



An investigation into the correlation between nutritional intake and glycemic response

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Abstract

Diabetes mellitus is characterized by persistent hyperglycemia, metabolic dysfunction involving fats, proteins, and carbohydrates, and a total deficiency of insulin. As one of the world's most prevalent and economically burdensome chronic conditions, its reach is expanding alongside shifting lifestyle patterns and enhanced medical care, which has extended the life expectancy of affected individuals. While its impact varies across ethnic groups, the disease is seeing a sharp rise in both incidence and prevalence, particularly within developing nations, and now ranks as the fourth primary cause of mortality globally. Because postprandial glucose levels and insulin secretion are significantly influenced by the nature of dietary carbohydrate intake, the consumption of low-glycemic index (GI) foods which are typically fiber-rich serves as a protective measure against both the development of diabetes and associated cardiovascular complications.

Keywords: Diabetes, protein, carbohydrate, blood sugar, control

Introduction

Managing blood glucose effectively requires a comprehensive understanding of the many lifestyle elements that influence it, including nutrition, exercise habits, and sleep quality, stress levels, hormonal fluctuations, and pharmaceutical intake. For those navigating diabetes or prediabetes, mastering these variables is essential.

Regarding nutrition, the volume and nature of carbohydrates consumed are primary drivers of glycemic response, a concept supported by research from Atkinson *et al.*, (2008) [3] and Foster-Powell *et al.*, (2002) [5]. Furthermore, integrating consistent physical activity into one's routine enhances insulin sensitivity, whereas a sedentary lifestyle often promotes insulin resistance. Psychological tension also plays a role, as stress-induced hormones like cortisol can trigger spikes in blood sugar. Furthermore, certain drugs, such as steroids or specific antidepressants, may inadvertently disrupt glycemic control.

Monitoring blood glucose is a vital health metric, categorized primarily into two states: fasting (measured after an eight-hour fast) and postprandial (measured one to two hours following a meal). By keeping blood sugar within recommended parameters, individuals can significantly mitigate the risk of long-term health crises, such as kidney impairment, neuropathy, and cardiovascular conditions.

For non-diabetic individuals, target ranges are typically 70–99 mg/dL for fasting and under 140 mg/dL postprandial. For those diagnosed with diabetes, the recommended targets are generally 80–130 mg/dL while fasting and under 180 mg/dL after meals. Beyond mere monitoring, dietary choices are foundational; foods with a lower Glycemic Index (GI) are often rich in fiber, which has been shown to offer protective benefits against both diabetes and heart disease (Shirani *et al.*, 2015; Tsihlias *et al.*, 2000) [9, 10]. Remaining within these designated ranges is a critical strategy for long-term health maintenance and complication prevention.

Factors Influencing Blood Sugar

1. Nutritional Habits

Carbohydrate Consumption:

A diet heavy in processed goods and refined sugars often triggers swift surges in blood glucose levels.

Scheduling Your Meals: Forgoing meals most notably breakfasts tends to result in elevated blood sugar readings as the day progresses. Furthermore, consuming heavy meals late in the evening can cause spikes while you sleep; opting for a smaller, earlier dinner is a more effective way to stabilize your glucose levels overnight.

2. Physical Activity

Staying physically active enhances your body's insulin sensitivity, which assists in keeping blood glucose levels in a healthy range by allowing cells to process energy more effectively. That said, it is important to be cautious; if you use insulin, strenuous or extended workouts can occasionally lead to hypoglycemia (dangerously low blood sugar).

3. Stress

Emotional and Physical Stress: Stress triggers the release of hormones like cortisol and adrenaline, which can increase blood sugar levels. A lack of physical activity can contribute to insulin resistance and elevated blood sugar. **Stress: Cortisol and Adrenaline:** Stress hormones like cortisol and adrenaline can trigger the liver to release stored glucose, increasing blood sugar.

Chronic Stress: Prolonged stress can lead to sustained high blood sugar levels.

Medications:

Steroids: steroids can increase blood sugar.

Certain Antidepressants: Some antidepressants can lower blood sugar, while others can increase it.

Antipsychotics: Certain antipsychotics can increase blood sugar.

Other Medications: Beta-blockers, thiazide diuretics, and other medications can also affect blood sugar.

Menstrual Periods: Changes in hormone levels during menstruation can affect blood sugar.

4. Sleep Patterns

Sleep Deprivation: Lack of sleep can reduce insulin sensitivity, leading to higher blood sugar levels.

5. Hydration

Dehydration: Insufficient fluid intake can lead to higher blood sugar concentrations.

6. Illness and Infection

Illness: Illness can trigger the release of hormones that raise blood sugar.

Acute Illness: During illness or infection, the body releases stress hormones that can increase blood sugar levels.

Dawn Phenomenon: A natural rise in blood sugar levels in the early morning hours due to hormonal changes.

Insulin Resistance: A condition where the body's cells don't respond properly to insulin, leading to elevated blood sugar levels.

Leptin Hormone: Emerging research suggests that leptin, a hormone produced in the brain, may also play a role in blood sugar regulation.

7. Other Factors

Age: Age is a risk factor for diabetes, and older individuals may be more susceptible to blood sugar fluctuations.

BMI: Higher BMI is associated with increased risk of type 2 diabetes.

Family History: A family history of diabetes can increase an individual's risk.

Dehydration: Dehydration can also contribute to higher blood sugar levels.

Sunburn: Sunburn can cause stress on the body, leading to higher blood sugar, according to Diabetes Research Connection.

Altitude: High altitudes can also impact blood sugar control.

It's important to note that these factors can interact with each other, and individual responses to these factors can vary. Monitoring blood sugar levels, especially for individuals with diabetes, is crucial for managing these fluctuations and preventing complications.

Diabetes management: How lifestyle, daily routine affects blood sugar

Diabetes management takes awareness. Know what makes your blood sugar level rise and fall — and how to control these day-to-day factors (Mayo Clinic, 2024; Kanika, 2024) [7, 8].

Dietary choices and fasting blood sugar (FBS)

Dietary choices significantly influence fasting blood sugar (FBS) through the management of carbohydrate intake, meal timing, and overall diet quality.

Direct Effects of Macronutrients

Carbohydrates: These have the most immediate impact. Consuming high-carbohydrate or high-sugar meals, especially late at night, can lead to elevated fasting glucose the next morning as the body metabolizes those sugars overnight.

Fiber: High-fiber diets (e.g., whole grains, legumes, vegetables) are strongly associated with lower FBS. Fiber slows down the digestion of carbohydrates and the absorption of glucose into the bloodstream.

Protein and Fats: Consuming healthy fats and lean proteins alongside carbohydrates can help stabilize blood sugar by slowing glucose absorption and preventing spikes that lead to higher baseline levels (e Clinical 2025).

Dietary Patterns and Timing

Intermittent Fasting (IF): Methods like the 16:8 or 5:2 schedules can lower FBS by improving insulin sensitivity and promoting fat adaptation, where the body burns stored fat for energy. Some studies show IF can reduce fasting glucose by an average of 4 mg/dL.

Meal Timing: Eating dinner earlier (at least 3 hours before bed) and starting the first meal of the day earlier (e.g., at or before 8:30 a.m.) are linked to more favourable metabolic measures and lower fasting glucose.

Portion Control: Eating smaller, frequent, well-balanced meals can prevent the drastic drops and subsequent compensatory spikes in glucose that often occur with infrequent, large meals.

Key Dietary Components to Manage FBS

Category	Recommended Foods/Habits	Foods to Limit
Carbs	Whole grains (quinoa, oats), non-starchy vegetables	Refined grains (white bread, pasta), sugary snacks
Proteins	Fish, poultry, tofu, eggs, beans	Processed red meats
Fats	Avocados, nuts, seeds, olive oil	Trans fats, fried foods
Timing	Early dinner, consistent meal schedule	Late-night snacking

10 Ways to Manage Blood Sugar Naturally, 14 Feb, 2024, Written by Team Dr Lal PathLabs, Medically Approved by Dr. Shuchi.

Post prandial sugar

Postprandial (post-meal) blood sugar values signify the body's dynamic ability to process and clear glucose from the bloodstream following nutrient intake. While a temporary rise is normal, research identifies specific significance for these values in health and disease management (A report card, 2025)

1. Indicators of Metabolic Health

Early Marker of Dysfunction: Elevated postprandial glucose (PPG) is often the earliest abnormality in glucose homeostasis, appearing before fasting glucose levels begin to rise.

Insulin Sensitivity: Sharp or prolonged spikes can indicate insulin resistance, where cells become less efficient at absorbing glucose, a hallmark of prediabetes and type 2 diabetes.

Overall Glycemic Control: PPG is a major contributor to HbA1c levels (three-month average). In patients with well-controlled diabetes (HbA1c < 7.3%), postprandial

excursions can contribute up to 70% of the total glucose burden.

2. Clinical Significance & Disease Risk

Cardiovascular Risk: High post-meal sugar is an **independent risk factor** for heart disease, stroke, and cardiovascular death, even in non-diabetic individuals. Spikes trigger oxidative stress and inflammation that damage the vascular endothelium (blood vessel lining).

Complication Predictor: PPG is often a better predictor of microvascular (retinopathy, neuropathy) and macrovascular complications than fasting glucose alone.

Short-Term Effects: Drastic "spikes and dips" are scientifically linked to increased appetite, fatigue, mood disturbances, and short-term systemic inflammation (Wirth et al., 2021)^[11]

A blood sugar spike, or glucose spike, is a rapid and sharp rise in the amount of glucose in your bloodstream. While it is normal for blood sugar to fluctuate slightly throughout the day, a "spike" typically occurs when your body has more glucose than its cells can immediately process for energy.

How Spikes Work

The Cause: Most spikes happen after eating, particularly when consuming **carbohydrates** (sugars and starches) that the body quickly breaks down into glucose.

The Response: In a healthy body, the pancreas releases **insulin** to move this glucose into your cells. A spike occurs if this process is delayed or if the amount of glucose is too large to be handled efficiently.

The Crash: Spikes are often followed by a sharp "dip" or "crash" as insulin overcompensates, leading to sudden fatigue or hunger.

Avoiding blood sugar spikes is necessary to prevent immediate negative effects on your well-being and to reduce the risk of severe long-term health complications. While minor fluctuations are normal, frequent or extreme spikes can damage various systems in the body (Hanssen *et al.*, 2020)^[6].

Short-Term Effects (Quality of Life)

Spikes often lead to a rapid "crash" in blood sugar, which causes immediate physical and mental discomfort:

Energy & Mood: Causes sudden lethargy, fatigue, and irritability.

Cognitive Function: Leads to "brain fog," difficulty concentrating, and impaired memory.

Cravings: The subsequent sugar crash triggers intense hunger and cravings for more simple carbohydrates, creating a cycle of overeating.

Physical Symptoms: Can cause headaches, blurred vision, and frequent urination.

Long-Term Health Risks

Persistent or severe spikes over time can lead to irreversible damage to your organs and tissues:

Metabolic Disorders: Frequent spikes contribute to insulin resistance, where cells stop responding to insulin, eventually leading to Type 2 diabetes.

Cardiovascular Health: High glucose levels can cause blood vessels to harden and narrow, significantly increasing the risk of heart disease, heart attack, and stroke.

Organ & Nerve Damage: Chronically high blood sugar is toxic to nerves and small blood vessels, leading to: Kidney Disease (Nephropathy). Eye Damage (Retinopathy) which can lead to blindness. Nerve Damage (Neuropathy), especially in the hands and feet.

Cognitive Decline: Large variations in blood sugar are associated with an increased risk of dementia and Alzheimer's disease.

Cellular Stress: During a spike, mitochondria produce harmful free radicals that cause oxidative stress, inflammation, and DNA damage.

Emergency Complications

Extremely high spikes can lead to life-threatening emergencies requiring immediate care:

Diabetic Ketoacidosis (DKA): A condition where the blood becomes too acidic due to toxic ketones.

Hyperosmolar Hyperglycemic State (HHS): Severe dehydration and dangerously high glucose levels that can lead to coma. (Abbott, 2024)^[2].

Conclusion

Developing dietary strategies for diabetic patients remains a significant clinical hurdle. Beyond mere caloric control, the specific distribution of macronutrients plays a critical role in metabolic regulation. Recent research underscores the efficacy of Mediterranean, low-carbohydrate, and plant-based diets in improving health outcomes. Currently, clinical guidelines for Type 1 Diabetes management suggest a macronutrient ratio consisting of 50–60% carbohydrates, 10–20% protein, and 20–30% fat.

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