

REVIEW ARTICLE

DIABETES CARE PRECAUTIONS FUNCTIONS REMEDIES: A REVIEW

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ABSTRACT:

This review provides a comprehensive overview of a patient's diabetes care plan, covering essential details related to diabetes type, diagnosis, medical history, and family background. The patient is diagnosed with either Type 1, Type 2, or gestational diabetes and has a relevant medical history that includes hypertension and hyperlipidemia. Family history reveals a predisposition to diabetes or related conditions. Current treatment includes insulin and oral hypoglycemics, with specified dosages and administration methods. Blood glucose monitoring is regularly performed, with a target range for glucose levels and A1C results that are routinely evaluated. Lifestyle modifications, such as carbohydrate counting, meal planning, and physical activity, are implemented alongside weight management goals. The care plan also includes protocols for screening complications like retinopathy, nephropathy, neuropathy, and foot care, ensuring that regular check-ups are scheduled. Diabetes Self-Management Education (DSME) and available support resources, such as counseling or support groups, are provided to enhance patient self-care. A follow-up schedule and goals for upcoming visits are outlined, along with an emergency plan for hypoglycemia management and when to seek medical assistance. Additionally, the document explores alternative treatments, including Ayurvedic remedies, to complement standard care practices.

KEYWORDS: Diabetes, Precautions, Diet, Ayurvedic Remedies

INTRODUCTION:

Diabetes currently affects around 537 million adults globally, with estimates indicating that this figure could increase to 783 million by 2045. The prevalence of diabetes varies widely across different regions, particularly impacting low- and middle-income countries.[1]

- **Types of Diabetes:** Type 2 diabetes represents approximately 90-95% of all diabetes cases.

- **Age Distribution:** The highest prevalence is observed in individuals aged 45 to 64 years.
- **Health Complications:** Diabetes is associated with severe health issues, including cardiovascular disease, kidney failure, and risk of amputations.

These figures underscore the significant global health challenge posed by diabetes, highlighting the urgent need for effective prevention and management strategies [7].

Recent estimates indicate that around 77 million people in India are living with diabetes, positioning the country among those with the highest prevalence globally. Projections suggest that this number could rise to approximately 134 million by 2045.

- **Types of Diabetes:** The vast majority of cases in India are Type 2 diabetes, which is often linked to lifestyle and dietary choices.
- **Age Distribution:** The highest prevalence is observed in adults aged 45 to 64 years, though there is a concerning increase among younger individuals.
- **Regional Differences:** Diabetes rates are generally higher in urban areas compared to rural regions, primarily due to lifestyle changes and dietary habits.
- **Health Complications:** The condition is associated with various serious complications, including cardiovascular diseases, neuropathy, and kidney problems.

These figures emphasize the critical need for enhanced awareness, prevention, and management strategies for diabetes in India.

What is Diabetes?

Diabetes is a chronic medical condition characterized by the body's inability to properly regulate blood sugar (glucose) levels. Glucose is vital for energy production in cells, but elevated blood sugar levels can lead to serious health issues over time.[8]

Types of Diabetes

1. Type 1 Diabetes:

- **Description:** An autoimmune disorder where the immune system attacks insulin-producing cells in the pancreas.
- **Onset:** Often diagnosed in children and young adults, but can occur at any age.
- **Management:** Requires lifelong insulin therapy along with dietary management and regular exercise.[6]

2. Type 2 Diabetes:

- **Description:** The most prevalent form, characterized by insulin resistance, meaning the body cannot effectively use insulin.
- **Onset:** Commonly develops in adults, but increasing numbers of children and adolescents are being diagnosed, often related to rising obesity rates.
- **Management:** Involves lifestyle changes, oral medications, and possibly insulin as the condition progresses.

3. Gestational Diabetes:

- **Description:** Develops during pregnancy and usually resolves after childbirth, but increases the risk of Type 2 diabetes later in life.

- **Management:** Typically managed with dietary changes and monitoring blood sugar levels; insulin may be required in some cases.[9]

Causes and Risk Factors

- **Genetic Factors:** A family history of diabetes can elevate risk.
- **Obesity:** Excess weight, particularly around the abdomen, significantly increases the likelihood of Type 2 diabetes.
- **Sedentary Lifestyle:** Lack of regular physical activity contributes to insulin resistance.
- **Unhealthy Diet:** Diets high in processed foods, sugars, and unhealthy fats can raise diabetes risk.
- **Age:** Risk increases with age, especially after 45.
- **Other Conditions:** Conditions such as hypertension and high cholesterol are often associated with diabetes.[5]

Symptoms

- **Common Symptoms:** Increased thirst, frequent urination, extreme fatigue, blurred vision, and slow-healing wounds or infections.
- **Type 1 Specific Symptoms:** May include rapid weight loss and nausea.
- **Type 2 Specific Symptoms:** Symptoms often develop gradually and may not be immediately noticeable.[10]

Complications

Unmanaged diabetes can lead to severe complications, including:

- **Cardiovascular Disease:** Higher risk of heart attacks and strokes.
- **Nerve Damage (Neuropathy):** Can cause pain, tingling, or loss of sensation, particularly in the feet.
- **Kidney Damage (Nephropathy):** Can progress to kidney failure or necessitate dialysis.
- **Eye Damage:** Risks include retinopathy, cataracts, and glaucoma, which can lead to blindness.
- **Foot Damage:** Poor circulation and nerve damage can lead to infections and amputations.

Diagnosis

- **Fasting Blood Glucose Test:** Measures blood sugar levels after fasting overnight.
- **Oral Glucose Tolerance Test (OGTT):** Assesses blood sugar levels before and after consuming a sugary solution.
- **Hemoglobin A1c Test:** Reflects average blood sugar levels over the past 2-3 months.

Management

- **Lifestyle Modifications:** Emphasizing healthy eating, regular physical activity, and weight management is essential for all diabetes types.
- **Medications:** Insulin therapy for Type 1 diabetes and sometimes for Type 2; oral medications for Type 2 to help control blood sugar levels.
- **Monitoring:** Regular blood sugar checks to track levels and adjust treatment as needed.[11]

Prevention

- **Healthy Eating:** Focus on a balanced diet rich in whole grains, fruits, vegetables, lean proteins, and healthy fats.
- **Regular Exercise:** Aim for at least 150 minutes of moderate aerobic activity weekly.
- **Weight Management:** Maintaining a healthy weight can significantly lower the risk of developing Type 2 diabetes.
- **Regular Check-Ups:** Early detection through routine screenings can facilitate better management and outcomes.[4]

Diabetes is a complex condition that poses significant health risks. Effective management requires a comprehensive approach, including lifestyle changes, medical treatment, and consistent monitoring. Education and awareness about diabetes are crucial for prevention and improving health outcomes for those affected.[12]

Diabetes Treatments in Ayurveda

Ayurveda, the ancient Indian system of medicine, offers a holistic approach to managing diabetes (Madhumeha). It emphasizes balancing the body's energies (doshas) and promotes overall health through lifestyle changes, dietary adjustments, herbal remedies, and various therapies.[3]

Understanding Diabetes in Ayurveda

In Ayurvedic terms, diabetes is viewed as a metabolic disorder primarily caused by an imbalance in the doshas, especially Kapha. Symptoms commonly associated with diabetes include excessive thirst, frequent urination, fatigue, and weight gain. Ayurvedic treatments aim to restore balance and enhance the body's ability to manage blood sugar levels effectively.

Principles of Ayurvedic Treatment for Diabetes

1. Dietary Modifications (Ahara):

- **Whole Foods:** Emphasis is placed on consuming whole, unprocessed foods. A diet rich in whole grains, legumes, vegetables, and fruits is highly recommended.
- **Low Glycemic Index Foods:** Incorporating foods with a low glycemic index helps regulate blood sugar levels. Examples include barley (jowar), millet (bajra), and various legumes.
- **Minimize Sugars:** It's essential to reduce the intake of refined sugars, sweeteners, and processed foods.[2]
- **Healthy Fats:** Use healthy fats like ghee and olive oil in moderation, while avoiding trans fats.

2. Herbal Remedies (Dravyaguna):

- **Bitter Herbs:** Herbs with a bitter taste are thought to help lower blood sugar levels. Notable examples include:
 - **Bitter Gourd (Karela):** Known for its effectiveness in reducing blood sugar levels.
 - **Fenugreek (Methi):** The seeds are often used to enhance insulin sensitivity.

- **Turmeric (Haldi):** Contains curcumin, which has anti-inflammatory and antioxidant properties, potentially aiding in blood sugar regulation.
- **Amla (Indian Gooseberry):** Rich in vitamin C, it is believed to improve insulin sensitivity and lower blood sugar levels.
- **Gymnema Sylvestre (Gurmar):** Traditionally used to suppress sugar cravings and enhance glucose metabolism.

3. Lifestyle Modifications (Vyayama and Dinacharya):

- **Regular Exercise (Vyayama):** Engaging in physical activities like yoga, walking, or swimming is crucial for maintaining a healthy weight and improving insulin sensitivity.
- **Dinacharya:** Adopting a daily routine that includes regular meal times, structured sleep patterns, and stress management practices, such as meditation or yoga, helps maintain balance.

4. Detoxification (Panchakarma):

- **Purification Therapies:** Panchakarma involves a set of therapeutic treatments designed to detoxify and rejuvenate the body. These can include:
 - **Virechana:** A purgation therapy aimed at cleansing the digestive system.
 - **Basti:** Enema treatments that help detoxify and restore balance to the body.
- These therapies should ideally be performed under the guidance of a qualified Ayurvedic practitioner.

5. Mind-Body Connection:

- **Stress Management:** Managing stress is vital, as it can significantly impact blood sugar levels. Practices like yoga, meditation, and breathing exercises (pranayama) can be effective.
- **Mindful Eating:** Encouraging a conscious approach to eating, focusing on the taste and texture of food, enhances digestion and satisfaction.[13]

Sample Ayurvedic Remedies for Diabetes

- **Karela Juice:** Drinking bitter melon juice daily is a common remedy for managing blood sugar levels.
- **Methi Water:** Soaking fenugreek seeds overnight and consuming the water on an empty stomach can be beneficial.
- **Amla Powder:** Taking amla powder mixed with honey can help regulate blood sugar.
- **Turmeric Milk:** Consuming warm milk with turmeric may support metabolic health.

Ayurvedic treatments for diabetes provide a comprehensive approach that includes dietary changes, herbal remedies, lifestyle modifications, and detoxification practices. It's essential to collaborate with a qualified Ayurvedic practitioner to develop a personalized plan and monitor blood sugar levels regularly. While Ayurveda can complement conventional treatments, it should not replace standard medical care for diabetes management.

Diabetes Medications for Management

Managing diabetes often requires medications to control blood sugar levels, especially when lifestyle changes alone are insufficient.

1. Insulin Therapy

Insulin is essential for individuals with Type 1 diabetes and may also be prescribed for some with Type 2 diabetes. The types of insulin differ based on their onset and duration of action:

- **Rapid-Acting Insulin:** Begins working within minutes and lasts for a few hours (e.g., **Lispro, Aspart**).
- **Short-Acting Insulin:** Takes about 30 minutes to start working and lasts for 6-8 hours (e.g., **Regular insulin**).
- **Intermediate-Acting Insulin:** Onset takes 1-2 hours and lasts for 12-18 hours (e.g., **NPH insulin**).
- **Long-Acting Insulin:** Starts working after several hours and lasts up to 24 hours or more (e.g., **Glargine, Detemir**).[14]

2. Oral Antidiabetic Medications

These medications are primarily used for Type 2 diabetes and are classified into several categories:

- **Biguanides:**
 - **Metformin** is the most widely used. It decreases glucose production in the liver and improves insulin sensitivity.
- **Sulfonylureas:**
 - Examples include **Glipizide, Glyburide, and Glimepiride**. These stimulate the pancreas to produce more insulin.
- **Meglitinides:**
 - Such as **Repaglinide** and **Nateglinide**, these medications also promote insulin secretion but act more quickly and for a shorter duration than sulfonylureas.
- **Thiazolidinediones (TZDs):**
 - Examples include **Pioglitazone** and **Rosiglitazone**. They improve insulin sensitivity but may lead to weight gain and other side effects.
- **DPP-4 Inhibitors:**
 - Medications like **Sitagliptin** and **Saxagliptin** help increase insulin production and reduce glucose output from the liver.
- **SGLT2 Inhibitors:**
 - These include **Canagliflozin** and **Dapagliflozin**, which prevent glucose reabsorption in the kidneys, promoting increased glucose excretion.

3. GLP-1 Receptor Agonists

These injectable medications mimic incretin hormones, enhancing insulin secretion and reducing appetite. Examples include:

- **Liraglutide** (Victoza)
- **Semaglutide** (Ozempic)

- **Dulaglutide** (Trulicity)

4. Amylin Analogs

- **Pramlintide** (Symlin) is an injectable medication used for both Type 1 and Type 2 diabetes. It helps control blood sugar by slowing gastric emptying and promoting feelings of fullness.[15]

5. Combination Medications

Some drugs combine two different classes of medications to enhance efficacy and convenience. Examples include:

- **Metformin with a DPP-4 inhibitor** (e.g., Metformin and Sitagliptin - Janumet).
- **Metformin with an SGLT2 inhibitor** (e.g., Metformin and Canagliflozin - Invokamet).

Diabetes treatment is highly personalized. The choice of medication depends on various factors, including the type of diabetes, blood sugar levels, potential side effects, and any coexisting health conditions. Regular monitoring and consultations with healthcare providers are crucial for effective diabetes management.

Natural Remedies for Diabetes Management

Managing diabetes effectively often involves a combination of lifestyle changes, dietary adjustments, and natural remedies. While these approaches can complement conventional treatments, they should not replace them.

1. Dietary Adjustments

a. Low Glycemic Index Foods:

- Foods with a low glycemic index (GI) release glucose slowly into the bloodstream, helping to maintain stable blood sugar levels. Examples include:
 - **Whole grains:** Quinoa, barley
 - **Non-starchy vegetables:** Broccoli, spinach
 - **Legumes:** Beans, lentils

b. Fiber-Rich Foods:

- High fiber intake can improve blood sugar control.[16] Sources include:
 - **Fruits:** Apples, pears, berries
 - **Vegetables:** Carrots, Brussels sprouts
 - **Whole grains:** Oats, brown rice

c. Healthy Fats:

- Incorporating healthy fats can enhance insulin sensitivity. Sources include:
 - **Avocados**
 - **Nuts:** Walnuts, almonds
 - **Seeds:** Chia, flaxseed
 - **Oils:** Olive oil

2. Herbal Remedies

a. Bitter Gourd (Karela):

- Known for its blood sugar-lowering properties, bitter gourd can be consumed as juice or in cooked dishes.

b. Fenugreek:

- Fenugreek seeds may help improve insulin sensitivity and lower blood sugar levels. They can be consumed soaked or ground into powder.

c. Cinnamon:

- Some studies suggest that cinnamon may enhance insulin sensitivity and lower blood sugar levels. It can be added to meals or taken as a supplement.

d. Aloe Vera:

- Aloe vera juice might help lower blood sugar levels and improve lipid profiles.

e. Berberine:

- Found in several plants (like goldenseal), berberine has shown promise in reducing blood sugar levels and improving insulin sensitivity.

3. Lifestyle Modifications**a. Regular Physical Activity:**

- Exercise helps improve insulin sensitivity and lower blood sugar levels. Aim for at least 150 minutes of moderate aerobic activity each week, such as:
 - Walking
 - Cycling
 - Swimming
 - Strength training

b. Weight Management:

- Maintaining a healthy weight is crucial for managing Type 2 diabetes. Even modest weight loss can lead to significant improvements in blood sugar control.

c. Stress Management:

- Stress can negatively impact blood sugar levels. Techniques for managing stress include:
 - Meditation
 - Deep breathing exercises
 - Yoga
 - Mindfulness practices

d. Sleep Hygiene:

- Poor sleep can contribute to insulin resistance. Aim for 7-9 hours of quality sleep per night and establish a consistent sleep routine.[17]

4. Supplements**a. Omega-3 Fatty Acids:**

- Found in fish oil, flaxseeds, and walnuts, omega-3 fatty acids can improve heart health and may have anti-inflammatory effects.

b. Magnesium:

- Low magnesium levels have been linked to insulin resistance. Foods rich in magnesium include spinach, nuts, and whole grains.

c. Vitamin D:

- Adequate vitamin D levels may enhance insulin sensitivity. Sun exposure and foods like fatty fish, fortified dairy products, and egg yolks can help maintain levels.

d. Chromium:

- This mineral may improve insulin sensitivity and glucose metabolism. Supplements are available, but it's advisable to consult a healthcare provider before starting.

5. Mind-Body Practices**a. Yoga:**

- Yoga can help reduce stress, improve flexibility, and enhance overall well-being. Certain poses may also aid in blood sugar control.

b. Tai Chi:

- This gentle form of exercise combines movement and meditation, improving balance, flexibility, and stress management.

Natural remedies and lifestyle changes can significantly support diabetes management. However, they should be integrated with conventional medical treatments under the guidance of healthcare professionals. Regular monitoring of blood sugar levels and consultations with healthcare providers are essential for effective management. Always consult with a healthcare provider before starting any new remedy or making significant changes to your diabetes management plan.

Chemistry of Diabetes

Diabetes is primarily characterized by abnormal glucose metabolism due to issues with insulin production, secretion, or action. Understanding the underlying chemistry is essential for grasping the mechanisms of this complex disease.[18]

1. Insulin and Its Role

- **Insulin Structure:** Insulin is a peptide hormone made up of 51 amino acids, arranged into two chains (A and B) linked by disulfide bonds. It is synthesized in the beta cells of the pancreas.
- **Function:** Insulin plays a crucial role in:
 - Facilitating glucose uptake by cells.
 - Promoting glycogen synthesis in the liver and muscle tissues.
 - Inhibiting gluconeogenesis, which is the production of glucose from non-carbohydrate sources.

2. Glucose Metabolism

- **Glucose Structure:** Glucose is a monosaccharide with the molecular formula $C_6H_{12}O_6$, serving as a primary energy source for cells.
- **Glycolysis:** This is the metabolic pathway that converts glucose into pyruvate, generating ATP (energy) in the process. Glycolysis occurs in the cytoplasm and does not require oxygen (anaerobic).

- **Glycogenesis and Glycogenolysis:**

- **Glycogenesis:** The conversion of glucose to glycogen for storage, primarily in the liver and muscles, stimulated by insulin.
- **Glycogenolysis:** The breakdown of glycogen back into glucose, stimulated by glucagon (another hormone from the pancreas) when blood sugar levels drop.

3. Types of Diabetes and Chemical Pathways

- **Type 1 Diabetes:**

- An autoimmune disorder where the immune system attacks insulin-producing beta cells, resulting in insulin deficiency and high blood glucose levels due to inadequate glucose uptake by cells.

- **Type 2 Diabetes:**

- Characterized by insulin resistance, where cells become less responsive to insulin. Contributing factors include obesity and lifestyle changes, which disrupt insulin signaling. This condition often leads to increased gluconeogenesis and decreased glycogen synthesis in the liver.

4. Biochemical Markers

- **Hemoglobin A1c (HbA1c):**

- This marker reflects average blood glucose levels over the past 2-3 months, forming when glucose binds to hemoglobin in red blood cells—a process called glycation.

- **C-Peptide:**

- A byproduct of insulin production, C-peptide levels can be measured to assess beta-cell function in the pancreas.

5. Complications and Chemical Reactions

- **Glycation and Advanced Glycation End Products (AGEs):**

- Chronic high blood sugar levels lead to the formation of AGEs, which can damage proteins, lipids, and nucleic acids, contributing to complications such as neuropathy and retinopathy.

- **Lipid Metabolism:**

- Diabetes often disrupts lipid metabolism, leading to dyslipidemia (abnormal lipid levels), which increases the risk of cardiovascular disease.[19]

6. Pharmacological Interventions

- **Insulin Therapy:**

- Insulin is administered to mimic or replace natural insulin, facilitating glucose uptake by tissues.

- **Oral Medications:**

- **Metformin:** Inhibits hepatic glucose production and enhances insulin sensitivity.
- **Sulfonylureas:** Stimulate insulin secretion from beta cells.

- **GLP-1 Agonists:** Enhance insulin secretion in response to meals and reduce glucagon secretion.

The chemistry of diabetes encompasses the complex interplay between hormones, metabolic pathways, and biochemical markers. A thorough understanding of these chemical processes is vital for developing effective treatment strategies and managing the disease.

Conclusion

Effective management of diabetes necessitates a comprehensive strategy that incorporates several key elements to maintain optimal blood sugar levels and prevent complications.

1. **Regular Monitoring:** Consistent monitoring of blood glucose is essential for understanding the impact of diet, physical activity, and medications on blood sugar levels.
2. **Healthy Eating:** A balanced diet rich in whole grains, lean proteins, healthy fats, and a variety of fruits and vegetables is vital. Attention to portion sizes and carbohydrate counting further aids in effective blood sugar management.
3. **Physical Activity:** Engaging in at least 150 minutes of moderate aerobic exercise weekly enhances insulin sensitivity and assists with weight management.
4. **Medication Adherence:** Strict adherence to prescribed medications, including insulin and oral antidiabetics, is critical for maintaining control over blood glucose levels.
5. **Weight Management:** Achieving and maintaining a healthy weight significantly contributes to diabetes management, especially for individuals with Type 2 diabetes.
6. **Stress Management:** Employing stress-reduction techniques such as mindfulness, meditation, and yoga can help stabilize blood sugar levels.
7. **Regular Check-Ups:** Routine medical examinations, including eye and foot care, are crucial for monitoring and addressing potential complications of diabetes.
8. **Education and Awareness:** Staying informed about diabetes empowers individuals to make healthier choices and advocate for their well-being.[20]

By integrating these practices into daily life, individuals with diabetes can effectively manage their condition, reduce the risk of complications, and improve their overall quality of life. Ongoing education and support from healthcare professionals play a vital role in ensuring effective diabetes management.

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REFERENCES:

1. American Diabetes Association. (2010). Diagnosis and classification of diabetes mellitus. *Diabetes Care*, 33(Suppl 1), S62-S69.
2. Piero, M. N., Nzaro, G. M., & Njagi, J. M. (2014). Diabetes mellitus - A devastating metabolic disorder. *Asian Journal of Biomedical and Pharmaceutical Sciences*, 1–7.

3. Nagesh, M. R., Vijayakumar, N., & Bhavani, K. (2020). A review on diabetes mellitus: An annihilatory metabolic disorder. *Journal of Pharmaceutical Sciences and Research*, 12(2), 232–233.
4. Cho, N. H., Shaw, J. E., Karuranga, S., Huang, Y., Fernandes, J. D. R., Ohlrogge, A., & Malanda, B. (2018). IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes Research and Clinical Practice*, 138, 271–281. <https://doi.org/10.1016/j.diabres.2018.02.023>
5. American Diabetes Association. (2018). Classification and diagnosis of diabetes: Standards of medical care in diabetes—2018. *Diabetes Care*, 41(1), 13–27. <https://doi.org/10.2337/dc18-S002>
6. Xie, F., Chan, J. C. N., & Ma, R. C. W. (2018). Precision medicine in diabetes prevention, classification, and management. *Journal of Diabetes Investigation*, 9, 998–1015. <https://doi.org/10.1111/jdi.12857>
7. McIntyre, H. D., Catalano, P., Zhang, C., Desoye, G., Mathiesen, E. R., & Damm, P. (2019). Gestational diabetes mellitus. *Nature Reviews Disease Primers*, 5, 47. <https://doi.org/10.1038/s41572-019-0078-1>
8. Ahadi, M., Tabatabaeiyan, M., & Moazzami, K. (2011). Association between environmental factors and risk of type 1 diabetes: A case-control study. *Endokrynologia Polska*, 62, 134–137.
9. Nishi, M., & Nanjo, K. (2011). Insulin gene mutations and diabetes. *Journal of Diabetes Investigation*, 2, 92–100. <https://doi.org/10.1111/j.2040-1124.2011.00110.x>
10. Oberoi, S., & Kansra, P. (2020). Economic menace of diabetes in India: A systematic review. *International Journal of Diabetes in Developing Countries*, 40, 464–475.
11. Anjana, R. M., et al. (2011). The Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) study: Methodological details. *Journal of Diabetes Science and Technology*, 5, 906–914. <https://doi.org/10.1177/193229681100500432>
12. Simmons, D., Williams, D. R., & Powell, M. J. (1989). Prevalence of diabetes in a predominantly Asian community: Preliminary findings of the Coventry diabetes study. *BMJ*, 298, 18–21. <https://doi.org/10.1136/bmj.298.6662.18>
13. Diamond, J. (2011). Medicine: Diabetes in India. *Nature*, 469, 478–479. <https://doi.org/10.1038/469478a>
14. Pradeepa, R., et al. (2015). Prevalence of generalized and abdominal obesity in urban and rural India — The ICMR-INDIAB Study (Phase-I) [ICMR-INDIAB-3]. *Indian Journal of Medical Research*, 142, 139–150.
15. Major, S. G. (1989). Blood pressure in diabetes mellitus: A statistical study. *Archives of Internal Medicine*, 44, 797.
16. Joshi, S. R., & Parikh, R. M. (2007). India - Diabetes capital of the world: Now heading towards hypertension. *Journal of the Association of Physicians of India*, 55, 323–324.

17. Mohan, V., Shanthirani, C. S., & Deepa, R. (2003). Glucose intolerance (diabetes and IGT) in a selected south Indian population with special reference to family history, obesity, and lifestyle factors — The Chennai Urban Population Study (CUPS 14). *Journal of the Association of Physicians of India*, 51, 771–777.
18. Tiwari, A. K. (2005). Wisdom of Ayurveda in perceiving diabetes: Enigma of therapeutic recognition. *Current Science*, 88(7), 10 April 2005.
19. National Diabetes Information Clearinghouse. (1999). *Diabetes Statistics* (NIH publication No. 99-3926). Bethesda, MD: National Institute of Diabetes and Digestive and Kidney Diseases.
20. Ramachandran, A., et al. (2001). High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. *Diabetologia*, 44, 1094–1101. <https://doi.org/10.1007/s001250100572>