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JOURNAL OF DIABETES EDUCATION

To Dispel Darkness of Diabetes

Vol. 12 **Number 2** **April-June 2024**

CONTENTS

PREDIABETES: A CRITICAL POINT OF INTERVENTION

Niti Desai*

The prevalence of prediabetes; a forerunner of diabetes is very high. Prediabetes has the potential of progressing to Type 2 diabetes mellitus (T2DM) in approximately 25% of individuals within 3–5 years and as many as 70% of individuals with prediabetes will develop T2DM within their lifetime. The conversion to Type 2 diabetes is more rapid among Asian Indians. Research suggests that more than 50% of individuals with T2DM in India remain undiagnosed or are unaware of their diabetes status. IDF 2021 reports that the prevalence of undiagnosed T2DM among the total diabetes population was 53.1%, totaling 39.4 million individuals. In 2021, an estimated expenditure on diabetes in India was USD 10.1 billion. Analysts predict that healthcare costs will increase to USD 15 billion by 2045, which can significantly burden the healthcare system. This issue is further compounded by a high number of diabetes-related deaths, with India having 6,00,000 deaths in 2021, ranking it third in the world after China and the United States. Considering the economic burden, diabetes alone exhausts 5 to 25% of the average Indian household's earnings. These findings highlight the urgent need for increased efforts to identify and diagnose individuals at risk for T2DM to improve outcomes and reduce the overall burden of the disease in India.

WHAT IS PREDIABETES?

Prediabetes is a critical stage in the development of T2DM. Blood sugar levels are higher than normal but not high enough to categorize it as diabetes. Referred to as borderline diabetes, it is a condition that puts one at a high risk of developing diabetes. The risk for macrovascular disease starts at the stage of prediabetes as it increases the risk of Cardiovascular disease (CVD) events such as myocardial infarction, stroke and death. Prediabetes has also been linked with retinopathy, neuropathy and nephropathy. The good news is that at this point, lifestyle changes such as dietary modification and physical activity alone can help bring the blood sugar levels back to normal. When lifestyle changes do not work, pharmacotherapy can be considered.

RISK FACTORS FOR PREDIABETES

National Family Health Service (NFHS-5) survey reveals that one in every four people with diabetes (24.82%) is not getting diagnosed, indicating a notable gap in the identification and treatment of the disease. Age, elevated postprandial plasma glucose, obesity, family history of diabetes, physical inactivity and poor high-density lipoprotein (HDL) are the common risk factors for the transition from normal glucose tolerance (NGT) to dysglycemia, according to a 10-year follow-up of the Chennai Urban Rural Epidemiology Study (CURES). The same study also demonstrated that in those with NGT, sedentary lifestyles and low HDL cholesterol predicted the onset of prediabetes (but not T2DM). Insights from the NFHS-5 survey also reveal that middle-aged individuals (45-49 years), those with the lowest wealth index, those with higher BMI and those living in the geographical south of India were found to be at a higher risk of undiagnosed T2DM. Additionally, females with no education and tobacco users were also at a higher risk of undiagnosed T2DM. Certain dietary factors like lower intake of pulses/beans for males and lower intake of green leafy vegetables, fish and lean meat for females were found to be associated with a higher risk of undiagnosed T2DM.

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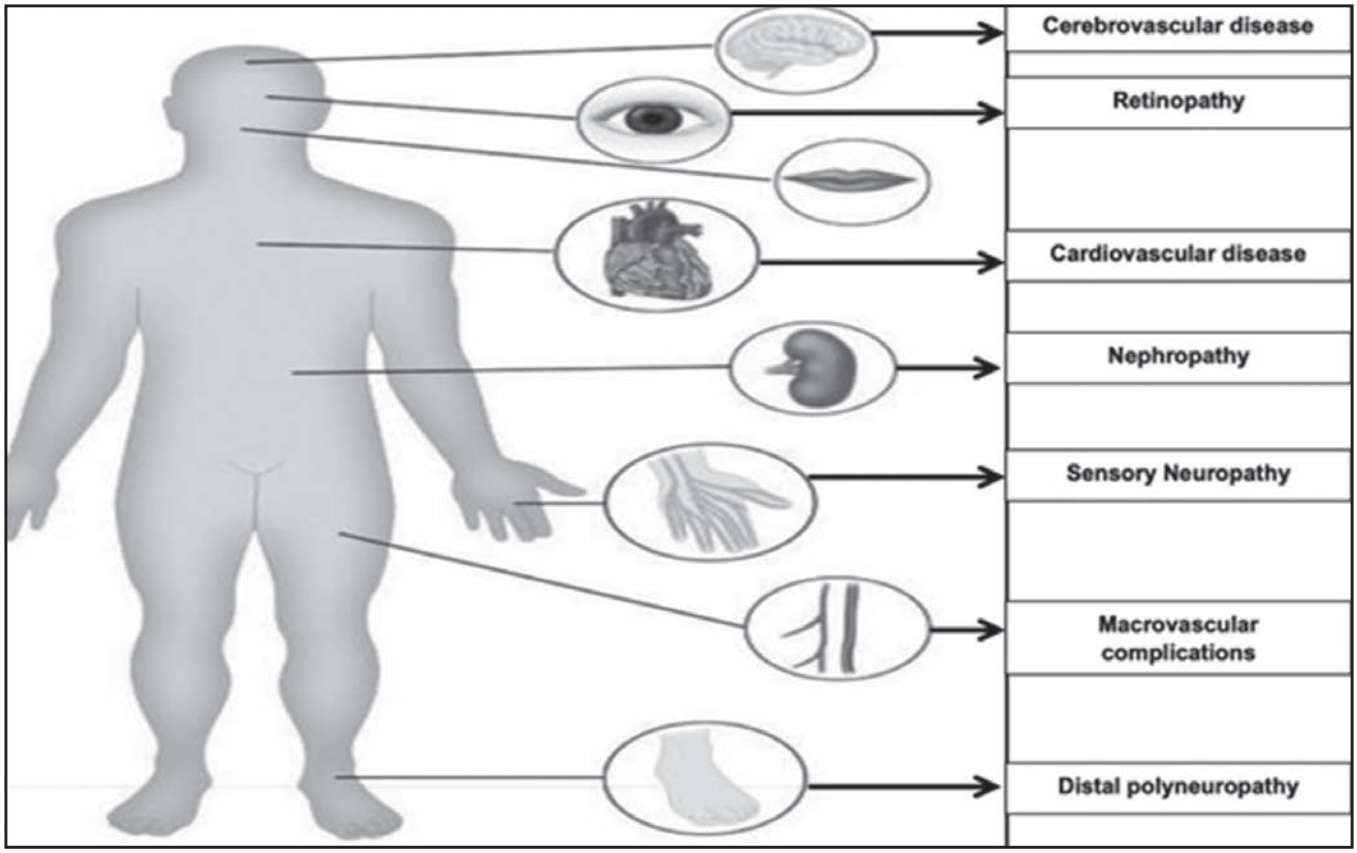
Figure 1:

Adverse Outcomes of Prediabetes, if Left Untreated



Source: Kacker S. et al. Int J Med Res Prof. 2018.

HOW CAN YOU KNOW IF YOU HAVE PREDIABETES?

A few aspects to consider at are:

1. **Common symptoms:** Prediabetes is not accompanied by any one significant symptom. You can have undetected prediabetes for years until it progresses to T2DM. For the few people who develop symptoms of prediabetes, it may be seen as skin tags and darkening of the skin in certain areas of the body such as elbows, neck and armpits. Excessive hunger could also be a sign.
2. **Family history:** The reason behind not being able to process sugar efficiently anymore could have a genetic link as many people with prediabetes are known to have family members with T2DM. Just like their family members, they are predisposed to developing T2DM, but the process starts off with prediabetes.
3. **Lifestyle factors:** Certain factors that increase the predisposition of developing prediabetes are- overweight/obesity, high blood pressure, smoking, advanced age. People who are inactive and whose diets are filled with processed and refined foods, fried foods, sugar sweetened foods and beverages are at a higher risk of developing prediabetes. The increasing prevalence of obesity, in particular, is a cause of concern as it leads to insulin resistance as well as a lack of insulin secretion from the pancreas.
4. **Gestational diabetes:** Women with a history of gestational diabetes face an 8 to 10 fold increased risk of developing diabetes, with the highest risk occurring 3–6 years after the occurrence of

gestational diabetes. This risk is even higher if gestational diabetes had to be managed by pharmacological treatments such as insulin.

5. **Drugs:** It is also important to note that certain classes of drugs, such as corticosteroids and estrogen-containing contraceptives, can lead to elevated blood sugar levels. These typically return to normal once the medication is discontinued. However, prolonged use may cause increased susceptibility to prediabetes. Hence, eliciting the medication history by the doctor is a must.

WHAT ARE SOME STRATEGIES FOR EARLY DIAGNOSIS?

- Pay attention to any symptoms described above, although it is highly unlikely to have symptoms at this early stage.
- Share family history with the doctor: If you have a family history of diabetes, be open about it with doctors to detect asymptomatic health conditions at the right time.
- Test early and regularly: This is the most important tool. Test one post-prandial blood glucose and HbA1c levels annually after the age of 40 years.

Prediabetes may be detected at annual checkups at a very early stage. This applies even more so for vulnerable groups such as people with obesity and women with a history of gestational diabetes. They should proactively get their blood work done annually as a preventative measure.

Research Society for the Study of Diabetes in India (RSSDI) clinical recommendation guidelines 2022 state that screening for prediabetes is recommended for individuals presenting to healthcare settings for an unrelated illness, family members of patients with diabetes, during antenatal care, overweight children and adolescents at the onset of puberty and dental care.

WHAT ARE THE TREATMENT OPTIONS FOR PREDIABETES?

Research Society for the Study of Diabetes in India clinical recommendation guidelines 2022 state that individuals with prediabetes should be educated on weight management through optimal diet and physical activity, stress management, avoidance of alcohol and tobacco chewing.

Lifestyle modification is the first line of treatment:

- To lose 5%-10% of body weight if overweight or obese.
- Participate in physical activity for at least 60 minutes (for obese) or 30 min (for normal weight) daily.
- Try and get 6-8 hours of sleep.

The primary focus in managing prediabetes is lifestyle modification. This includes adopting a well-balanced, nutrient-dense diet, increasing physical activity, quitting smoking, limiting alcohol intake and achieving and maintaining a healthy weight. By adopting intense lifestyle changes, there can be a significant risk reduction. The biggest determinant of risk reduction is weight loss. For every 1 kg decrease in weight, the risk of developing T2DM in the future is reduced by 16%. A relatively small amount of weight, about 5-10% of current weight, produces great health benefits. The Indian Diabetes Prevention Programme (IDPP) conducted among Asian Indians showed that T2DM was preventable in participants with impaired glucose tolerance utilizing lifestyle changes. On a 3-year follow-up, lifestyle changes significantly lowered the chance of developing T2DM by 28.5%.

Diet

No particular diet can help with prediabetes, as every individual is different. Taking a more personalized approach based on general recommendations is the key to a sustainable diet that works in the long run. The primary goal should be weight loss. In the Indian context, the need to reduce the intake of carbohydrate-rich foods, specially refined and processed grains in the from of biscuits, cookies, pasta and

pizza is required. Refined grains such as white rice, puffed rice and rice flakes also add to the carbohydrate load. For effective dietary changes, limit the intake of carbohydrate and replace it with protein-rich foods such as dals, beans, soy, low-fat dairy, egg-white and lean meat such as fish and chicken in the diet.

In order to lose weight and prevent blood sugar spikes, a well-balanced meal should be consumed. An ideal plate should have ¼ plate of whole grains, ¼ plate of protein and ½ plate of non-starchy vegetables and salad with water on the side. Focus on healthy fats such as nuts, seeds and oils rich in monounsaturated fats such as canola, groundnut, mustard and olive oil. Increase fibre intake, avoid red meat, fried foods, *mithais*, sweets, cakes and pastries and sugary drinks.

Figure 2:

Ideal Plate

Source: American Diabetes Association, 2020.

Exercise

Regular physical activity means getting at least 150 minutes a week (30 mins/day, 5 days/week) of moderate to vigorous intensity physical activity. It can include brisk walking, swimming, cycling, strength training, playing a sport and trekking.

Medications

When lifestyle interventions alone do not work, the doctor may prescribe medication. The medication also helps with weight loss, which in turn improves prediabetes outcomes. It is still important to continue working on diet and exercise irrespective of taking medication, as lifestyle interventions have been observed to produce more sustainable results.

Research Society for the Study of Diabetes in India clinical recommendation guidelines 2022 state that people with prediabetes failing to achieve any benefit on lifestyle modification after six months may be initiated on medication.

WHAT IS THE STATUS OF PREDIABETES IN INDIA?

Asian Indians experience a rapid conversion from normoglycemia to dysglycemia and have one of the highest incidence rates of T2DM. There is now strong epidemiological evidence that Asian Indians progress rapidly through the prediabetes

phase to develop T2DM in comparison to other ethnic populations. Indians are more susceptible to T2DM as we are `thin fat Indians- the "Asian Indian" phenotype, which is distinguished by hyperinsulinemia and levels of total and visceral fat that are higher than those of white Caucasians with comparable BMIs.

In a large community-based epidemiological study, the Indian Council of Medical Research–India Diabetes (ICMR–INDIAB), data reported an overall prevalence of prediabetes of 10.3%, derived from 15 Indian states. The incidence rates of prediabetes and "any dysglycemia" were found to be 29.5 and 51.7 per 1,000 person-years, respectively, in a 10-year follow-up of the CURES study. The rate of conversion from prediabetes to T2DM in the CURES follow-up is one of the highest reported in a large population (49.0 per 1,000 person-years). Studies have also confirmed that nearly half of people with diabetes in the Indian population remain undiagnosed, further emphasizing the need for increased awareness and screening.

CONCLUSION

Type 2 diabetes mellitus is becoming a rising epidemic that is threatening our healthcare systems. Creating awareness about prediabetes and its potential effects is paramount. Since prediabetes has the potential to be reversed, it should be taken as a window of opportunity for adopting a healthy lifestyle and seen as a measure to prevent T2DM.

REFERENCES FOR FURTHER READING

1. Anjana RM, Unnikrishnan R, Deepa M, Pradeepa R, Tandon, N, Das AK, et al. Metabolic non-communicable disease health report of India: the ICMR-INDIAB national cross-sectional study (ICMR-INDIAB-17). Lancet Diabetes Endocrinol. 2023;11:474-89.
2. Hostalek U. Global epidemiology of prediabetes - present and future perspectives. Clin Diabetes Endocrinol. 2019;5:5.
3. Insulin Resistance & Prediabetes | NIDDK. National Institute of Diabetes and Digestive and Kidney Diseases. 2018. Accessed March 1, 2024. https://www.niddk.nih.gov/health-information/diabetes/overview/what-is-diabetes/prediabetes-insulin-resistance
4. Prediabetes - Diagnosis and treatment. Mayo Clinic. 2017. Accessed March 1, 2024. https://www.mayoclinic.org/diseases-conditions/prediabetes/diagnosis-treatment/drc-20355284
5. Prediabetes - Symptoms and causes. Mayo Clinic. 2017. Accessed March 1, 2024. https://www.mayoclinic.org/diseases-conditions/prediabetes/symptoms-causes/syc-20355278
6. Prediabetes is on the rise—here's how to reverse it. Yale Medicine. 2024. Accessed March 1, 2023. https://www.yalemedicine.org/news/prediabetes
7. Ramachandran A, Snehalatha C, Mary S, Mukesh B, Bhaskar AD and Vijay V. The Indian Diabetes Prevention Programme shows that lifestyle modification and metformin prevent Type 2 diabetes in Asian Indian subjects with impaired glucose tolerance (IDPP1). Diabetologia. 2006:49;289-97.
8. RSSDI Clinical Practice Recommendations for the Management of Type 2 Diabetes Mellitus. International Journal of Diabetes in Developing Countries.2022; 42:1-143.
9. Sahadevan P, Kamal VK, Sasidharan A, Bagepally BS, Kumari D and Pal A. Prevalence and risk factors associated with undiagnosed diabetes in India: Insights from NFHS-5 national survey. J Glob Health. 2023;13:04135.

BEYOND DIAGNOSIS: REVERSAL & REMISSION IN PREDIABETES AND DIABETES

Meenakshi Sachdev*, Priyadarshini R**

Think of 'prediabetes' as a friendly warning–it's like your body discreetly hinting, 'Guess what? Diabetes could be coming over for a visit!' It's not a standalone prediction; consider it an alert about the potential for developing Type 2 diabetes mellitus (T2DM) and the consistent threat of cardiovascular diseases (CVD). Hence, it's not merely an interpretation of blood reports but a guidepost nudging one to step away from the doorstep of diabetes and move towards a healthier future.

UNDERSTANDING PREDIABETES AND ITS RISK FACTORS

The American Diabetes Association (ADA) categorizes prediabetes as a metabolic state marked by moderately elevated blood glucose levels, striking a delicate balance within defined ranges: fasting plasma glucose (FPG) levels of 100–125 mg/dL (the impaired fasting glucose (IFG) category), 2-hour plasma glucose levels during a 75-g oral glucose tolerance test (OGTT) ranging from 140 to 199 mg/dL or HbA1c levels between 5.7–6.4%. Notably, compared to FPG and HbA1c cut-off points, the 2-hour plasma glucose value emerges as a more inclusive diagnostic tool for identifying individuals with prediabetes. A single post-prandial blood glucose coupled with HbA1c estimation is an efficient tool for diagnosis of prediabetes. The following factors increase the risk of developing prediabetes:

- Overweight or obesity with BMI 23 kg/m2 in Asians or >25 kg/m2 in Caucasians
- First-degree relative with diabetes
- High-risk race/ethnicity (e.g., African American, Latino, Native American, Asian American, Pacific Islander)
- History of CVD
- Hypertension (above 130/80 mmHg or on therapy)
- Low HDL cholesterol (<35 mg/dL) or high Triglyceride level (>250 mg/dL)
- Polycystic ovary syndrome
- Physical inactivity
- Other conditions linked to insulin resistance (e.g., severe obesity, acanthosis nigricans)
- Diagnosed with gestational diabetes mellitus (undergo lifelong testing, at least once a year)

COMPLICATIONS OF PREDIABETES

Prediabetes may already be associated with an increased risk of long-term 'diabetes-related' complications, even which one can go unnoticed without symptoms for years. Beyond the sugar spectrum, prediabetes individuals often harbour hidden threats like hypertension and dyslipidemia, propelling them into the danger zone of cardiovascular diseases. It increases the chances of facing various health issues like "silent" heart attacks, stroke, kidney problems, cancer and dementia.

Therefore, vigilant screening and aggressive intervention against modifiable risk factors are not just suggested; they are the urgent keys to breaking this threatening thread and securing a healthier future.

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REVERSAL OF PREDIABETES

Early detection of prediabetes brings promising news as it proves entirely reversible through prompt lifestyle modifications like dietary adjustments, increased physical activity, proper screening and medications if indicated. These strategies extend beyond blood glucose control, positively influencing overall health by effectively managing blood pressure and cholesterol levels. The timeline for reversal is individual and contingent upon factors such as initial weight and activity levels. While the process may span weeks, months or even years, the substantial benefits far surpass the required commitment. This approach not only mitigates the risk of progressing to T2DM but also enhances overall well-being for a significant period, potentially up to a decade. Moreover, individuals at increased risk for T2DM, including those with a BMI exceeding 35 kg/m², higher glucose levels and a history of gestational diabetes mellitus, should consider more intensive preventive and reversal strategies.

Adopting a model akin to the Diabetes Prevention Program (DPP) emerges as a cornerstone for T2DM prevention and prediabetes reversal in some individuals. The directive is clear: enroll into an intensive lifestyle behaviour change program to reduce body weight by at least 7%-10% from the initial point. This program entails adherence to a nutritionally balanced, reduced-calorie diet, alongside a commitment to engage in a minimum of 150 minutes per week of moderate-intensity physical activity.

In a noteworthy study, captive great Apes showed prediabetes reversal with simple dietary interventions. By strategically reducing simple sugars and increasing fibre content, these Apes were no longer monkeying around with high blood glucose. The success of this intervention underscores the potential of dietary adjustments in prediabetes reversal.

LOSING EVEN A MODEST AMOUNT OF WEIGHT MAY HELP TO REVERSE PREDIABETES

Within the sphere of nutritional counselling for weight management, the DPP lifestyle intervention underscores the reduction of total dietary fat and caloric intake. Various dietary patterns, including Mediterranean-style and low-carbohydrate plans, exhibit efficacy for individuals with prediabetes. Observational studies highlight the benefits of vegetarian, plant-based and Dietary Approaches to Stop Hypertension (DASH) emphasizing a balanced intake of whole foods, fruits, vegetables, lean proteins, low-fat dairy and reduced sodium intake in mitigating the risk of prediabetes progressing to T2DM.

However, a study compared the effects of two diets, a personalized postprandial-targeting (PPT) diet and a Mediterranean (MED) diet, for those with prediabetes. The PPT diet used a smart algorithm that considered individual factors to predict how the body responds to meals. Both diets reduced high blood glucose levels and HbA1c, but the PPT diet showed significant improvements. The results suggest that a personalized approach may be more effective in managing blood glucose levels in prediabetes compared to a Mediterranean diet.

Thus, here's the key – no one-size-fits-all diet works for everyone to prevent T2DM. Instead, a personalized strategy is advocated, considering individual eating habits, preferences and metabolic objectives. Crucially, the focus extends beyond mere caloric considerations to the quality of dietary choices. Emphasizing whole grains, legumes, nuts, fruits and vegetables while minimizing the intake of refined and processed foods aligns with a reduced risk of T2DM. Tailored medical nutrition therapy, mirroring approaches employed for those with diabetes, proves effective in reducing HbA1c levels among individuals diagnosed with prediabetes.

The ‘Diabetes Plate Method’ designed by ADA is a useful guide for those aiming to improve their diet and understand portion sizes, especially individuals with prediabetes. Divided into sections on a nine-inch plate, it emphasizes three essential food groups: vegetable, carbohydrate and protein, forming the basis of a healthy diet.

- Allocate half of the plate to non-starchy vegetables, which are low in carbohydrates. Examples include a cup of raw vegetables like salad greens or half a cup of cooked vegetables such as broccoli, cabbage, cauliflower and capsicum.
- Devote one-fourth of the plate to carbohydrates, opting for whole grains like oats, whole wheat, unpolished foxtail millet and barnyard millet, brown rice or quinoa which are rich in vitamins, minerals and fibre. This section also includes beans, lentils and low-fat or fat-free dairy.
- Assign the remaining one-fourth of the plate to protein, encompassing plant-based sources and lean meat protein such as egg white (preferred to whole egg) regularly, fish, tofu and lean cuts of poultry. A three-ounce cooked portion similar to 100gram is suitable for this group.

In the world of movement, 150 is the magic number. The prescribed physical activity regimen is 150 minutes per week of moderate-intensity exercises, such as brisk walking. An integration of aerobic and resistance training contributes to overall health, enhances glucose uptake by the cells and diminishes abdominal fat, particularly in the younger population. The synergetic impact of nutritional and physical interventions paves the way toward a healthier future.

Consistent screening and monitoring of blood glucose levels are pivotal in tracking progress and guiding personalized interventions for prediabetes reversal. Consider more frequent testing based on initial results and risk status. Turning attention to glycemic control and self-glucose monitoring is a proactive approach to managing prediabetes. Self-monitoring emerges as a critical tool, empowering individuals with insights into the details of their body's rhythms. Medications, such as interventions for weight management and the prevention of hyperglycemia progression, may be explored to align with objectives for individualized care.

Your body's early warning—prediabetes—is not a sentence but an opportunity for positive change. With tailored nutrition, lifestyle modifications and vigilant monitoring one holds the key to freedom from embarking on the journey of T2DM. Dance to the rhythm of 150 and let your health saga embark with vitality. The stage is yours; let the curtain fall on prediabetes, unveiling a vibrant act of wellness.

REMISSION AND REVERSAL OF DIABETES

Over the past five decades, the global rise in obesity and T2DM has posed significant economic challenges to healthcare systems. Traditional treatments have failed to curb the growth of T2DM and it is often seen as an irreversible and progressive disease. However, in 2016, the World Health Organization (WHO) acknowledged the possibility of T2DM reversal in its global report, highlighting that it could be achieved through various therapeutic approaches. Numerous studies have shown that T2DM reversal and potentially long-term remission is possible, challenging the conventional view. Despite this, the reversal is not yet a standardized practice and international guidelines broadly do not prioritize it as a treatment goal, focusing instead on general lifestyle interventions.

T2DM typically remains a progressive disease without a personalized strategy for reversal because conventional treatments focus on lowering blood glucose levels without addressing the complex underlying causes, such as visceral fat. The Diabetes and Aging Study found partial remission in 1.47% and complete remission in 0.14% patients with T2DM, with higher rates (4.6%) in those with new-onset diabetes (diagnosed within two years). Previous studies highlight the benefits of early intensive insulin therapy for newly diagnosed T2DM, showing significantly higher remission rates after one year in insulin groups (51.1% for continuous subcutaneous insulin infusion and 44.9% for multiple dose insulin) compared to the oral hypoglycemic agent’s group (26.7%). The potential for even higher remission rates with initial intensive insulin therapy followed by a low-calorie diet in T2DM patients remains uncertain.

Numerous studies demonstrate that reversing T2DM with pharmacotherapy is feasible, particularly with early intensive insulin therapy, which can induce remission in nearly half of patients within 12-24 months. Triple and multidrug therapies have also shown effectiveness in reversing newly diagnosed T2DM. Additionally, despite its gastrointestinal side effects, the anti-obesity drug Orlistat can significantly improve glycemic control and prevent T2DM progression when appropriately used. Despite initial concerns about liver injury Orlistat is now considered a calorie restriction mimetic (CRM), mimicking the effects and outcomes of calorie restriction without reducing food intake. These pharmacological strategies highlight the potential for modifying the disease course, they have yet to be widely adopted as first-line treatments.

Jennings et al. demonstrated that a triple therapy involving metformin, pioglitazone and repaglinide effectively reverses newly diagnosed T2DM when administered at maximum tolerated doses and then tapered based on results. Panikar et al. found that combination therapy of metformin, pioglitazone and gliclazide successfully reversed T2DM in patients diagnosed for less than two years. For patients who had T2DM for up to five years and had started insulin but had no severe co-morbidities, add-on therapy with metformin, glibenclamide and pioglitazone resulted in 43% of patients no longer needing insulin after six months. The ADA advises initiating insulin therapy for symptomatic T2DM patients with an HbA1c over 9.0% at diagnosis. However, a study found that nearly all newly diagnosed T2DM patients who started with a low-calorie diet, exercise and metformin achieved glycemic control within 1-3 months. Starting with insulin or a combination of oral medications could have led to quicker euglycemia. Reducing or stopping oral hypoglycemic agents when HbA1c dropped below 6.5% often left patients in the prediabetic range, which still poses some risk for complications. Using a stricter HbA1c threshold of less than 5.7% would be more effective in minimizing long-term diabetic complications.

SUSTAINABILITY OF DIABETES REMISSION

The sustainability of T2DM remission varies with different treatment approaches, including bariatric surgery (BS), low-calorie diets (LCD) and low-carbohydrate diets (LC). Bariatric surgery offers high initial remission rates, with up to 80% remission shortly after the procedure. However, long-term efficacy declines to 37-45% after five years and 36-72% after ten years due to the need for significant lifestyle changes and the risks associated with surgery. LCDs can effectively reverse T2DM in the short term, particularly in those with shorter disease duration. However, long-term maintenance is challenging due to physiological adaptations leading to weight regain and potential health issues. Low-carbohydrate diets also provide promising short-term results with improved glycemic control and reduced medication needs. However, long-term sustainability is uncertain due to difficulty in maintaining dietary changes. The DiRECT trial showed that long-term T2DM remission is possible through weight management, with significant remission rates and health benefits maintained after five years with ongoing low-intensity dietary support. Meal replacements have been used in several important clinical trials, such as PREVIEW (Prevention of Diabetes Through Lifestyle Intervention and Population Studies in Europe and Around the World), DiRECT (Diabetes Remission Clinical Trial) and Look AHEAD (Action for Health in Diabetes), which demonstrate that using meal replacements in part or in full can be a viable short-term weight loss strategy.

PREDIABETES REMISSION CRITERIA

- FPG <5.6 mmol/L (100 mg/dL)
- 2-hour plasma concentration of glucose during 75-gram OGTT <7.8 mmol/L (140 mg/dL)
- HbA1c <5.7%

Bariatric surgery offers the most prolonged remission but has considerable risks and lifestyle demands. At the same time, LCD and LC diets are effective for short-term T2DM reversal but

face challenges in achieving long-term remission. Understanding the mechanisms of T2DM reversibility, developing strategies for long-term adherence and personalized treatment plans are crucial for sustained remission

Relapse

The likelihood of T2DM remission and the glycemic level improvement that follows weight loss are positively correlated. An impressive example can be found in the results of The Diabetes Remission Clinical Trial (DiRECT), which used lifestyle modifications mainly consisting of strict dietary management and increased physical activity; in the DiRECT trial, there was an ascending probability of T2DM remission across categories of increasing absolute weight loss.

The incidence of T2DM remission per 1000 person-years was 10.5. Higher remission rates were observed in those with specific characteristics: HbA1c levels of 48 to 53 mmol/mol, no glucose-lowering drugs at baseline and a significant BMI reduction of ≥10% within a year. Key factors for remission included shorter disease duration, lower initial HbA1c, higher initial BMI, significant BMI reduction and not using glucose-lowering drugs at the start. Among those who achieved remission, about two-thirds relapsed within a year, with longer disease duration, lower initial BMI and less BMI reduction being significant factors for relapse. The study suggests that baseline BMI and BMI reduction's impact on remission and relapse may vary significantly between East Asian and Western populations, indicating potential ethnic differences in diabetes management and outcomes.

While it was largely uncommon in routine care settings, remission of T2DM could be a fair aim for a minority of individuals who have significant weight loss soon after diagnosis. The results of the study indicated that Roux-en-Y gastric bypass would be a better treatment plan for obese people with T2DM than sleeve gastrectomy since it is linked to a decreased risk of long-term relapse and a relatively larger initial remission. With short-term T2DM, a lower HbA1c and less need for glucose-lowering drugs, remission is most likely to occur. Weight increase and low beta cell reserve are risk factors for relapse. The available data suggests that all individuals diagnosed with T2DM should receive effective weight management as soon as possible after diagnosis or even earlier, at the stage of prediabetes, which is defined in the USA as HbA1c ≥39 and <48 mmol/mol [≥5.7 and <6.5%] and in Europe, Australasia, Canada and most of the world as ≥42 and <48 mmol/mol [≥6.0 and <6.5%].

OUTCOMES WITH REMISSION: VASCULAR, RENAL AND RETINAL

Remission of T2DM is associated with a substantially lower incidence of chronic kidney disease (CKD) by 33% and cardiovascular disease (CVD) by 40%, likely influenced by improvements in weight, fitness, HbA1c and LDL-cholesterol. Remission can also prevent or slow the progression of diabetic retinopathy (DR), a leading cause of blindness, enhancing both visual and systemic outcomes for patients. Furthermore, remission is particularly beneficial for younger individuals (<45 years) and those with 0 or 1-2 co-morbidities (<3), reducing microvascular complications and associated health costs. Weight loss exceeding 10 kg and remissions lasting 1 to 2 years may delay vascular complications, although more evidence is needed to confirm these findings. Intentional weight loss in recent-onset T2DM patients rapidly induces changes in plasma protein that predict improved cardio-metabolic health, including cardio-metabolic fitness and reduced cardiovascular risk. Protein changes with greater (>10 kg) weight loss also predicted lower cardiovascular risk.

Among the various interventions, bariatric surgery stands out as the most effective method for achieving long-term T2DM remission and mitigating cardiovascular risk factors, despite its high costs and associated risks, including severe complications and mortality. While gastric band surgery is effective for weight loss and modestly increases the likelihood of T2DM remission, it does not significantly improve HbA1c levels, cardiovascular risk or quality of life compared

to medical care. Remission with bariatric surgery is very likely if pre-operative C-peptide levels are normal. In a study conducted by Lee WJ et al, diabetes remission rates following metabolic surgery were 55.3%, 82.0% and 90.3% for pre-operative C-peptide levels of <3, 3–6 and >6 ng/ml respectively. This indicates a strong association between higher pre-operative C-peptide levels and improved rates of remission in T2DM. Diet and lifestyle interventions are expected to reduce cardiovascular events and associated mortality by improving cardiovascular risk factors. Moreover, C-peptide levels influence the remission outcomes of T2DM.

CONCLUSION

The ADA, the Endocrine Society, the European Association for the Study of Diabetes and Diabetes UK jointly released a consensus statement that defined T2DM remission as achieving glycemic control below the WHO/ ADA diagnostic thresholds. Without the use of hypoglycemic medication, this condition must be sustained for at least three months. The status must be reviewed annually. Future research and guidelines should consider the remission of prediabetes, as it may safeguard β-cell function before the onset of T2DM and potentially lower its conversion to T2DM.

REFERENCES FOR FURTHER READING

1. American Diabetes Association Professional Practice Committee; 5. Facilitating Positive Health Behaviors and Well-being to Improve Health Outcomes: Standards of Care in Diabetes—2024. Diabetes Care. 2024; 47:S77-110.
2. Birkenfeld A and MohanV. Prediabetes remission for Type 2 diabetes mellitus prevention. Nat Rev Endocrinol.2024; 20:441-42.
3. Ciudin A, Fidilio E, Ortiz A, Pich S, Salas E, Mesa J, Hernández C, Simó-Servat O, Lecube A and Simó R. Genetic Testing to Predict Weight Loss and Diabetes Remission and Long-Term Sustainability after Bariatric Surgery: A Pilot Study. Journal of Clinical Medicine. 2019;8:964.
4. Diabetes Prevention Program Research Group. Long-term effects of lifestyle intervention or metformin on diabetes development and microvascular complications over 15-year follow-up: the Diabetes Prevention Program Outcomes Study. The Lancet Diabetes & Endocrinology. 2015;3:866-75.
5. Fujihara K, Khin L, Murai K, Yamazaki Y, Tsuruoka K, Yagyuda N, Yamazaki K et al. Study Group. Incidence and predictors of remission and relapse of Type 2 diabetes mellitus in Japan: Analysis of a nationwide patient registry (JDDM73). Diabetes, Obesity & Metabolism. 2023;25,2227-35.
6. Gregg EW, Chen H, Bancks MP, Manalac R, Maruthur N, Munshi M, Look AHEAD Research Group. Impact of remission from Type 2 diabetes on long-term health outcomes: findings from the Look AHEAD study. Diabetologia. 2024;67:459-69.
7. Holman N, Wild SH, Khunti K, Knighton P, O'Keefe J, Bakhai C, Young B et al. Incidence and Characteristics of Remission of Type 2 Diabetes in England: A Cohort Study Using the National Diabetes Audit. Diabetes Care. 2022: 45;1151-61.
8. Hounkpatin H, Stuart B, Farmer A and Dambha-Miller H. Association of Type 2 diabetes remission and risk of cardiovascular disease in pre-defined subgroups. Endocrinology, Diabetes & Metabolism. 2021;4:e00280.
9. Kumar A, Margekar SL and Kumar R. Diabetes remission: Myth or reality? Indian Journal of Medical Specialities. 2023;14:3-8.
10. Lean ME, Leslie WS, Barnes AC, Brosnahan N, Thom G, McCombie L, Taylor R, et al. 5-year follow-up of the randomised Diabetes Remission Clinical Trial (DiRECT) of continued support for weight loss maintenance in the UK: an extension study. Lancet Diabetes & Endocrinology. 2024;21:e1004327
11. Qi QYD, Playfair J, Brown WA, Burton P, O'Brien PE and Wentworth JM. Long-term impact of weight loss for people with overweight but not obesity and with Type 2 diabetes: 10-year outcomes of a randomized trial of gastric band surgery. Diabetes, Obesity and Metabolism. 2023; 25:1464-72.
12. Rothberg A, Lean M and Laferrère, B. Remission of Type 2 diabetes: always more questions, but enough answers for action. Diabetologia. 2024;67:602-19.
13. Sattar N, Taheri S, Astling DP, Chadwick J, Hinterberg MA, Holmes MV, Williams S. Prediction of cardiometabolic health through changes in plasma proteins with intentional weight loss in the DiRECT and DIADEM-I randomized clinical trials of Type 2 diabetes remission. Diabetes Care. 2023;46:1949-57.
14. Sattar N, Valabhji J and Gregg EW. Incidence and Characteristics of Remission of Type 2 Diabetes in England: A Cohort Study Using the National Diabetes Audit Diabetes Care. 2022: 45;1151-61.
15. Wu H, Yang A, Lau ESH, Zhang X, Fan B, Ma RCW et al. 1-year weight change after diabetes diagnosis and long-term incidence and sustainability of remission of Type 2 diabetes in real-world settings in Hong Kong: An observational cohort study. PLoS Medicine. 2024;21:e1004327.
16. Yu Z, Li P, Zhang, H and Zhang Y. Meta-analysis of Long-Term Relapse Rate of Type 2 Diabetes Following Initial Remission After Roux-en-Y Gastric Bypass. Obesity Surgery 2021;31:5034-43.

MANAGING PREDIABETES AND IMPROVING ITS OUTCOMES

Shikha Thosani*, Ameya Joshi**

Type 2 diabetes mellitus (T2DM) is a slow developing disease that starts as insulin resistance gradually raises glucose levels in individuals with generalized obesity or abdominal obesity. The disease is classified as diabetes when the glucose levels exceed 126 mg% during fasting and 200 mg% after meals (or a three-month average known as glycated hemoglobin, or HbA1c > 6.5%).

Prediabetes is defined as raised blood glucose levels that are higher than normal but not high enough to be diagnosed as diabetes, representing a crucial window of opportunity. Prediabetes prevalence is on the rise globally and it's expected that over 470 million people will have it by 2030. Insulin resistance and β-cell dysfunction often coexist in individuals with prediabetes. Various factors such as body measurements and blood tests, including checking sugar levels, can predict the risk of diabetes. It's important to note that intermediate blood sugar levels do not solely determine the likelihood of developing diabetes. It additionally depends on factors like age, gender, body mass index and genetic, environmental or ethnic factors. This variability makes measuring the progression from prediabetes to T2DM quite complex. For people with prediabetes, changing lifestyle habits is crucial in preventing T2DM, with evidence showing a 40%–70% decrease in the risk. Additionally, there is growing evidence suggesting that pharmacotherapy may offer some benefits. Specific risk factors for diabetes, such as a history of gestational diabetes, having a first-degree relative with diabetes, or a combination of factors like metabolic syndrome, can identify populations at risk. However, their predictive accuracy is lower compared to that of prediabetes.

Due to their usual phenotype, Indians are more likely to develop metabolic syndrome, which raises their risk of developing T2DM and related cardiovascular disease as well as other non-communicable diseases. Characteristics of this phenotype include abdominal obesity, insulin resistance and dyslipidemia. The number of people with diabetes burdening the healthcare system is enormous right now. A demographic group needs immediate lifestyle and medicinal interventions to prevent diabetes because untreated early-stage prediabetes raises the risk of T2DM. One of the metabolic health disorders that is causing concern on a global scale is prediabetes. The ICMR India 17 study found that a startlingly large proportion of Indians have prediabetes. According to estimates, 136 million Indians had prediabetes in 2021. It went on to say that 351 million people had abdominal obesity and 254 million had generalized obesity. If Indians do not take the necessary measures to control their diabetes, the observed high prevalence of obesity, particularly abdominal fat, points to a future with an even higher risk of prediabetes and T2DM. As it is a serious concern, it is essential to raise awareness and motivate people to adopt preventative measures and lifestyle changes to slow the development of T2DM.

It is crucial to remember that prediabetes may not always present with obvious symptoms, making routine screening necessary for early identification. With modifications to one's diet and lifestyle, prediabetes can be reversed and lower the chance of acquiring T2DM. Adopting

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preventive measures includes incorporating a well-balanced diet, managing a healthy weight, exercising frequently and avoiding alcohol, tobacco and smoking.

Table 1:

Prediabetes Diagnostic Criteria

Fasting plasma glucose (FPG)	Normal is less than 100 mg/dL Prediabetes: 100 to 125 mg/dL Diabetes: 126 mg/dL
Oral glucose tolerance test	Normal is less than 140 mg/dL Prediabetes: 140 to 199 mg/dL Diabetes: 200 mg/dL or higher
HbA1c	Normal is less than 5.7% Prediabetes: 5.7% to 6.4% Diabetes above 6.5%

HEALTH RISKS OF PREDIABETES

Individuals with prediabetes may experience simultaneous harm to vital organs like the eyes, kidneys, blood vessels and heart, which are conventionally seen as complications of diabetes. Prediabetes, characterised by elevated blood glucose levels below the diagnostic threshold for diabetes, is indeed a significant risk factor for the development of T2DM. Diabetes-related complications, particularly cardiovascular disease (CVD), pose substantial morbidity and mortality risks. Prediabetes is closely linked with other cardiovascular risk factors, such as obesity, dyslipidemia, hypertension and insulin resistance, collectively known as metabolic syndrome. This clustering of risk factors significantly increases the likelihood of developing both T2DM and CVD. Individuals with prediabetes are at higher risk for microvascular complications such as nephropathy, retinopathy and neuropathy and macrovascular complications, including coronary artery disease, congestive heart failure, stroke and peripheral vascular disease.

UNDERSTANDING CARDIOVASCULAR, RENAL AND RETINAL COMPLICATIONS WITH RESPECT TO PREDIABETES

Elevated blood sugar levels, insulin resistance and abnormal lipid levels contribute to atherosclerosis, heart attacks and heart failure. Relevant tests include HbA1c for blood sugar control, lipid profile for cholesterol levels, blood pressure monitoring, electrocardiogram (ECG) for heart function and ankle-brachial index (ABI) for peripheral artery disease (PAD). Effective management of prediabetes involves lifestyle modifications, including a healthy, well-balanced diet, regular exercise and smoking cessation. Additionally, medications such as antihypertensives and statins play a role. Patient education on treatment adherence and symptom recognition is crucial for reducing cardiovascular disease risk and improving health outcomes.

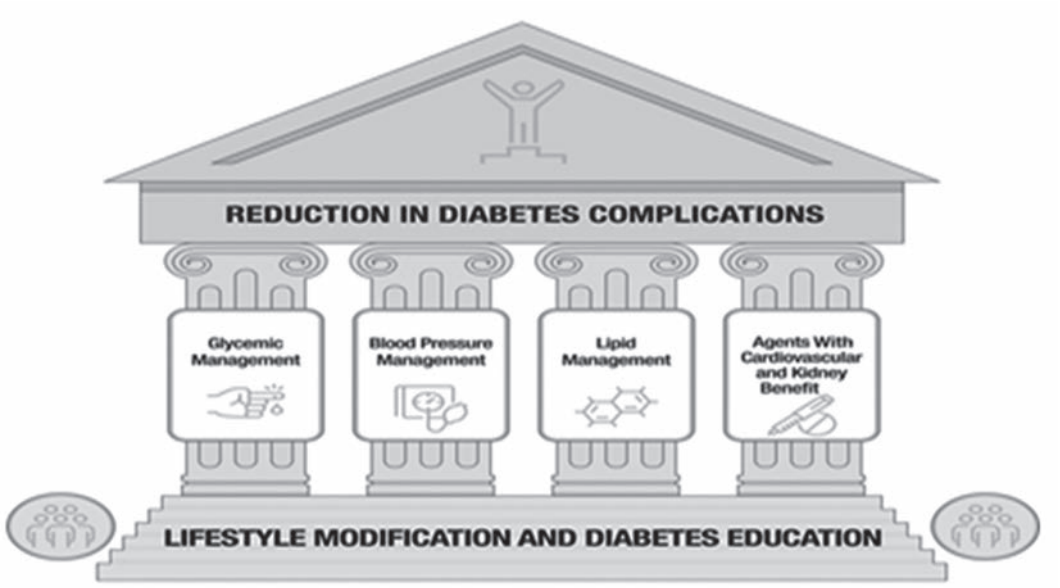
Prediabetes significantly raises the risk of renal complications, including diabetic nephropathy, characterized by kidney damage due to chronic high blood sugar levels. This condition progresses slowly, often unnoticed, until it reaches advanced stages. Relevant tests include monitoring urine albumin levels and estimating the glomerular filtration rate (eGFR). Kidney damage heightens the risk of cardiovascular disease, creating a dangerous synergy with prediabetes. Lifestyle modifications, such as weight loss and a low-sodium diet, are crucial in managing both prediabetes and preventing kidney complications. Regular medical check-ups, including blood pressure monitoring, are essential. Early detection and intervention through medication and lifestyle changes can slow or halt kidney disease progression. This underscores the importance of proactive management for prediabetes patients to safeguard renal health and overall well-being.

Prediabetes significantly heightens the risk of retinal and ophthalmic complications, particularly diabetic retinopathy, characterized by microvascular damage to the retina. Long-term high blood sugar can cause damage to blood vessels, leading to small bulges and bleeding in the eyes, eventually resulting in

vision problems or blindness if not treated. Regular eye examinations, including dilated fundus are indispensable for early detection and intervention. Lifestyle modifications, such as glycemic control and smoking cessation, are pivotal preventive measures. Prediabetes patients should prioritise regular eye screenings and adhere to treatment plans to mitigate the risk of vision-related complications. Implementing early measures and timely actions can preserve vision and enhance overall health outcomes for individuals with prediabetes.

Figure 1:

Reduction in Diabetes Complications



Source: Standards of Medical Care in Diabetes, Diabetes Care. 2022.

WATCHING FOR A PERSON OR INDIVIDUAL AT RISK FOR PREDIABETES

For a person with prediabetes, monitoring of the following parameters is recommended in addition to blood glucose levels to evaluate risk and general health:

1. A blood test called a lipid profile determines your body's lipid levels. Cardiovascular disease risk assessment measures total cholesterol, including LDL, HDL and triglycerides.
2. People with prediabetes frequently have an increased risk of hypertension; thus, it's vital to check blood pressure regularly.
3. Weight management.
4. The body mass index (BMI) determines the risk of obesity by calculating weight in relation to height. Waist circumference and waist-hip ratio (WHR) are valuable tools for determining body fat distribution and mass. The waist-hip ratio is calculated by dividing the hip measurement by the waist measurement. A measuring tape is used directly on the skin to measure the waist circumference. Halfway between the lowest ribs is the point to measure the waist.
5. A stress test once every three years and an annual ECG cardiac examination are advisable.

STRATEGIES FOR MANAGING PREDIABETES

Reversing the state of prediabetes and preventing the progression of T2DM are the primary goals.

Medical nutrition therapy (MNT) for diabetes has long emphasized the quantity and type of carbohydrates. However, protein, a crucial macronutrient for managing diabetes, also requires attention. This is particularly important in India, where protein consumption often falls below the levels recommended by most guidelines.

1. **The complex connection between prediabetes and diet:** Make sure to incorporate complex carbohydrate and foods rich in fibre with low glycemic index (GI) and glycemic load (GL). Complex carbohydrate from whole grain cereals and millets is relatively high in fibre and nutrients. It keeps one satiated providing steady energy release. Incorporate protein-rich foods such as dals, pulses, legumes, egg-white, lean meat, fish, low-fat dairy and its products such as milk, paneer, curd and buttermilk. Choosing healthy fat is important such as monounsaturated fatty acid (MUFA) rich oils in visible form for example groundnut oil, sesame oil, mustard oil, canola oil and olive oil (pomace, virgin, extra-virgin) by rotation. Incorporate invisible dietary fat from omega-3 rich sources such as fatty fish, nuts such as almond and walnut. Individuals with prediabetes should focus on a balanced diet rich in colourful non-starchy vegetables and fruits, complex carbohydrate, protein and kindly fat from visible and invisible sources such as nuts and oilseeds in prescribed amounts. A balanced diet in terms of protein, healthy fat and complex carbohydrate delays digestion and promotes satiety. Avoid processed meats, pastries, biscuits and fried chips. Limit table salt, sugar, jaggery, honey and butter.
2. **Physical activity and exercise:** Regular exercise improves blood sugar levels, muscle strength and energy levels, among many other things lowers the risk of stroke and heart disease. An active lifestyle helps maintain strong muscles and flexible joints, tendons and ligaments. One can maintain a healthy weight by exercising. A minimum of 150 minutes per week should be dedicated to moderate-intensity aerobic exercise. Walking, cycling, jogging and swimming are examples of aerobic exercise. Exercises like weightlifting, free weights and elastic resistance bands are examples of resistance (strength) training. Furthermore, practising yoga can help improve flexibility, muscle strength and balance.
3. **Weight management:** Strive to maintain a healthy weight. The risk of prediabetes can be considerably decreased by losing even a small amount of present body weight by 5% to 10%.
4. **Stress management:** Prolonged stress has shown to affect blood sugar regulation. Activities that can lower stress and improve blood sugar regulation include deep breathing, yoga, meditation and regular exercise.
5. **Sleep:** The risk of prediabetes and T2DM is increased by inadequate or poor-quality sleep. Making proper sleep hygiene a priority is crucial for overall health. Eight hours of good sleep per night is the optimum recommendation. Large meals, coffee and alcohol should be avoided right before bedtime. Reduce the time spent in front of displays (computers, laptops, TVs and cell phones) before bed. Make your sleeping space cosy and dark. Sleep apnea, often associated with obesity may need to be addressed.

In addition, some people find they are unable to adhere to the lifestyle changes entirely or that they are unable to lose weight despite their best efforts. Research suggests, taking metformin or acarbose may help or delay the progression to T2DM. Advent of GLP-RA drugs may enhance weight loss and cause remission of prediabetes.

In conclusion, prediabetes, also known as early diabetes, is a slightly raised blood glucose level that is not accompanied by any symptoms but

has the potential to develop into T2DM. There is a chance to change one's lifestyle to the fullest and reverse prediabetes, or at the very least, stop or slow the onset of T2DM.

REFERENCES FOR FURTHER READING

1. American Diabetes Association Professional Practice Committee. 10. Cardiovascular Disease and Risk Management: Standards of Care in Diabetes-2024. Diabetes Care. 2024;47: S179-218.
2. Anjana RM, Unnikrishnan R, Deepa M, Pradeepa R, Tandon N, et al;ICMR-INDIAB Collaborative Study Group. Metabolic non-communicable disease health report of India: the ICMR-INDIAB national cross-sectional study (ICMR-INDIAB-17). Lancet Diabetes Endocrinol. 2023;11:474-89.
3. Magliano DJ and Boyko EJ. IDF Diabetes Atlas, 10th edn. Brussels, Belgium: International Diabetes Federation, 2021.
4. Yau JW, Thor SM, Ramadas A. Nutritional Strategies in Prediabetes: A Scoping Review of Recent Evidence. Nutrients. 2020;12:2990.
5. Mohan V, Misra A, Bhansali A, Singh AK, Makkar B, Krishnan D, et al. Role and Significance of Dietary Protein in the Management of Type 2 Diabetes and Its Complications in India: An Expert Opinion. J Assoc Physicians India. 2023;71:36-46.
6. Shibib L, Al-Qaisi M, Ahmed A et al. Reversal and Remission of T2DM - An Update for Practitioners. Vasc Health Risk Manag. 2022;18:417-43.
7. Tabák AG, Herder C, Rathmann W, Brunner EJ, Kivimäki M. Prediabetes: a high-risk state for diabetes development. Lancet. 2012;379:2279-90.

QUESTION AND ANSWER

Q. What is the role of gut microbiota composition and function in the pathogenesis and progression of prediabetes to Type 2 diabetes? How do diet lifestyle interventions modulate the gut microbiota?

A. The gut microbiome, comprising bacteria, viruses, fungi and other microbes, is a complex ecosystem. It influences a myriad of physiological processes such as digestion, metabolism, immune function and mental health. A symbiotic relationship between the host and its gut microbiota is essential for nutrient absorption, synthesis of vitamins and protection against pathogenic microbes. For decades, an enhanced understanding of the gut microbiome has revealed its complexity and profound impact on human health. An imbalance in the gut microbiota, also known as gut dysbiosis, has been linked to various conditions such as obesity, diabetes, inflammatory bowel disease and neurological disorders. The burgeoning field of research underscores the importance of restoring gut health by dietary and lifestyle interventions, which helps maintain a healthy gut microbial community.

Role of Gut Microbiota in Prediabetes:

The gut microbiota plays a crucial role in the pathogenesis and progression of prediabetes. Patients with prediabetes often exhibit a reduced microbial diversity compared to healthy individuals, with significant difference in the abundance of certain bacterial. For example, the genera *Blautia, Faecalibacterium* and *Bifidobacterium* are typically less abundant in individuals with prediabetes, while harmful bacteria like *Streptococcus* and *Eggerthella* are more prevalent. Gut dysbiosis increases gut permeability of the gut lining which is associated with abnormal insulin signalling and chronic low-grade inflammation. Increased gut permeability allows bacterial endotoxins such as lipopolysaccharides, to enter the bloodstream and interact with the immune system. This process stimulates an inflammatory response which in turn exacerbates insulin resistance and beta-cell dysfunction.

Diet and Lifestyle Interventions:

Low-carbohydrate and high-fibre diets have been shown to increase microbial diversity. Short-chain fatty acids (SCFAs) such as acetate, butyrate and propionate are produced through fermentation of dietary fibre by gut bacteria. They support gut barrier integrity regulating immune function and metabolic health. Probiotics, including strains of *Lactobacillus* and *Bifidobacterium* and prebiotics such as fructooligosaccharides and inulin promote the growth of beneficial bacteria, promising therapeutic potential for managing prediabetes. Furthermore, fecal microbiota transplantation (FMT) has shown potential in restoring microbial balance and improving insulin sensitivity in metabolic syndrome patients. On the other hand, exercise improves gut bacterial diversity and composition too.

Exercise increases SCFA production in lean individuals, with changes reverting upon exercise cessation. Healthy-fit individuals exhibit higher levels of butyrate-producing good bacteria such as *Clostridiales, Roseburia, Lachnospiraceae* and *Erysipelotrichaceae*. Additionally, randomized trials showed that both sprint interval training (SIT) and moderate-intensity continuous training (MICT) reduced inflammatory markers and altered gut microbiota by increasing the *Bacteroidetes* phylum and decreasing the *Firmicutes/Bacteroidetes* ratio, which is linked to T2DM. Furthermore, exercise improves glycemic response and a long-term

exercise regime repairs leaky gut, reduces intestinal mycetes overgrowth, contributing to better gut health.

Modulating the gut microbiota composition through targeted dietary and lifestyle interventions plays a pivotal role in gut health.

Q. What are the most effective lifestyle interventions for individuals with prediabetes in preventing progression to Type 2 diabetes and improving overall metabolic health? How can these interventions be tailored to individual needs and preferences?

A. Lifestyle modification that focuses on improved dietary quality, increased physical activity and as required times, medical care is the preferred first-line treatment for prediabetes. This helps prevent progression to Type 2 diabetes as it improves glycemic control and reduces cardiovascular risk factors.

A dietary plan should be curated with personal and cultural preferences, food availability and food allergies in mind. Additionally, following dietary guidelines encourages a high consumption of vegetables, fruits, unrefined (whole) grains with natural fibre, pulses, legumes, lean meat, fish, low amount of saturated fat, nuts and low-fat dairy products. Furthermore, nutritionists should concentrate on several key factors common among successful dietary patterns such as emphasizing on the intake of non-starchy vegetables; minimizing added sugars and refined grains; suggesting for whole foods over highly processed foods.

It is recommended that an organized, systematic, and patient-centered approach be used to manage prediabetes. Understanding and working the plan around patients' individual discipline, whether they are inclined to adhere to a diet regimen, engage in physical fitness activities or both is crucial. Moreover, self-management education and support, which can be delivered individually or in groups through technology or in-person must be considered. The patient education process can be tailored after assessing the individual's grasping ability. It could be one of the following or a combination of two or more such as reading, from books and authentic websites, listening to audiobooks, creative brochures/handouts, constant reminders to adhere to the intervention planned and in-person or online sessions.

Nutrition counselling and physical activity for a minimum of 150 min per week would promote healthy living. This enables an individual to achieve and maintain body weight, glycemic index, blood pressure and lipid targets. It is likely to reverse the progression of prediabetes to Type 2 diabetes and improves overall metabolic health.

Q. How do psychosocial factors such as stress, depression, socioeconomic status and social support influence adherence to lifestyle interventions individuals with prediabetes? What strategies can be implemented to address these factors and optimize engagement in prediabetes management programs?

A. High levels of stress can significantly hinder adherence to lifestyle interventions crucial for managing prediabetes. Stress triggers unhealthy coping behaviours such as overeating and lack of exercise, which leads to hyperglycemia and insulin resistance. Hence, it significantly impacts the clinical outcome of individuals with prediabetes. Depression, another common medical condition with diabetes, reduces the quality of life and the risk of hyperglycemia increases. This can complicate treatment adherence. The intensity of depression correlates with poorer dietary choices,

lapses in medication adherence and higher healthcare costs. This highlights the need for integrated mental health care in diabetes management. Promoting dietary and lifestyle changes, encouraging regular physical activity to reduce anxiety and antidepressant effects are essential. Practicing relaxing methods like yoga and meditation helps manage stress. Additionally, adequate sleep, an often neglected factor, lowers stress levels and improves health.

Socioeconomic status (SES) also plays a pivotal role in the outcome of diabetes. Lower SES is consistently associated with higher risk of developing Type 2 diabetes and its complications. Factors like education, occupation and income influence access to healthcare, choosing healthy food options and exercise facilities, which collectively impact diabetes prevention and management. Addressing educational disparity through targeted intervention is critical for improving health equity. By investing in high-quality education across sociodemographic groups it helps make better health choices leading to a healthier life. Tailoring health education material in the convenient language for low-literate communities is essential. To alleviate the harmful effects socioeconomic disparities, healthcare providers must emphasize on holistic approaches.

Moreover, fostering strong social support networks is invaluable. Family and friend support improves motivation and responsibility and helps follow treatment regimens. This improves glycemic control and overall health outcomes. A comprehensive approach that integrates stress management, mental health support, socioeconomic interventions and robust social networks is essential for effective prediabetes care.

RECIPES

RAW PAPAYA SALAD (SOM TAM)

INGREDIENTS (for 4 servings)

- 500 gm shredded raw papaya
- 200 gm cherry tomatoes, halved
- 100 gm green beans, cut into 1-inch pieces
- 2 cloves garlic, minced
- 2-3 bird's eye chilies (or fresh red chillies), finely chopped
- 2 tsp lime juice
- ½ tsp sucralose powder (non-nutritive sweetener)
- 20 gm roasted peanuts
- Onion and lettuce leaves for garnish

METHOD OF COOKING

1. In a large mixing bowl, combine the shredded raw papaya, cherry tomatoes and green beans.
2. In a mortar and pestle, pound the garlic and chilies together to form a paste.
3. Add the lime juice and sucralose sweetener to the paste and mix well.
4. Pour the dressing over the papaya mixture and toss to combine.
5. Garnish with roasted peanuts before serving.

NUTRITION INFORMATION PER SERVING

Energy (Kcal)	Carbohydrate (g)	Protein (g)	Fat (g)
70	10	2	2

SPECIAL FEATURES

- Low glycemic index
- Low fat
- Rich in vitamins and antioxidants

PANEER STIR-FRY

INGREDIENTS (FOR 4 SERVINGS)

- 500 gm skim milk paneer, diced
- 250 gm broccoli florets
- 150 gm bell pepper, sliced
- 50 gm carrot, sliced
- 2 cloves garlic, minced
- 1 tbsp olive oil
- Salt and pepper to taste

METHOD OF COOKING

- In a large skillet, heat olive oil and sesame oil over medium-high heat.
- Add skim milk paneer and cook until browned on all sides. Remove it from the skillet and set aside.
- In the same skillet, add garlic, broccoli, bell pepper and carrot. Cook until vegetables are tender-crisp.
- Add in the skim milk paneer in the skillet. Stir to combine and cook for another 2 minutes.
- Season with salt and pepper to taste.

NUTRITION INFORMATION PER SERVING

Energy (Kcal)	Carbohydrate (g)	Protein (g)	Fat (g)
160	13	20	3

SPECIAL FEATURES

- High protein
- Rich in MUFA fat
- Rich in vitamins and minerals

HOW KNOWLEDGEABLE ARE YOU?

1. **What is prediabetes?**
   A. A type of cancer
   B. A condition with higher than normal blood sugar levels, but not high enough to be classified as diabetes
   C. A form of allergy
   D. A rare genetic disorder
2. **Which of the following is a common symptom of prediabetes?**
   A. Frequent urination
   B. Sudden weight gain
   C. Blurred vision
   D. Usually, prediabetes has no symptoms
3. **Which pharmacological agent has shown efficacy in delaying the progression from prediabetes to Type 2 diabetes in clinical trials?**
   A. Metformin
   B. Atorvastatin
   C. Amlodipine
   D. Omeprazole
4. **Which of the following dietary patterns have shown to significantly improve insulin sensitivity in individuals with prediabetes?**
   A. Saturated fat and zero carbohydrate
   B. High-glycemic index carbohydrate foods
   C. Omega-3 fatty acids and low-glycemic index carbohydrate foods
   D. Trans fat and refined carbohydrate
5. **How does chronic low-grade inflammation contribute to the development of insulin resistance in prediabetes?**
   A. By promoting pancreatic beta-cell regeneration
   B. By increasing adiponectin levels
   C. By activating pro-inflammatory cytokines disrupting insulin signalling pathways
   D. By reducing oxidative stress in muscle tissue
6. **What role does the incretin hormone GLP-1 (glucagon-like peptide-1) play in glucose metabolism and prediabetes?**
   A. It decreases insulin secretion
   B. It increases hepatic glucose production
   C. It stimulates insulin secretion in response to elevated blood glucose
   D. It stimulates glucagon release from the pancreas
7. **Which test is commonly used to diagnose prediabetes?**
   A. Oral glucose tolerance test (OGTT)
   B. HbA1c test
   C. Fasting plasma glucose (FPG) test
   D. All of the above
8. **How does visceral adiposity contribute to the pathogenesis of prediabetes?**
   A. By storing excess glucose as glycogen
   B. By secreting adipokines that promote inflammation and insulin resistance
   C. By reducing free fatty acid release
   D. By enhancing lipoprotein lipase activity
9. **How does physical activity improve insulin sensitivity in individuals with prediabetes?**
   A. By decreasing muscle glucose uptake
   B. By increasing muscle glucose uptake and utilization
   C. By lowering a hormone that helps regulate glucose
   D. By increasing glucose production in the liver
10. **In the context of prediabetes, what does an elevated level of fasting insulin indicate?**
    A. Decreased pancreatic beta-cell function
    B. Enhanced hepatic insulin clearance
    C. Compensatory hyperinsulinemia due to insulin resistance
    D. Lower risk of developing Type 2 diabetes

ANSWERS:

1.	B	2.	D	3.	A
4.	C	5.	C	6.	C
7.	D	8.	B	9.	B
10.	C				

MYTHS AND FACTS

Myth: Prediabetes always progresses to diabetes

Fact: Prediabetes is a condition that may progress to Type 2 diabetes when there is lack of any intervention. Genetic factors such as family history may play a significant role in determining the progress of prediabetes to Type 2 diabetes. Prediabetes may not necessarily develop into Type 2 diabetes but can be reversed through lifestyle intervention which may mitigate the associated risk factors.

It is an established fact that long-term diabetes complications silently progress which can lead to permanent damage. Prediabetes, if treated, gives an opportunity to potentially prevent the early onset of not just Type 2 diabetes but also the inherent impending complications. Meta-analysis studies demonstrated that approximately 21% of the subjects achieve normoglycemia from prediabetes state. Individual studies have reported similar findings, highlighting the potential for prediabetes reversal. The studies underscore the importance of early intervention strategies to reverse prediabetes state. This suggests that the efforts in reversing prediabetes is worthwhile as it may help in alleviating cardio-metabolic risk factors in the long run.

Myth: Carbohydrates should not form more than 15% of calories if you have prediabetes

Fact: Macronutrients used by the body in the most significant amount is carbohydrate, fat and protein. These are used in the body as a source of energy and to maintain the structure and systems of the body. The optimal macronutrient distribution from total daily colories are 45–50%, 18–20% and 25–30% from carbohydrate, protein and fat respectively.

Carbohydrate, is the primary fuel. For the brain, the recommended daily allowance (RDA) of carbohydrates for adults is 130 grams. In a 1200-1300 Kcal diet, 130 grams of carbohydrates account for approximately 40% of daily energy intake. Studies suggest that diets lower than 40% of carbohydrate may lead to short-term weight loss rather than diets low in fat. Additionally, a sudden drop in carbohydrate content in the diet can cause as constipation, headache and muscle cramps.

Furthermore, the quality of carbohydrate is equally important. Complex carbohydrates from unprocessed, unpolished whole cereals, whole fruits and vegetables are good sources. It benefits the brain and gut health by providing fibre which supports beneficial gut bacteria and slows digestion. It enables steady energy release, better blood sugar control and higher nutrient density compared to simple carbohydrate found in refined food products. This promotes a healthier gut microbiome and more stable brain function through the gut-brain axis.

The breakdown of fat into ketones for energy is called ketosis. This may cause side effects such as headache, fatigue and weakness. In the long term, it may cause vitamin and mineral deficiencies. People on a very low carbohydrate diet trend to eat large amounts of fat and protein, mainly from animal sources. This increases the risk of heart disease or certain cancers. Thus, choosing the right type and quality of protein and fat is also crucial.

Myth: Cutting out sugar alone completely reverses prediabetes

Fact: Prediabetes, also known as borderline diabetes, is known to occur when blood sugar levels are elevated but not high enough to be classified as diabetes. The increase in obesity. Type 2 diabetes and cardiovascular disease is strongly associated with the adoption of a modernized lifestyle, characterized by reduced physical activity, diet high in processed foods refined grain intake, excessive hydrogenated fats and high-fat meat consumption. While eliminating sugar alone might result in short-term weight loss, achieving sustained management of prediabetes and requires a comprehensive approach. This includes a combination of lifestyle intervention such as regular physical activity, cessation of smoking and stress management intervention.

The most successful dietary intervention for both the prevention and treatment of prediabetes is one that an individual can adapt and follow sustainably. Restrictive diets that focus solely on cutting out sugar or severely limiting carbohydrates may lead to weight loss initially but can be difficult to maintain. This potentially compromises long-term success in managing blood sugar levels and overall health. Therefore, effective strategies for reversing or achieving remission of diabetes needs to be practical.

CERTIFIED DIABETES EDUCATOR COURSE

Dr Chandalia's DENMARC in association with Help Defeat Diabetes Trust (HDDT) presents to you a course to be a Certified Diabetes Educator (CDE)!

Help Defeat Diabetes Trust (HDDT) is a registered, non-profit public trust, having amongst its many objectives, the main objective of promoting education and awareness about diabetes among people from different fields.

Who can enroll?

Graduates in Nutrition, Doctors, Nursing, Pharmacy, Occupational and Physiotherapy.

What is the duration of the course?

6 months, including 3 months (300 Hours) of hands-on training and experience with a recognized mentor in your own town (see this on our website).

How can I do this course from my place of residence?

A Suitable Mentor can be selected from the registrant locality under whom the training can be done.

How will I get the course material?

All course material is available online on our website.

What are the course fees?

The standard fee for the course are INR 10,000/- only.

Where can I get more information about this course?

Kindly visit our website **http://www.helpdefeatdiabetes.org** or you can get in touch with us on our email id: heldefeatdiabetesinfo@gmail.com.

MEMBERSHIP FORM

Association of Diabetes Educators (ADE)

(For eligibility criteria: Check Website www.diabeteseducatorsindia.com)

Name …… Date of Birth: ……

Address ……

……

Telephone: Res: …… Office: …… Cell: ……

E-mail id: ……

Educational Qualifications:……

……

……

Work Experience: ……

……

……

Currently employed at: ……

……

Certificates attached*: ……

……

Please pay the membership fees through NEFT / RTGS to the following bank account.

Account name: Association of Diabetes Educators
Account type: Savings Account
Name of the bank: Bank of India
Account number: 006610110001734
IFSC Code: BKID0000066

……
Signature

CHALLENGES IN DIABETES EDUCATION

AN AWARD FOR PROBLEM RESOLUTION IN DIABETES EDUCATION

SPONSORED BY DR. CHANDALIA'S HELP DEFEAT DIABETES TRUST

Prize money of Rs. 10,000 for reporting a problem case

Dr. Chandalia's HDDT aims to enhance the quality of Diabetes education in India by creating a world-class research and education environment and to build up a platform of networking and knowledge sharing within diabetologists and/or diabetes educators.

Challenges in Diabetes Education places special emphasis on supporting educational initiatives that have the potential to improve and significantly revolutionize diabetes care, enhance self-management and/or support patients with Type 1 or Type 2 Diabetes Mellitus. The educator should describe an individual or group case history and identify the problem in diabetes education. Furthermore, s/he should describe the plan of education to resolve the issue, partly or totally. The issue described may be related to patient perceptions, knowledge, behaviors and implementation of advice given. S/He should describe her struggle in resolving the issue including her triumphs and failures, the methodologies used and ethical, socio-economic and behavioral aspects of the case.

General Rules and Regulations regarding the eligibility Criteria for the Award

- The applicant of the Award should be a citizen of India and member of Association of Diabetes Educators.
- The case discussion should be on the subject of Diabetes Education.

The best case chosen by a group of referees will be awarded "Challenges in Diabetes Education Award-2024" which will carry a cash prize of Rs 10,000. The awardee will get the opportunity to present the case in the annual meeting of Association of Diabetes Educators and publish it in the journal of Diabetes Education.

The last date for the submission is October 31, 2024 !!!!

(Instructions for authors is available on website www.diabeteseducatorsindia.com)

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#: Standl E, Owen DR. New Long-Acting Basal Insulins: Does Benefit Outweight Cost? Diabetes Care. 2016 Aug;39 Suppl 2:S172-9.

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