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NUTRITION + WELLNESS

Blood Sugar Dysregulation from a Nutritional Perspective

An estimated 98 million American adults (more than 1 in 3) have prediabetes—blood sugar levels that are higher than normal but not high enough yet to be classified as type 2 diabetes. This represents approximately 40% of U.S. adults, the majority of whom do not know they have it. Of those with prediabetes, many of them will go on to develop type 2 diabetes. According to the CDC, approximately 36 million Americans have type 2 diabetes. Together, prediabetes and type 2 diabetes affect nearly half of the U.S. population.

Prediabetes is a precursor to diabetes mellitus. Those with prediabetes often show no signs and symptoms but will have blood sugar levels higher than normal. Normal fasting blood glucose level is between 70 mg/dL to 99 mg/dL. People with prediabetes have elevated blood glucose levels - between 110 mg/dL to 125 mg/dL. If left unmanaged, prediabetes may go on to become type 2 diabetes. However, prediabetes is reversible with lifestyle and dietary changes.

Contributing factors associated with prediabetes, insulin resistance, and the progression to type 2 diabetes include a diet high in refined carbohydrates, increased inflammatory markers, lack of exercise, abdominal weight gain, environmental pollutants, hormonal imbalances and nutrient deficiencies.

(Alvarez et al., 2023; American Diabetes Association, n.d.; Centers for Disease Control and Prevention [CDC], n.d.; Dagogo-Jack et al., 2025; Murray & Pizzorno, 2012)

Progression of Type 2 Diabetes and Insulin Resistance

The major risk factor for type 2 diabetes is obesity. Approximately 80-90% of individuals with type 2 diabetes are obese (maintaining a body mass index greater than 30).

Understanding the relationship between insulin, the pancreas, fat cells and blood glucose is critical to preventing diabetes. Glucose is the body's main source of fuel and its presence in the blood is tightly regulated. Insulin is a hormone produced by the pancreas. It plays a central role in regulating blood glucose levels by facilitating the uptake of glucose into cells - especially muscle, liver, and fat cells - where glucose is either used for energy or stored for future use. The pancreas produces insulin and regulates production through beta cells, located in the islets of Langerhans. The beta cells act as sensors of blood glucose levels and direct the pancreas to produce insulin accordingly.

Obesity is the primary risk factor of diabetes due to fat cells' role in glucose regulation. When fat cells become full of fat, they secrete molecules that dampen the effect of insulin, impairing glucose uptake by skeletal muscle and promoting glucose production by the liver (the liver produces glucose, when necessary). *Insulin resistance* is the term used to describe the cells' reduced responsiveness to insulin As fat cells become larger, they secrete less adiponectin, a protein that is associated with improved insulin sensitivity, but also has antiinflammatory activity, lowers triglycerides, and blocks the development of atherosclerosis.

The reduced levels of adiponectin, together with increased insulin resistance, result in pancreatic beta cells working to increase insulin output. Eventually, the pancreas cannot compensate and elevations in blood glucose develop. An elevation in blood glucose is referred to as *hyperglycemia* and is a consequence of insulin resistance. Chronic hyperglycemia can damage blood vessels, nerves, and organs, and eventually develop into diabetes.

(Murray & Pizzorno, 2012)

Prediabetes occurs when one of the following are present:

- Fasting blood glucose levels of 100-125 mg/dL
- A 2 hour glucose challenge of 140-199 mg/dL
- A1C of 5.7-6.4%

Diabetes occurs when one of the following are present:

- A1C of 6.5% or higher
- Fasting blood glucose levels of 126 mg/dL or higher
- A 2 hour glucose challenge of 200 mg/dL or higher

(Raymond & Marrow, 2023)

Risk Factors for Type 2 Diabetes

- Obesity
- A diet high in refined carbohydrates and/or low in dietary fiber
- Family history/genetics
- Increased waist to hip ratio
- Age (increased risk begins at 45)
- Race/ethnicity
- Previously identified impaired fasting glucose or impaired glucose tolerance
- History of gestational diabetes or delivery of baby weighing more than 9 pounds
- Hypertension
- Triglycerides level higher than 250
- Low adiponectin levels

- Polycystic ovary syndrome
- Environmental exposure, particularly to POPs
- Chronic Stress
- Lack of Physical Activity
- A diet high in saturated fats and trans-fatty acids and insufficient monounsaturated and Omega 3 fatty acids
- High levels of free radicals

(CDC, 2023; Murray & Pizzorno, 2012; Raymond & Marrow, 2023)

Pathophysiology and Signs and Symptoms

Uncorrected insulin resistance leads to hyperglycemia, which leads to inflammation, which contributes to further insulin resistance. As insulin becomes less effective, glucose remains elevated in the blood. Elevated blood glucose levels promote oxidative stress and advanced glycation end products (AGEs), which damage tissues and activate the immune system. Adipose tissue in insulin resistant states becomes inflammatory, contributing to disrupted insulin metabolism and further insulin resistance.

(Murray & Pizzorno, 2012)

Typical symptoms of diabetes include:

Frequent urination	Excess glucose in urine pulls water along (polyuria)
Extreme thirst	Body tries to replenish lost fluids (polydipsia)
Increased hunger	Cells aren't receiving glucose (polyphagia)
Blurred vision	High blood sugar affects the eyes
Fatigue	Energy isn't properly utilized
Numbness/tingling	Nerve damage from prolonged high glucose (neuropathy)
Dry skin/slow healing	Impaired circulation and immune response.
Frequent infections	High glucose supports bacterial/fungal growth

(Centers for Disease Control and Prevention [CDC], 2023)

Long term complications associated with diabetes are extremely common and include:

- atherosclerosis
- Retinopathy

- Neuropathy
- kidney disease
- poor wound healing and foot ulcers
- immune system dysfunction
- depression and cognitive decline
- Hypertension
- cardiovascular disease
- Elevated cholesterol
- Increased oxidative damage

(Murray & Pizzorno, 2012; Raymond & Marrow, 2023)

Dietary and Lifestyle Management Strategies

Diet

- Consume a whole food, nutrient dense diet
- Avoid processed and refined foods
- Avoid smoking and alcohol
- Hydrate sufficiently
- Fiber intake of minimum of 25/38 g per day
- Avoid starchy carbohydrates
- Increase intake of fatty fish like wild caught salmon, sardines and mackerel
- Reduce saturated fats and substitute healthy fats like coconut oil, avocado oil, flax, nuts and seeds
- Include fermented foods daily
- If consuming grains, ensure that they are whole grains
- Consume 2-3 cups of vegetables at each meal
- Maintain a low glycemic load
- Avoid sweetened beverages
- Minimize fructose consumption, avoiding high fructose corn syrup and high fructose fruits like pineapple, bananas and mangos. The potential harm of fructose arises from its potential to glycate tissue proteins, cause intracellular accumulation of sorbitol and oxidative stress.

(Murray & Pizzorno, 2012; Raymond & Marrow, 2023; Zhang et al., 2023)

Meal Frequency and Meal Patterns

- Aim for 2-3 structured meals per day, with optional snacks, only if needed
- Consider a 10 hour or less eating window with your fasting window being in the afternoon/evening

- Eat breakfast within one hour of waking
- Front load meals with the largest meal of the day being breakfast
- Maintain regular meal timing to support circadian rhythm

(Ali et al., 2023; Gómez-Ruiz et al., 2024)

Exercise: Exercise is critical for the prevention and management of diabetes because it helps improve insulin sensitivity and reduces cardiovascular risk factors. Focus on aerobic exercise, resistance/strength training and stretching.

- Engage in aerobic activity and strength training for at least 150 minutes per week
- Interrupt sedentary activity every 30 minutes for active movement
- Walk after each meal, for a minimum of 15 minutes

(Colberg et al., 2016)

Cooking Methods: Advanced glycation end products are formed during high temperature cooking and play a role in insulin resistance. Avoid cooking on an open flame or at high temperatures. Focus on boiling, poaching, and stewing over frying, broiling and roasting. Cook at lower temperatures whenever able.

(Murray & Pizzorno, 2012

Minimize exposure to pesticides, heavy metals and food additives: these substances impair glucose metabolism and pose a significant risk of obesity.

- Avoid storing our eating off of plastic food and beverage containers (this includes takeout containers); use glass instead
- Choose organic, grass fed and finished and pasture raised produce and meats
- Eat a whole foods diet
- Thoroughly wash and rinse produce
- Drink only filtered water

(Gaby, 2023; Murray & Pizzorno, 2012)

Avoiding stress: Exposure to stress activates the body's stress response and elevates production of the stress hormones adrenaline and cortisol. These hormones cause blood sugar levels to rise and when consistently elevated, can negatively impact the immune system.

Sleep: Aim for 8 hours of quality sleep each night. Short sleeping impairs glucose metabolism and reduces insulin sensitivity and irregular sleep patterns disrupt the circadian rhythm.

(Tasali, Leproult, & Spiegel, 2009)

Some Key Nutrients and Herbs for Blood Sugar Support

- *Chromium* is vital to proper blood glucose control because it functions in the body as a key constituent of glucose tolerance factor - a molecule that facilitates the action of insulin. It works with insulin to assist in the uptake of glucose into cells. Chromium polynicotinate and chromium picolinate offer the best results. 400-600 mg/day
- *Green tea* has been shown to reduce fasting glucose and A1c levels in diabetics.
- *Vitamin C* is an antioxidant, required for immune function, has been shown to mildly improve glucose control but more importantly, reduce the formation of compounds linked to the development of diabetic complications. The transport of vitamin C into cells is enhanced by insulin, so many people with diabetes suffer from a deficiency of vitamin C.
- *Magnesium* is involved in glucose metabolism and most people with diabetes are deficient. Supplementation of 400-500 mg/day improves insulin response and action as well as glucose tolerance.
- *Biotin* has been shown to increase insulin sensitivity and the activity of glucokinase, the enzyme responsible for the first step in utilization of glucose by the liver. 9-16 mg/day
- *Cinnamon* has been shown to improve glycemic control at 1-3 g/day.
- *Berberine* has been shown to have effects similar to metformin in decreasing blood sugar levels; it also decreases LDL cholesterol and activates AMPK.
- *Fenugreek* seed extract at 1 g/day has been shown to increase insulin sensitivity, possibly because it contains 4-hydroxyisoleucine, which directly stimulates insulin.

(Gaby, 2023; Murray & Pizzorno, 2012; Raymond & Marrow, 2023; Yin, Xing, & Ye, 2008)

Address Gut Dysbiosis with Targeted Healing

There is a strong association between type 2 diabetes and gut dysbiosis. Increasing evidence shows that alterations in gut bacterial microbiota play a crucial role in the development of diabetes. Gut bacterial dysbiosis contributes to increased gut permeability, systemic inflammation from translocated bacterial toxins (like LPS, lipopolysaccharide), and reduced production of short-chain fatty acids (SCFAs) such as butyrate, which help regulate glucose metabolism and insulin sensitivity. In addition, studies consistently shown that individuals with diabetes tend to have lower microbial diversity, especially in beneficial species like *Akkermansia muciniphila* and *Faecalibacterium prausnitzii*, which are linked to metabolic health. There is also often an increase in pro-inflammatory bacteria that may promote insulin resistance.

(Oyarzun-Ampuero et al., 2025)

Blood Sugar Dysregulation Protocol

For complete protocol, see:
https://docs.google.com/document/d/1euGi3jUFtJFNVNAHBMFbRoqPKKxloZY2Kw43iTFN15M/edit?usp=sharing

Phase 1 (4-12 weeks)

- Rebalancing Diet for a minimum of 30 days
- Ensure 25-30 grams of fiber
- Breakfast within one hour of waking
- Minimum 10 hour fast between dinner and breakfast
- Green tea each day
- 8 hours of sleep
- Morning sunshine
- 10-30 minutes walking after evening meals
- Daily exercise of choice - aim for 30 minutes of movement per day
- Filtered Water
- Beginning replacing household and personal products with non-toxic versions
- Gluco Resolve 3 caps 2/day with meals
- Bio-Omega 1000 1 with dinner
- ActiMag 3 caps 3/day with meals

Phase 2 (4-12 weeks) (in addition to the above)

- Self monitor blood glucose levels
- Begin reintroducing low glycemic substitutes of any foods that you've missed, one food every three days. Any introductions must follow the above guidelines. Monitor blood sugar with reintroduction.
- Daily fermented food
- Strength training 2-3 per week
- Walk 10-20 minutes after lunch and dinner
- Minimum of 12 hour fast between dinner and breakfast
- Substitute Gluco Balance for Gluco Resolve once blood sugar has stabilized
- Substitute Bio-Omega 500 for 1000 once fish and appropriate omega 3's are well established in the diet
- Consider probiotic such as Megaspore Biotic for 2-3 months
- Continue replacing household and personal products

References

Ali, M., Reutrakul, S., Petersen, G., & Knutson, K. L. (2023). Associations between timing and duration of eating and glucose metabolism: A nationally representative study in the U.S. *Nutrients, 15*(3), 729. https://doi.org/10.3390/nu15030729

Alvarez, S., Taneja, A., & Khanna, D. (2023, July 17). *Prediabetes*. In StatPearls. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK459332/

American Diabetes Association. (n.d.). *Hyperglycemia (high blood glucose)*. https://diabetes.org/living-with-diabetes/treatment-care/hyperglycemia

Centers for Disease Control and Prevention. (n.d.). *1 in 3 adults has prediabetes* [Infographic]. Centers for Disease Control and Prevention. https://www.cdc.gov/diabetes/news/media/images/1in3L-735px-updat.png

Centers for Disease Control and Prevention. (2023, October 24). *About type 2 diabetes*. Centers for Disease Control and Prevention. https://www.cdc.gov/diabetes/about/about-type-2-diabetes.html

Centers for Disease Control and Prevention. (2023, October 30). *Diabetes symptoms*. U.S. Department of Health & Human Services. https://www.cdc.gov/diabetes/signs-symptoms/index.html

Colberg, S. R., Sigal, R. J., Yardley, J. E., Riddell, M. C., Dunstan, D. W., Dempsey, P. C., Horton, E. S., Castorino, K., & Tate, D. F. (2016). Physical activity/exercise and diabetes: A position statement of the American Diabetes Association. *Diabetes Care, 39*(11), 2065–2079. https://doi.org/10.2337/dc16-1728

Dagogo-Jack S, et al. (2025, April 18). *Prediabetes affects more than 97 million Americans, but 77 million of them are not aware*. Patient Care Online. https://www.patientcareonline.com/view/prediabetes-affects-more-than-97-million-americans-but-77-million-of-them-are-not-aware

Gaby, A. R., M.D.. (2023). Nutritional Therapy, Third Edition, 3rd Edition. [VitalSource Bookshelf 10.4.1]. Retrieved from vbk://9780982885024

Gómez-Ruiz, R. P., Cabello-Hernández, A. I., Gómez-Pérez, F. J., & Gómez-Sámano, M. Á. (2024). Meal frequency strategies for the management of type 2 diabetes subjects: A systematic review. *PloS one*, *19*(2), e0298531. https://doi.org/10.1371/journal.pone.0298531

Murray, M. T., & Pizzorno, J. E. (2012). *The encyclopedia of natural medicine* (3rd ed.). Atria Books.

Oyarzun-Ampuero, F., García-Fernández, M., Martinez, A., & López, C. (2025). Gut microbiota and type 2 diabetes associations: A systematic review. *Frontiers in Endocrinology, 12*, Article 1486793. https://doi.org/10.3389/fendo.2024.1486793

Raymond, J. L., & Morrow, K. (2023). *Krause and Mahan's Food and the Nutrition Care Process*. Elsevier.

Tasali, E., Leproult, R., & Spiegel, K. (2009). Reduced sleep duration or quality: relationships with insulin resistance and type 2 diabetes. *Progress in cardiovascular diseases*, *51*(5), 381–391. https://doi.org/10.1016/j.pcad.2008.10.002

Yin, J., Xing, H., & Ye, J. (2008). Efficacy of berberine in patients with type 2 diabetes mellitus. *Metabolism*, *57*(5), 712–717. https://doi.org/10.1016/j.metabol.2008.01.013

Zhang, X. F., Qi, Y., Zhang, Y. P., Deng, J. L., Chen, X. L., Li, R. N., … Fan, J. M. (2023). Fermented foods and metabolic outcomes in diabetes and prediabetes: A systematic review and meta-analysis of randomized controlled trials. *Critical Reviews in Food Science and Nutrition*, *64*(26), 9514–9531. https://doi.org/10.1080/10408398.2023.2213770