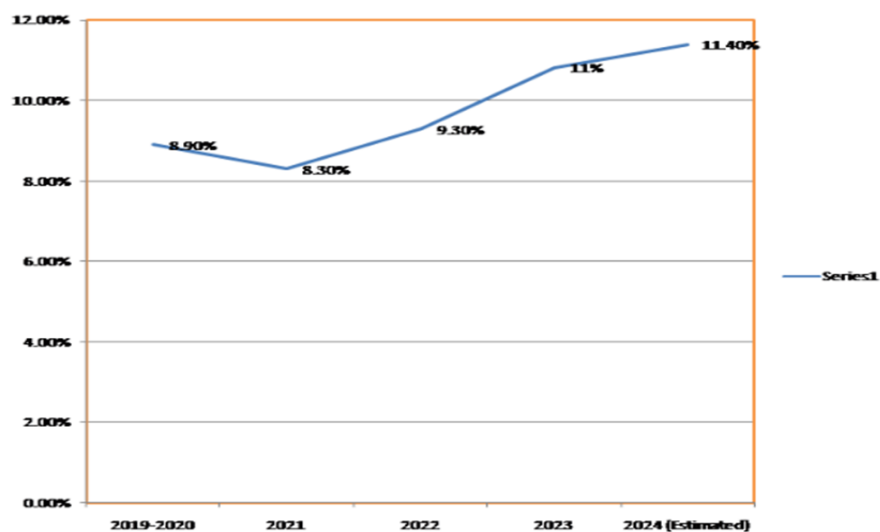


Figure 5: Graphical representation of the prevalence rate of Diabetes Mellitus Type 2 in India from 2019–2024.

DISCUSSION

This review provides key information on the DM patients across India. Overall, 10.1 crores of Indians have diabetes, according to a study published in 2023 by the Indian Council of Medical Research - India Diabetes (ICMR INDIAB).

4.1 Why is Diabetes Research Important for the Indian Population?

Type 2 Diabetes Mellitus (T2DM) is on the rise in adolescents and young adults, with India as a global hotspot. The findings match international data showing increased obesity and T2DM rates in Asia, Europe, and Pacific Island nations.

4.2 Indian Burden Globally

India has one of the world's highest diabetes populations, with 101 million cases in 2023 and 134 million by 2045. These data reflect global trends but highlight Indians' earlier beginning, frequently one to two decades earlier than Western populations. Early onset increases the probability of long-term consequences and socioeconomic stress.

4.3 Obesity and Lifestyle

The increased prevalence of T2DM in adolescents is closely linked to obesity, central adiposity, sedentary behavior, and poor diet. Alarming, approximately 70% of Indian adolescents with T2DM have a familial history and over 60% are overweight or obese. These data show that genetic predisposition and environmental triggers interact, requiring culturally relevant lifestyle treatments.

4.4 Early Issues

T2DM problems in adolescents and young adults are alarmingly fast. Studies show youth-onset diabetes causes nephropathy and retinopathy earlier than adult-onset. Early difficulties lower quality of life and raise healthcare costs. The SEARCH study also found that youth-onset T2DM advances faster than Type 1 diabetes, emphasizing the necessity for early detection and strict control.

4.5 Public Health Effects

Rising youth T2DM has major consequences for healthcare systems. India, with its big young population, has a “double burden” of controlling communicable diseases and non-communicable diseases like diabetes. To prevent diabetes in school-aged children and young adults, preventive strategies should include school and college screening programs, public health campaigns promoting physical activity and healthy diet, community-based interventions, and low-cost pharmacological options like metformin for high-risk prediabetic youth. Genetic susceptibility, obesity, and lifestyle hazards have caused T2DM in adolescents and young people to skyrocket. India risks becoming the global diabetes epicentre without immediate preventive action, affecting public health and economic sustainability.

Of India's 1.4 billion inhabitants, 74 million suffer from diabetes at the moment. This accounts for 14% of global diabetes (95% type 2 diabetes), positioning India alongside the United States and China as an epicenter for the illness. [41] Research in India has to prioritize developing creative national and regional policies that are adapted to local contexts and combine decentralized monitoring with innovative approaches to improve diabetes care [41].

Research indicates notable disparities both between and within states regarding the prevalence of undiagnosed diabetes among Indians, the proportion not adhering to medication, and the fact that nearly two-thirds of diagnosed individuals lack adequate control of their diabetes. Research in India must prioritize developing creative national and regional policies that are adapted to local contexts and combine decentralized monitoring with innovative approaches to improve diabetes care [41].

This emphasizes how the Indian healthcare system needs to incorporate regular DD screening and management to enhance overall diabetes outcomes. According to the INDIAB study by The Indian Council of Medical Research reports that only 25.3% of T2DM patients achieved the recommended HbA1c levels, suggesting insufficient management of modifiable risk factors [42].

4.6 Initiation Required

Government-sponsored diabetes screening and lifestyle education programs for prediabetics can help control this epidemic and its morbidity. Therapeutic lifestyle intervention is the first step in any program like this, and nurses, paramedics, social workers, teachers, and schoolchildren are essential to energizing the population and creating the political will and state policy needed for success¹. Generic metformin is cheap and widely available in India's governmental and private health care systems. These prediabetics may benefit from additional metformin medication since they are more likely to acquire type 2 diabetes. Strong family history of T2DM, obesity, especially central obesity, gestational diabetes, impaired fasting glucose, and impaired glucose tolerance are risk factors [30]. A cross-sectional examination of Indian children aged 5 to 19, including underweight or stunted children, discovered an unusual load of chronic disease biomarkers, suggesting that early childhood is the origin of India's rapid diabetes growth. Early cohorts may be good starting points [43].

4.7 Limitations and Future Scope

India has long possessed a first-rate clinical infrastructure (as well as a large patient base) for conducting superior clinical trials that validate methods for providing clinical care for patients who are already established. However, these trials should promote early prevention—possibly even in childhood—and a lifelong precision healthcare and prevention paradigm. Cohort building must be done cautiously.

CONCLUSIONS

The incidence of Type 2 diabetes is escalating swiftly in young demographics globally, with notably elevated rates in areas such as the Pacific Islands, Western Europe, and South Asia. In India, instances are anticipated to rise from 77 million in 2019 to 134 million by 2045. Evidence indicates that most impacted young individuals are overweight or obese, underscoring the significant influence of alterable lifestyle factors. These trends underscore the pressing necessity for extensive studies to ascertain fundamental risk factors and for proactive preventive measures including awareness, education, and the promotion of healthy behaviors.

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