

Prediabetes: Prevalence and Causes

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Abstract

Prediabetes is a condition where the blood glucose levels are high, but not enough to be diagnosed as diabetes. The HbA1C test can identify the prediabetes conditions as the blood glucose levels are between 5.7% to 6.4%. The fasting glucose level are said to be around 125 mg/dL and IGT levels are seen around 199 mg/dL. Prediabetes have a high burden of Cardiovascular Risk. Prediabetes is a multifactorial condition, the environmental risk factors include diet, lack of physical activity, increase age, obesity or overweight and the biological risk factors include insulin resistance, genetic disposition and beta cell dysfunction. According to research carried out in 2021, the global prevalence is said to be around 14%, combining the prevalences of IGT and IFG. Awareness of Prediabetes is very much needed because an affected individual, if not aware, may end up in a severe disease such as CVD.

Keywords: prediabetes, cardiovascular diseases, diabetes, impaired fasting glucose, glucose tolerance

Introduction

Prediabetes, a term endorsed by the American Diabetes Association but debated by the World Health Organization and the International Diabetes Federation, is a condition characterized by blood glucose levels that are higher than normal but not high enough to be classified as diabetes (WHO). This metabolic state is intermediate between normal glucose homeostasis and diabetes and is identified by laboratory measurements of fasting blood glucose (FBG), glycosylated hemoglobin (HbA1C), or 2-hour postload blood glucose (2hBG). Prediabetes is also used to describe the presence of impaired glucose tolerance or impaired fasting glucose without meeting the criteria for diabetes (12).

Impaired fasting glucose (IFG) is defined as blood glucose levels of 100 to 125 mg/dL, and impaired glucose tolerance (IGT) is defined as blood glucose levels of 140 to 199 mg/dL during a 75-gram oral glucose tolerance test (13). An HbA1C level between 5.7% and 6.4%, which measures average blood glucose levels over the preceding 3 months, is indicative of prediabetes (12).

Prediabetes is also associated with a high burden of cardiometabolic risk factors and is linked with poor outcomes (23). Considered a substantial risk factor for progression to diabetes and associated complications, prediabetes can be a precursor to Type 2 diabetes and increases the risk of cardiovascular disease. This stage is critical and presents an opportunity for preventing the development of full-blown diabetes with early intervention (24).

It is important to note that prediabetes often goes undiagnosed because many individuals with the condition do not experience any symptoms (22). This highlights the need for increased awareness and screening for prediabetes, as early detection and intervention can help prevent or delay the onset of Type 2 Diabetes Mellitus and its associated complications (11).

Prediabetes is a significant public health concern globally, with an estimated 47% or 374 million adults affected in 2019 according to the International Diabetes Federation (4). The magnitude of prediabetes is high, affecting about 10% to 40% of the adult population on average based on population-based studies. However, the actual numbers and proportions may be much higher, as many people with prediabetes may be undiagnosed.

Cumulatively, all subcategories of diabetes mellitus affect approximately 382 million people worldwide, increasing to an estimated 592 million by 2035. In the UK, 3.2 million people have been diagnosed with diabetes, and an estimated increase to 5 million by 2025 is predicted.(6) Approximately one in seventeen people in the UK have diabetes, equating to a prevalence of 6.0%.

In India, the magnitude of prediabetes is 10.1%, ranging from 5.8% to 16.2% across the 15 studied states.(2)

Prediabetes is known to increase the risk of developing type 2 diabetes, as well as other complications such as cardiovascular disease, which can result in high healthcare costs and decreased quality of life. Early detection and intervention can help prevent or delay the onset of Type 2 Diabetes Mellitus and its associated complications, underscoring the importance of increased awareness and screening for the condition. In conclusion, prediabetes is a significant health problem worldwide.(23)

Prediabetes: Incidence and prevalence

The incidence of prediabetes, a condition characterized by elevated blood glucose levels, is quite high and is a growing problem globally. It is a significant public health concern. According to the 2017 National Diabetes Statistics Report from the US Centers for Disease Control and Prevention, the prevalence of prediabetes in the adult US population is estimated to be 33.9%, representing a significant proportion of the population (7). However, the incidence of prediabetes varies significantly depending on the diagnostic criteria used to define it. On average, the risk of developing diabetes is about 5% to 10% per year in individuals with Impaired Fasting Glucose (IFG) or Impaired Glucose Tolerance (IGT) compared with approximately 0.7% per year in normoglycemic individuals (8).

In children, the global prevalence of prediabetes is 8.84%, with an upward trend in prediabetes prevalence from 0.93% to 10.66% over the past decades. The pooled prevalence increased from 7.64% to 14.27% with increased BMI .(9)

According to the 2017 National Diabetes Statistics Report from the US Centers for Disease Control and Prevention, the prevalence of prediabetes in the adult US population is estimated to be 33.9%, and even higher in adults aged 65 years and older, at 48.3%(10). However, only 11.6% of US adults are aware that they have prediabetes, underscoring the need for increased awareness and screening

Prediabetes is diagnosed based on impaired fasting glucose, impaired glucose tolerance, or elevated HbA1c levels between 5.7% and 6.4%(5) The prevalence of prediabetes varies across different populations and depends on the diagnostic criteria and laboratory tests used. Global data on prediabetes are limited, but estimates suggest that a substantial proportion of the adult population worldwide is affected. The International Diabetes Federation reported that the global prevalence of impaired glucose tolerance, one of the diagnostic criteria for prediabetes, was 7.5% among adults in 2019, corresponding to an estimated 374 million adults aged 18-99 years(11).

In 2021, it was reported that 9.1% (464 million) of adults worldwide had impaired glucose tolerance and 5.8% (298 million) had impaired fasting glucose (16). These figures indicate that the overall prevalence of prediabetes is high, necessitating urgent implementation of effective diabetes prevention policies and

interventions. The estimated prevalence of prediabetes for adults globally is 352 million (14). However, based on the International Diabetes Federation criteria, 541 million adults worldwide are estimated to have impaired glucose tolerance, and 319 million adults worldwide have impaired fasting glucose(20). The global prevalence of prediabetes in childhood is 8.84%, with higher prevalence observed in males than females (8.98% vs 8.74%), in older compared to younger children (7.56% vs. 2.51%), in urban compared to rural areas (6.78% vs. 2.47), and in children with a family history of diabetes (6). These statistics highlight the significant prevalence of prediabetes, but it's important to note that these figures are based on statistical estimates and may not be up-to-date or applicable to specific regions or populations (18).

Prediabetes: Etiology and Causes

The etiology of prediabetes is multifactorial and not fully understood, involving a complex interplay between genetic, environmental, and lifestyle factors. Prediabetes is a condition that indicates a higher-than-normal blood sugar level but not high enough to be classified as type 2 diabetes.

Key factors contributing to the development of prediabetes include:

- 1. Insulin Resistance:** This is a condition in which the body's cells become less responsive to insulin, a hormone that helps regulate blood glucose levels. This can lead to elevated blood glucose levels, a hallmark of prediabetes.
- 2. Beta-cell Dysfunction:** Beta cells in the pancreas produce and secrete insulin into the bloodstream. In individuals with prediabetes, these beta cells may not function properly, leading to insufficient insulin production and secretion.
- 3. Genetic Predisposition:** Certain genetic factors may increase an individual's risk of developing prediabetes.
- 4. Lifestyle Factors:** Unhealthy lifestyle habits, such as lack of physical activity, an unhealthy diet, and being overweight or obese, can increase the risk of developing prediabetes.(6)

Other risk factors include race and ethnicity, low birth weight, gestational diabetes, polycystic ovary syndrome, sleep disorders, high blood pressure, low levels of high-density lipoprotein (HDL) cholesterol, and high levels of triglycerides (15). The pathogenesis of prediabetes involves impaired insulin secretion, increased hepatic glucose production, peripheral insulin resistance, impaired incretin action, and insulin hypersecretion (17)

It's important to note that the exact etiology of prediabetes may vary between individuals, and the precise underlying mechanisms that lead to the development of prediabetes are complex and not entirely understood (19). However, it is most commonly associated with being overweight or obese and having a sedentary lifestyle. The condition may develop as a result of a complex interplay between these various factors (3)

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Key factors contributing to the development of prediabetes include:

- 1. Overweight or Obesity:** Being overweight or obese is a significant risk factor for prediabetes because excess body fat can interfere with the body's ability to use insulin effectively.
- 2. Lack of Physical Activity:** A sedentary lifestyle can increase the risk of prediabetes. Exercise can help improve insulin sensitivity and glucose tolerance.

3. **Unhealthy Diet:** A diet high in refined carbohydrates, saturated and trans fats, and low in fiber can contribute to the development of prediabetes.
4. **Family History:** Having a family history of prediabetes or diabetes can increase the risk of developing the condition.
5. **Age and Ethnicity:** Increasing age and certain ethnic groups, such as African Americans, Hispanic/Latino Americans, Asian Americans, and Pacific Islanders are at higher risk for developing prediabetes(21).

Other risk factors include high blood pressure, low levels of high-density lipoprotein (HDL) cholesterol, high levels of triglycerides, certain medications, polycystic ovary syndrome, and certain medical conditions such as Cushing's syndrome or hemochromatosis (4)

Insulin resistance, impaired incretin action, and insulin hypersecretion are central to the pathophysiology of prediabetes. However, in many cases, the precise mechanisms that lead to prediabetes are not entirely understood (16).

Factors that are associated with an increased prevalence of prediabetes in childhood according to the study in the source include male gender, older age, urban living, higher BMI, and a family history of diabetes (1) The study also suggests that lifestyle modifications, such as healthier eating habits and increased physical activity, can help manage the condition.

It's important to note that not all individuals with these risk factors will develop prediabetes, and a diagnosis of prediabetes is not necessarily an indication that an individual will develop diabetes in the future. However, individuals with prediabetes are at increased risk of developing Type 2 Diabetes Mellitus, and lifestyle changes and/or medical interventions may be necessary to help prevent or delay the onset of the disease (21).

Conclusion

Prediabetes is a condition characterized by blood glucose levels that are higher than normal but not high enough to be classified as diabetes. The major causes of prediabetes are Obesity or Overweight, increasing age, improper diet, lack of physical activity. They major biological factors that contribute to the condition are genetic disposition, beta cell dysfunction and insulin resistance. Prediabetes is a warning condition for diabetes. Prediabetic individuals also has a high burden of Cardiovascular risk and awareness of this condition is to be made by the public as well as private health sectors.

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