

# Nutritional Approaches to Preventing Type 2 Diabetes in At-Risk Teenagers

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## Abstract:

The diabetes epidemic is primarily driven by the global rise in obesity rates, especially abdominal obesity, a major risk factor for type 2 diabetes. Lifestyle factors like physical inactivity, poor diets, and genetics contribute significantly. Teenage behaviors, like high sugar intake, lack of physical activity, and stress, are crucial risk factors. Food choices, such as sugary beverages and processed foods, directly affect diabetes risk. Socioeconomic changes have influenced these habits, underscoring the need for proper nutrition practices to prevent diabetes in adolescents. This study reviews academic literature on diabetes, nutritional behaviors of adolescents, risks, and guidelines for diabetes prevention through appropriate nutrition practices. The information is gathered from research databases and related academic sources. The key to preventing type 2 diabetes in teenagers lies in promoting a balanced and nutritious diet, regular physical activity, and fostering an understanding of healthy lifestyle choices.

**Keywords —obesity, teenager, nutrition**

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## Background

One of the most significant drivers of the diabetes epidemic is the global rise in obesity rates. Excess body weight, especially around the abdomen, is a major risk factor for developing type 2 diabetes. As more people become overweight or obese due to changes in dietary habits and reduced physical activity, the prevalence of diabetes. The development of type 2 diabetes is strongly influenced by lifestyle factors such as obesity, physical inactivity, and an unhealthy diet. Genetic factors can also contribute to an individual's risk.<sup>1-3</sup> Teen behaviors can be significant factors in the development of type 2 diabetes because they influence key aspects of health, including diet, physical activity, and weight management. Teen behaviors can contribute to the risk of developing type 2 diabetes such as high sugar intake, lack of physical activities, stress, sleep etc.<sup>4</sup> Current food choices are indeed a significant factor in the development of type 2 diabetes in teenagers. The types of foods that teenagers consume directly impact their risk of developing the condition such as high sugar consumption, processed and fast foods, lack of

fiber, excessive portion sizes, sugary beverages, unbalanced diets, snacking habits, etc.<sup>5</sup>

From previous studies, it has been found that the majority of Thai teenagers have changed their consumption habits due to economic and societal changes, which have led to shifts in their way of life, including their eating habits<sup>6</sup> From a study conducted among junior high school students, it was found that students have a low level of knowledge about food consumption and hold a moderate attitude towards food consumption.<sup>7</sup> Teenagers have a moderate level of fast food consumption behavior. They have a moderate level of knowledge and attitude towards fast food consumption.<sup>8</sup> Currently, the majority of teenagers have inappropriate eating habits, which not only lead to the risk of being overweight or obese but also contribute to various health problems in adulthood. Furthermore, these habits may also have an impact on their self-esteem and academic success.<sup>9</sup>

This research reviews academic literature on diabetes, nutritional behaviors of adolescents, risks, and guidelines for diabetes prevention through appropriate nutrition practices. The information is gathered from research databases and related academic sources

## **Trend of diabetes patients**

### **Global trends**

As of 2021, there were 537 million adults (20-79 years) living with diabetes worldwide, which is approximately 1 in 10 adults. This number is projected to increase to 643 million by 2030 and a staggering 783 million by 2045. Over 90% of people with diabetes have type 2 diabetes, influenced by socio-economic, demographic, environmental, and genetic factors. Contributing factors include urbanization, an aging population, decreasing physical activity levels, and increasing rates of overweight and obesity.

In 2022, global data from the Disease Control Department revealed that there were 573 million people with diabetes, resulting in a high mortality rate of approximately 6.7 million deaths, equivalent to one person every 5 minutes. This trend indicates a steady increase in diabetes cases, with around 300,000 new patients each year.

In 2023, an estimated 422 million people worldwide will have diabetes, which accounts for around 10.5% of the global population. Over 75% of adults living with diabetes reside in low- and middle-income countries. Projections suggest that the number of people living with diabetes could rise to over 643 million by 2023 and further increase to 783 million by 2045.

Looking ahead to 2053, it's anticipated that the global diabetes epidemic will continue to worsen, with more than double the number of cases, reaching 1.3 billion people. This dramatic increase is expected to affect individuals of all ages, in every country, highlighting the urgency of addressing this global health issue. Furthermore, the impact of diabetes is not only measured in terms of its prevalence but also in the rising death toll it causes. Deaths attributable to diabetes have increased from 4.6 million in 2010 to 6.7 million in 2021. This underscores the importance of diabetes prevention and management on a global scale.<sup>10-12</sup>

### **Trends in the United State**

As of the latest data available in 2022, there are approximately 37.3 million people with diabetes in the United States, which accounts for 11.3% of the total population. Among them, about 28.7 million have been officially diagnosed with diabetes, while an additional 8.5 million have undiagnosed diabetes. This demonstrates the significant impact of diabetes across various age groups and demographics in the country. Prediabetes is also a growing concern in the United States. In 2022, there are a total of 96 million people aged 18 and older with prediabetes, representing 38% of the adult population. Among those aged 65 and older, 26.4 million individuals have prediabetes. The trend of diabetes in the United States is

alarming, with projections indicating that the number of people with diabetes is expected to reach 57 million by 2030 and further increase to 63 million by 2045. This rapid rise is attributed to factors such as obesity, poor diets, and lack of physical activity.

Additional statistics reveal the impact of diabetes in the United States:

- Every 17 seconds, an American is diagnosed with diabetes.
- There are 1.5 million new cases of diabetes in the United States each year.
- The United States Diabetes Population is expected to continue growing with a CAGR (Compound Annual Growth Rate) of 3.26% from 2022 to 2028, primarily due to physical inactivity and excess body weight.
- More than 34 million Americans currently have diabetes, which is nearly 11% of the U.S. population.

These statistics underscore the urgent need for diabetes prevention and management efforts in the United States, given its significant societal, economic, and ethnic impacts.<sup>13-14</sup>

### **Trends in Thailand**

Diabetes is a growing public health challenge in Thailand, with a prevalence rate of 1 in 10 adult Thais diagnosed with diabetes. Over the past decade, the number of people with diabetes in Thailand has significantly increased, rising from 4.1 million in 2011 to 6.1 million in 2021. Thailand is ranked as the 7th largest country in the Western Pacific region in terms of diabetic patients, with a diabetes rate of 7.7% in the adult population, totaling 4.8 million people in 2022. Projections suggest that the number of people with diabetes in Thailand is expected to reach 5.3 million by 2040. Many individuals in Thailand with diabetes also suffer from complications, including diabetic retinopathy, diabetic nephropathy, large blood vessel complications, and diabetic foot ulcers. These complications highlight the importance of effective diabetes management and control. Contributing factors to the increasing trend of diabetes in Thailand include lack of physical activity, consumption of high-sugar foods, stress, and various other issues. The incidence of diabetes continues to rise steadily, with approximately 300,000 new patients diagnosed each year, resulting in a total of 3.3 million registered patients in the healthcare system. In 2020, diabetes-related complications led to 16,388 total deaths in Thailand, with a death rate of 25.1 per 100,000 population. The public health expenses for diabetes treatment in Thailand averaged up to 47,596 million baht per year, highlighting the significant economic burden of diabetes on the healthcare system.<sup>15</sup>

### **Why Global diabetic patients keep increasing?**

The increase in the global burden of diabetes can be attributed to several interconnected factors. First and foremost, lifestyle and dietary changes have played a pivotal role. Over recent decades, there has been a significant shift towards more sedentary lifestyles and diets high in processed foods, sugar, and unhealthy fats. These changes have substantially contributed to an elevated risk of developing diabetes.

Urbanization and industrialization constitute another significant driver of this global health challenge. These trends have reshaped occupation and physical activity patterns, leading to a workforce with reduced physical activity levels. This, in turn, heightens the risk of obesity and insulin resistance, both well-established risk factors for diabetes.

Genetics also play a role in this complex equation. Some populations carry genetic predispositions to diabetes, and as these groups grow and interact with the globalized food market, diabetes rates can surge.

Furthermore, improved healthcare systems and better access to medical care have led to increased detection and diagnosis of diabetes. While this is positive for early intervention and management, it also contributes to the reported increase in diabetes cases.

An aging global population represents yet another facet of this issue. As life expectancy increases in many regions, so does the number of older adults living with diabetes.

Finally, environmental factors such as pollution and exposure to endocrine-disrupting chemicals may also play a role in the development of diabetes.<sup>16</sup>

In light of these multifaceted contributors, the global trend in diabetes prevalence is a matter of deep concern. In 2021, approximately 537 million people were living with diabetes worldwide. This number is projected to surge significantly, with an estimated 643 million individuals expected to be affected by 2030. Tragically, diabetes-related deaths remain alarmingly high, with around 6.7 million people losing their lives to the disease. This equates to one person succumbing to diabetes-related complications every 5 seconds globally.

The situation is equally disconcerting in Thailand, where diabetes is on the rise. Currently, 3.3 million people are registered in the healthcare system as diabetes patients, and this number continues to climb by approximately 300,000 new cases each year. In 2020 alone, 16,388 individuals in Thailand lost their lives due to diabetes-related complications, resulting in an annual healthcare expenditure of approximately 47,596 million Baht for diabetes-related treatments.<sup>1,15</sup>

In response to this burgeoning global health crisis, the observance of World Diabetes Day in 2021 emphasized the paramount importance of education as a fundamental strategy to combat the growing diabetes epidemic. Under the theme "Education to protect tomorrow," the campaign sought to raise awareness and knowledge about diabetes, targeting not only healthcare professionals but also individuals living with diabetes and their caregivers.

In conclusion, diabetes persists as a major global health concern, characterized by an escalating prevalence and substantial health and economic burdens. Tackling this multifaceted challenge demands a comprehensive approach that encompasses public health initiatives, lifestyle modifications, early detection, and improved access to quality healthcare, all underpinned by a robust foundation of education and awareness.<sup>17</sup>

### **What is diabetes**

Diabetes is a chronic health condition that disrupts the body's ability to convert food into energy. There are three primary types of diabetes: type 1, type 2, and gestational diabetes (which occurs during pregnancy).

Type 1 diabetes is characterized by an autoimmune reaction that hampers the production of insulin. It typically manifests rapidly and is commonly diagnosed in children, teenagers, and young adults. Approximately 5%-10% of individuals with diabetes have type 1.

Type 2 diabetes arises when the body doesn't utilize insulin effectively, leading to elevated blood sugar levels. It develops gradually and is usually diagnosed in adults, but it's becoming more prevalent in children, teenagers, and young adults. Symptoms may not always be noticeable, emphasizing the importance of regular blood sugar testing.

Gestational diabetes occurs in pregnant women who have not previously had diabetes. It poses health risks for both the baby and mother during pregnancy. While gestational diabetes typically resolves after childbirth, it increases the risk of developing type 2 diabetes later in life for the mother and obesity and type 2 diabetes for the child.

The causes of these diabetes types vary:

Type 1 diabetes results from an autoimmune reaction where the body mistakenly attacks its own insulin-producing cells.

Type 2 diabetes is primarily caused by factors such as being overweight, obesity, and physical inactivity.

Gestational diabetes arises when the body cannot produce enough insulin during pregnancy.

Type 1 diabetes accounts for about 5-10% of all diabetes cases and currently cannot be prevented but can be managed through lifestyle choices and medical treatment. Type 2 diabetes, on the other hand, is largely preventable through weight management, regular exercise, a healthy diet, and not smoking. To prevent gestational diabetes, it is advisable to maintain a healthy weight and engage in regular physical activity before getting pregnant.

To care for individuals with diabetes, it's essential to:

Adhere to prescribed medications and treatments, even when feeling well. Perform daily foot checks for cuts, blisters, red spots, and swelling. Maintain good oral hygiene by brushing and flossing daily. Monitor blood sugar levels regularly.<sup>18-24</sup>

### **Factors on Dietary Choices and Diabetes Risk**

#### **1. Dietary choices**

The choice to eat foods that could potentially lead to type 2 diabetes is influenced by a combination of individual, cultural, social, economic, and environmental factors. Many foods high in sugar, salt, and unhealthy fats are designed to be highly palatable, often referred to as "comfort foods." These foods can be very satisfying and pleasurable to eat, making them attractive choices for many people.<sup>25-28</sup> Busy lifestyles and a lack of cooking skills can deter individuals from preparing healthier meals at home, leading them to opt for pre-packaged or fast foods.<sup>29</sup> Additionally, teenagers who live with their parents also absorb their consumption behaviors. Many people prioritize convenience food choice, processed and fast foods are convenient and readily available, making them an appealing option for those with busy lifestyles or limited access to fresh and healthy alternatives.<sup>16,29</sup> Food companies often heavily market and advertise unhealthy foods and beverages, making them more visible and appealing to consumers, including children and teenagers.<sup>30-31</sup> Unhealthy foods are often more affordable than healthier options. Many people, especially those with limited financial resources, may choose cheaper, calorie-dense foods to stretch their budgets.<sup>32-34</sup> Some groups of teenagers have a behavior of choosing their meals based on their peers, as a social influence to gain acceptance. This is a decision to consume without considering nutritional aspects.

#### **2. Awareness about diabetes, nutrition**

Many individuals may not have access to adequate nutrition education or may not fully understand the nutritional value of foods. This lack of knowledge can result in poor dietary choices.<sup>35-36</sup> In Thailand, previous studies have shown that currently, the majority of teenagers have inappropriate eating habits. This not only leads to the risk of overweight or obesity, but also contributes to various health problems in adulthood. It may also have an impact on their self-esteem and academic success.<sup>6-9</sup>

### **Symptoms of Type 2 Diabetes**

**Elevated Blood Sugar (Hyperglycemia):** Hyperglycemia, or "high blood sugar," occurs when the body lacks sufficient insulin or cannot use it properly. Normal levels range from 70-99 mg/dl, while readings of 100-125 mg/dL suggest prediabetes, and 126 mg/dL or higher indicate diabetes. Factors like illness, stress, missed medication, reduced exercise, or increased carbohydrate intake can lead to high blood sugar levels, sometimes signaling an underlying issue.<sup>37-38</sup> **Excessive Hunger (Polyphagia):** Polyphagia is characterized by increased and extreme hunger. In uncontrolled diabetes, glucose cannot enter cells due to either a lack

of insulin or insulin resistance, preventing the conversion of food into energy.

**Excessive Thirst (Polydipsia):** Polydipsia is an abnormal urge for consistent fluid consumption, triggered by fluid loss within the body. Even after adequate fluid intake, the persistent feeling of thirst can indicate underlying health issues like diabetes mellitus or diabetes insipidus. This process can lead to dehydration and persistent thirst.<sup>38-40</sup>

**Frequent Urination (Polyuria):** Polyuria, or frequent urination, is a common symptom in both Type 1 and Type 2 diabetes. It occurs when the body cannot utilize insulin to break down glucose, resulting in increased urine production.<sup>41-43</sup>

**Blurred Vision:** High blood sugar levels can lead to visual disturbances affecting the eye's health. This can cause lens swelling, impacting its ability to focus light onto the retina and resulting in blurred vision.<sup>44-45</sup>

**Nerve Damage (Neuropathy):** Elevated blood glucose levels can damage small blood vessels that supply nerves throughout the body, leading to symptoms like tingling, pain, and loss of sensation.<sup>46</sup>

**Cardiovascular Complications:** Diabetes significantly increases the risk of cardiovascular disease, making it the leading cause of mortality among individuals with diabetes. It is influenced by factors like lipids, blood pressure, and glycemia.<sup>47-48</sup>

**Kidney Failure (Diabetic Nephropathy):** Diabetic nephropathy can lead to kidney failure due to ongoing energy deficit in kidney cells and the burden on kidneys from elevated blood sugar levels.<sup>49-50</sup>

**Bone and Joint Issues:** Diabetes can lead to musculoskeletal problems, causing joint damage and limiting range of motion. This is influenced by factors like nerve damage, arterial disease, obesity, and chronic inflammation.<sup>51</sup>

**Teeth and Gum Infections:** Diabetes and certain medications can reduce saliva production, increasing vulnerability to dental cavities, gum disease, and other oral health issues.<sup>52-53</sup>

**Skin Symptoms:** Diabetes can lead to various skin problems, including rashes, infections, dryness, and itchiness.<sup>54</sup>

**Unintentional Weight Loss:** When glucose doesn't reach cells, the body compensates by burning fat and muscle at a rapid pace, resulting in unexplained weight loss.<sup>55</sup>

**Fatigue:** People with diabetes are ten times more likely to experience fatigue compared to those with normal blood sugar functions. This fatigue is likely caused by a combination of physiological, psychological, and lifestyle factors.<sup>56-59</sup>

### **Risk factor of diabetes**

The risk factors for developing type 2 diabetes are multifaceted and encompass various aspects of a teen individual's health and lifestyle. Having unhealthy eating habits such as consuming excessive amounts of high-calorie, low-nutrient foods, particularly those high in sugar, saturated fats, and refined carbohydrates.<sup>60</sup> Drinking sugary beverages like sodas, energy drinks, and fruit juices, which can lead to weight gain and elevated blood sugar levels.<sup>61</sup> Skipping Meals such as irregular eating patterns, including skipping meals, which can disrupt blood sugar levels and lead to overeating later in the day.<sup>62</sup> Lack of Physical Activity such as engaging in little to no regular exercise or physical activity, leading to weight gain and reduced insulin sensitivity.<sup>60</sup> Having an inactive lifestyle such as spending prolonged periods sitting, such as watching TV, playing video games, or using computers, which can contribute to weight gain and insulin resistance. And Spending a significant amount of time in front of screens (TV, computer, smartphone), which is often associated with a lack of physical activity and unhealthy eating habits. Not getting enough quality sleep, which can disrupt hormone regulation and contribute to insulin resistance.<sup>63</sup> Engaging in unhealthy coping mechanisms for stress, such as emotional eating or excessive consumption

of comfort foods.<sup>64</sup> Engaging in smoking or excessive alcohol consumption, which can exacerbate the risk of developing Type 2 diabetes.<sup>65</sup> Insufficient knowledge about the importance of a balanced diet, regular exercise, and maintaining a healthy lifestyle.<sup>66</sup> And having a family history of Type 2 diabetes, which can increase the risk, especially when combined with unhealthy behaviors.<sup>67-68</sup>

### **Recommended Nutrition Preventing Type 2 Diabetes**

Preventing Type 2 diabetes in teenagers involves adopting a balanced and healthy lifestyle, including a nutritious diet. Dietary guidelines for teenagers to help reduce the risks. Encourage whole, minimally processed foods like fruits, vegetables, whole grains, lean proteins, and healthy fats. These provide essential nutrients without excessive added sugars, unhealthy fats, or artificial additives.<sup>69</sup> Encourage balanced meals that include a variety of nutrients. Each meal should ideally have a mix of carbohydrates, proteins, and healthy fats.<sup>70</sup> Promote a diet low in fast food, processed foods, sugary snacks, and beverages. Encourage whole fruits for natural sweetness while discouraging excessive intake of unhealthy fats, sugars, and sodium.<sup>71-72</sup> Control Portion Sizes; teach portion control to prevent overeating. Understanding appropriate serving sizes can help maintain a healthy weight.<sup>73</sup> Choose Complex Carbohydrates; opt for complex carbohydrates like whole grains (e.g., brown rice, whole wheat bread), legumes, and starchy vegetables. These have a lower glycemic index and provide sustained energy.<sup>74</sup> Eat Fiber-Rich Foods; a high-fiber diet with plenty of fruits, vegetables, whole grains, and legumes. Fiber helps regulate blood sugar levels and promotes overall digestive health.<sup>75</sup> Lean Proteins; include lean sources of protein like poultry, fish, tofu, beans, and legumes. Limit consumption of processed meats, which may contain unhealthy additives.<sup>76</sup> Healthy Fats; include sources of healthy fats such as avocados, nuts, seeds, and olive oil. Limit saturated and trans fats found in fried foods, processed snacks, and certain baked goods.<sup>77</sup> Regular eating habits, including balanced breakfasts, lunches, dinners, and nutritious snacks. This helps stabilize blood sugar levels throughout the day. Stay Hydrated with Water; water is the best choice for hydration. Limit sugary drinks and opt for water, herbal teas, or infused water with fruits and herbs.<sup>78</sup> Encourage Physical Activity; regular exercise is crucial in preventing Type 2 diabetes. Encourage at least 60 minutes of moderate to vigorous physical activity each day.<sup>79</sup> And educate about Nutrition Labels; teach teenagers how to read and understand nutrition labels. This helps them make informed choices about the foods they consume.<sup>80</sup>

### **Conclusion**

Excess body weight, particularly around the abdomen, poses a substantial risk for the development of type 2 diabetes. This risk is further compounded by lifestyle factors such as physical inactivity and unhealthy dietary habits. Among teenagers, behaviors regarding diet, physical activity, and weight management play a pivotal role in diabetes risk. High sugar intake, lack of physical activity, and other contributing factors like stress and inadequate sleep can significantly elevate the likelihood of developing type 2 diabetes. Current food choices, particularly those high in sugar, processed and fast foods, and lacking in fiber, contribute significantly to the risk of diabetes in teenagers. The prevalence of inappropriate eating habits among teenagers not only increases the risk of overweight or obesity but also contributes to various health issues in adulthood. Factors such as lack of physical activity, consumption of high-sugar foods, and stress contribute to this concerning trend. To address this complex global health challenge, a comprehensive approach is needed. This should encompass public health initiatives, lifestyle modifications, early detection, and improved access to quality healthcare, all underpinned by a robust foundation of education and awareness. The key to preventing type 2 diabetes in teenagers lies in promoting a balanced and nutritious diet, regular physical activity, and fostering an understanding of

healthy lifestyle choices.

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