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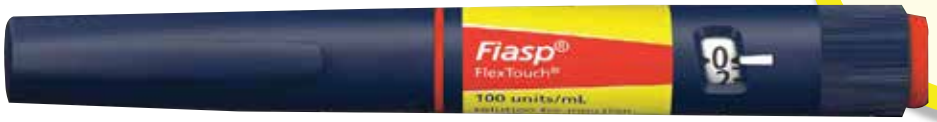

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JOURNAL OF DIABETES EDUCATION

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HIDDEN DANGERS OF PHTHALATES IN FOOD PACKAGING FOR PEOPLE WITH DIABETES

Aditi Goyal*, Simran Khandagale**

INTRODUCTION

Phthalates are a group of synthetic chemical compounds originating from the diesters of 1,2 benzenedicarboxylic acid (phthalic acid) varying based on their molecular weight. High molecular weight phthalates like di(2-ethylhexyl) phthalate (DEHP), di-isononyl phthalate (DiNP), di-n-octyl phthalate (DnOP), are mainly used in the manufacture of flexible vinyl as plasticizers, used in consumer products, food contact applications and medical devices. The low molecular weight phthalates are diethyl phthalate (DEP) and dibutyl phthalate (DBP) used in personal-care products like perfumes, body lotions, as solvents and plasticizers for cellulose acetate and in making lacquers, varnishes and coatings (1).

INDUSTRIAL USE OF PHTHALATES

The most widespread use of phthalates is as plastic stabilizers for the production of flexible polyvinyl chloride (PVC). It is an odourless and colourless compound found in the most unassuming places. The primary role of phthalates is to increase the durability and strength of plastics. They are used in the manufacture of rigid, semi-rigid, flexible, very flexible and extremely flexible PVC. In addition to flexibility, they improve surface adhesion, colour, elasticity and wrinkle resistance. Consequently, they are used in the manufacturing of adhesives, solvents and waxes. Phthalates are also commonly found in products like shower curtains, plastic key rings, films, cables, vinyl flooring, boots, clothing, and polymer clay. They are used extensively in the perfumery and cosmetic industries. They act as stabilizers and make fragrances last longer. They are used in lacquers like paints and nail polishes to reduce chipping by making them less brittle. In products like hair spray, they reduce stiffness and facilitate the formation of a flexible film on the hair. They are also used in other products like creams, lotions, shampoos and cleansers.

Due to their cost-effective production, durability and ability to increase shelf life, plastics are a common and preferred food packaging material. Different types of plastics are used in food packaging depending upon the type of food and desired shelf-life. The rapid development of the food industry and the advent of food delivery systems have substantially increased the risk of exposure to phthalates. The common use of plasticized plastics in food packaging materials, especially products like cling film, increases the contact between phthalates and food products. A 2022 study by Baranenko et al. found a highly variable transfer of different phthalates to beef. The study investigated various processing and packaging methods for the treatment of farm-fresh beef and found increased phthalate levels in all cases. These findings clearly indicate the transference of these chemicals from packaging to food. Furthermore, the study also reported a high level of phthalates in unprocessed, unpackaged farm-fresh beef. A concerning result, this indicated that phthalates may be present in significant quantities in farm fodder or water (2,3).

Phthalates are bonded weakly to the base substrate. Mechanical stress or temperature extremes can cause them to leach into the food material they envelope. Due to these properties, food safety authorities in various countries have

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placed strict and clearly defined limitations on the use of phthalates in food packaging. The European Food Safety Authority, for example, has specified tolerable daily intakes (TDIs) of 0.01mg/Kg bodyweight for di-n-butyl phthalate (DnBP), 0.05 mg/Kg bodyweight for DEHP, 0.50 mg/Kg bodyweight for benzylbutyl phthalate (BBP) and a group TDI of 0.15 mg/Kg bodyweight for diisodecyl phthalate (DiDP) and DiNP. As of October 2024, the US Food and Drug Administration (FDA) allows nine phthalates to be used in the food industry in food contact (4,5). Despite such regulations, the use of phthalates is not well controlled and its wide-reaching applications continue to be a part of the food industry.

IMPACT OF PHTHALATES ON METABOLIC HEALTH

Human beings are majorly exposed to phthalates through two major sources – dermal absorption through food packaging or ingestion through phthalate migration to the food matrix from packaging material. The ubiquitous use of plastics in the last 5 decades means that phthalates reach almost every individual daily in one way or another. Following exposure and intake, phthalates are readily hydrolyzed and conjugated in the human body. These processes form short-branched phthalates, which are bioactive and excreted through urine; and long-branched phthalates, which are conjugated and excreted through feces. Despite their documented metabolism in the body, reports have suggested that phthalates can percolate into semen, breast milk and amniotic fluid.

These xenobiotics can be a major source of the increased health risk in humans. For over two decades, phthalates have been categorized as endocrine disruptors due to their toxicity and potential for bioaccumulation. An endocrine disrupter can be defined as an exogenous agent that interferes with the synthesis, secretion, transport, metabolism, binding action or elimination of natural blood-borne hormones in the body. Phthalates have been found to be detrimental to the reproductive health of men and women alike. While further research into this matter is still required, many studies have reported an increased risk for embryonic homeostasis, delayed female sexual maturation, diminished sperm quality and disrupted follicle maturation. One of the phthalate compounds, DBP was found to act as an estrogen antagonist.

Additionally, phthalates can cause cancer, asthma, rhinitis and eczema in children, as well as metabolism and neurological development disruption. An examination of decadal data from 2001 to 2010 showed that people with higher concentrations of phthalates or metabolites had higher odds of metabolic syndrome. Neurotoxicity, infertility, respiratory symptoms, epigenetic, immune and metabolic abnormalities are other endpoints of target organ toxicity caused by phthalates.

Animal studies have reported that phthalates can lead to reduced growth rates and a tendency for obesity and higher organ weights. Furthermore, adverse effects have been seen on the hepatic, renal, developmental and reproductive systems in animals (6,7,8,9,10).

IMPLICATIONS FOR DIABETES MELLITUS

The increasing global burden of diabetes and its complications is insurmountable. The global prevalence of diabetes in 2019 was approximately 9.3% and it is estimated to increase significantly by 2045. Literature has identified the most common and prominent risk factors of diabetes like obesity, family history and sedentary lifestyle. The current research also suggests the involvement of some environmental endocrine disruptors that may also act as a risk factor for developing diabetes. Phthalate exposure has been identified as a potential risk factor for diabetes mellitus.

The occurrence of diabetes mellitus, especially Type 2 diabetes mellitus (T2DM), is mainly caused by pancreatic beta cell dysfunction. Exposure to phthalates affects beta cells through various pathways, creating a risk of developing diabetes mellitus. A study conducted in vivo stated

that maternal exposure to DEHP promoted the disruption of beta cell function in the rat offspring by affecting the glucose-sensing mechanism and insulin gene transcription. Exposure to phthalates like monoethyl phthalate (MEP) also led to an increase in insulin secretion via activating estrogen receptor-α (ER-α), peroxisome proliferator-activated receptor- γ (PPARγ) and pancreatic duodenum homeobox-1 (PDX-1); leading to progressive exhaustion and eventually loss of pancreatic beta cell function (11).

Phthalates are also linked to an increase in insulin resistance markers. Phthalates increase the secretion of reactive oxygen species (ROS) and induce inflammation, leading to insulin resistance. Oxidative stress and adiponectin play an important role in the pathophysiology of diabetes. Research indicates a relationship between phthalate exposure and these parameters. In an epidemiological study, phthalate concentrations in the urine of diabetic participants, biomarkers for oxidative stress, malonyl dialdehyde (MDA) and adiponectin were analyzed. A positive correlation was seen in phthalates and MDA, while a negative correlation with adiponectin was reported (12). An association was found between high phthalates exposure, oxidative stress parameter and an increased incidence of T2DM. The mechanism involved in this was mediated by γ-glutamyltransferase. Through these studies, it can be stated that phthalate exposure causes insulin resistance, involving oxidative stress, adiponectin and inflammatory factors and leading to the progression of diabetes mellitus (13).

Reviews have shown a higher molecular weight phthalate – DEHP activates JNK, affecting Bcl-2 and Bax and causing apoptosis and inhibition of insulin sensitivity of hepatic cells in mice. DEHP also inhibits the PI3K/AKT signalling pathway and leads to impaired glucose transporters, reducing glucose tolerance, increasing insulin resistance and causing hyperglycemia. Experimental studies carried out on humans state that phthalate-induced insulin resistance possibly involves the activation of PPARγ and oxidative stress. DEHP promotes the activation of PPARy in preadipocytes and hepatocytes. The phthalate compound-induced oxidative stress in hepatocytes and adipocytes disturbs lipid and glucose metabolism, leading to insulin resistance and causing diabetes mellitus (14).

CONCLUSION

From the crack of dawn to nightfall, there seems to be no way of avoiding phthalates. Their widespread usage has ensured that almost everyone is exposed to this harmful chemical in one way or another. In addition to their direct negative impacts on health, phthalate-containing plastic disposal poses significant long-term environmental consequences that are detrimental not only to human health but also to the planet. Percolating easily from landfills, phthalates threaten to contaminate the groundwater table and the soil. This can potentially be used for agriculture or even home-level vegetative growth, further contaminating the food material in raw form. All reports regarding their potentially harmful effects on human health, warrant a careful consideration as to the use of phthalates in food packaging. It is especially imperative to consider the materials being used for foods targeted towards pregnant women, lactating mothers and young children to limit phthalate contamination. The implications of phthalate contamination from the context of insulin sensitivity and diabetes, reinforce the need to use safer alternatives to plasticized plastic in food packaging.

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IMPORTANCE OF URINARY LAB TESTS IN DIABETIC KIDNEY DISEASE

Arshita Shidaganal*, Ashwin Patil, Rushi Deshpande*****

INTRODUCTION

Diabetic kidney disease (DKD), also known as diabetic nephropathy, is a complication of diabetes that coexists with chronic kidney disease (CKD), manifested by elevated urinary albumin excretion and/or decreased glomerular filtration rate (1). There are currently about 500 million diabetic patients in the world (2). Approximately 40% of Type 2 diabetes mellitus patients (T2DM) and 30% of Type 1 diabetes mellitus (T1DM) patients develop DKD, a leading cause of CKD and end-stage renal disease (ESRD) (3,4).

Early identification of DKD is crucial for preventing the progression, as significant renal damage may occur even before changes in conventional biomarkers, such as serum creatinine and estimated glomerular filtration rate (eGFR). Consequently, urinary biomarkers have gained increasing attention as valuable tools for detecting early kidney damage, monitoring disease progression and guiding therapeutic interventions.

This article aims to provide a comprehensive overview of the importance of urinary lab tests in the management of DKD. We will discuss the pathophysiology of DKD, review the key urinary biomarkers used in diagnosis and monitoring and examine clinical guidelines for the management of DKD based on urinary biomarkers.

PATHOPHYSIOLOGY OF DIABETIC KIDNEY DISEASE

Diabetic kidney disease occurs as a consequence of long-term hyperglycemia, which causes structural and functional changes in the kidneys. The pathophysiology of DKD is multifactorial, involving glomerular and tubulointerstitial damage. Key mechanisms include glomerular hyperfiltration, mesangial expansion, tubulointerstitial fibrosis, activation of the renin-angiotensin-aldosterone system (RAAS) (5,6,7,8).

Figure 1 shows the natural history of diabetic kidney disease. By detecting the disease early and managing the risk factors, the progression of diabetic kidney disease can be slowed, reducing the likelihood of reaching ESRD. Understanding urinary sediment is an important diagnostic tool in determining the aetiology of kidney disease as it provides valuable insights into the nature of kidney damage, the underlying pathophysiology and the type of kidney disease involved. Urinary sediment analysis involves examining a urine sample under a microscope to identify various cellular and non-cellular components, including red blood cells (RBCs), white blood cells (WBCs), casts, crystals and epithelial cells.

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Figure 1

The Natural History of Diabetic Kidney Disease

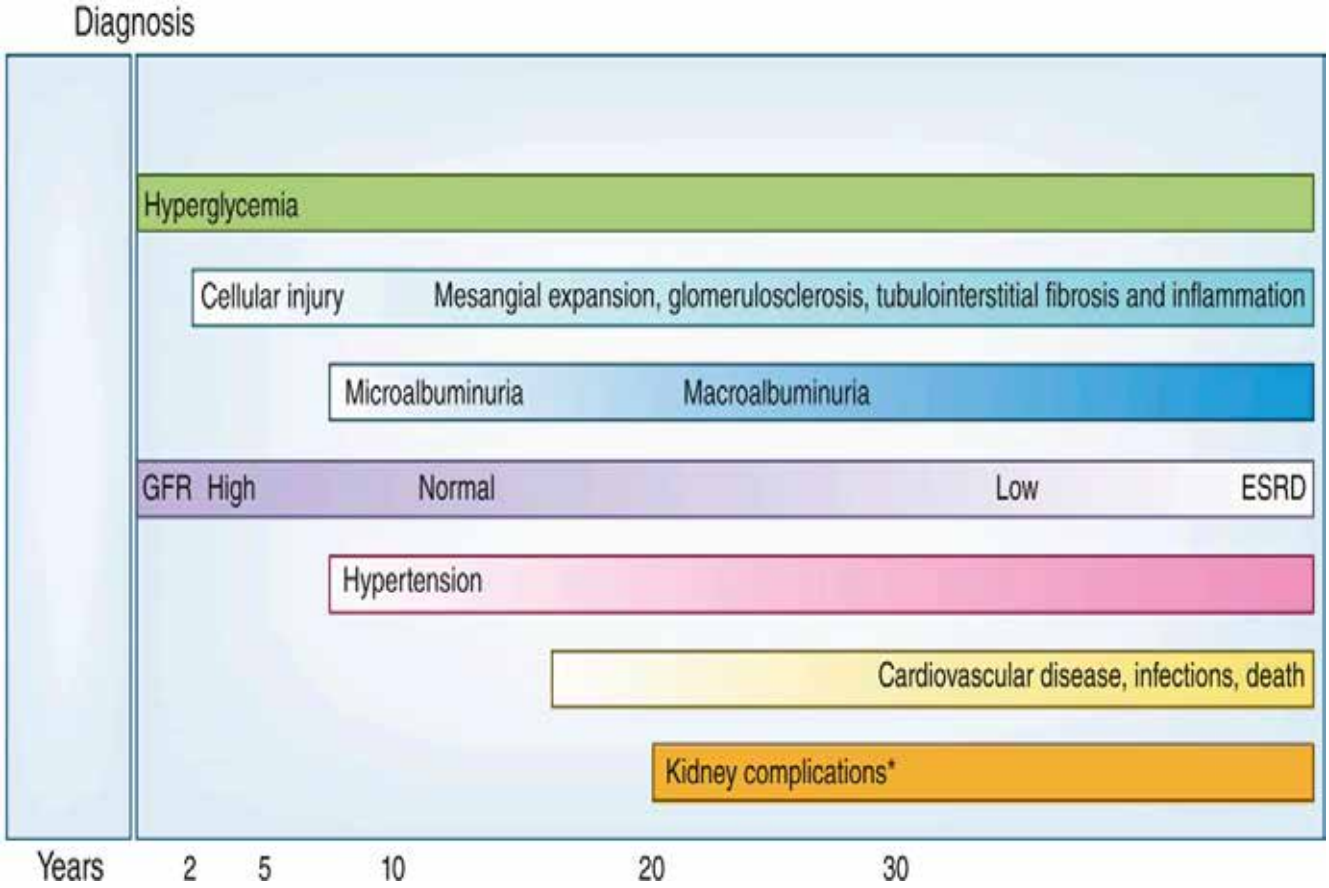

*Figure 1 Conceptual model of the natural history of diabetic kidney disease. The duration of diabetes, in years, is presented on the horizontal axis. Timeline is well characterized for type 1 diabetes mellitus; for type 2 diabetes mellitus, timeline may depart from the illustration due to the variable timing of the onset of hyperglycemia. *Kidney complications: anemia, bone and mineral metabolism, retinopathy and neuropathy. (9)*

The presence of dysmorphic RBCs in the urine is usually indicative of glomerular damage, as they are deformed while passing through the glomeruli. Often seen are glomerular diseases like IgA nephropathy. Renal tubular epithelial cells or renal tubular casts can suggest acute tubular injury (ATI), possibly due to ischemia, toxins or drugs affecting the renal tubules. White blood cells in the urine (pyuria) are commonly associated with inflammation. Pyelonephritis has a high number of WBCs and WBC casts in the urine. Elevated WBCs without bacterial infection is seen in interstitial nephritis, often due to drug-induced injury or autoimmune diseases. The presence of free hemoglobin or myoglobin in the urine is indicative of conditions like hemolysis or rhabdomyolysis. These can also show up in urinary sediment as granular casts. Certain types of crystals seen in the urinary sediment can provide clues to the etiology of kidney diseases. For example, calcium oxalate crystals may be seen in cases of nephrolithiasis. Uric acid crystals might be seen in gout or certain metabolic disorders.

Urinary sediment analysis is useful not only for diagnosing kidney diseases but also for monitoring the progression of diseases and the effectiveness of treatment. For instance, a decrease in RBC casts or a reduction in WBCs may suggest improvement in glomerulonephritis or interstitial nephritis, respectively, with appropriate therapy. By analyzing the components of urinary sediment, healthcare providers can detect disease early and make more informed decisions about management, which is essential for improving patient outcomes.

IMPORTANCE OF URINARY BIOMARKERS IN EARLY DIAGNOSIS AND DISEASE MONITORING

Urinary biomarkers are essential in the early diagnosis and ongoing monitoring of DKD. Unlike serum biomarkers, which reflect advanced kidney damage, urinary biomarkers detect renal injury even before a significant functional decline occurs. The key urinary biomarkers in DKD are as follows:

1. **Urinary Albumin**

   Urinary albumin is the most widely used and clinically validated marker for the diagnosis and monitoring of DKD. Albuminuria occurs when the glomerular filtration barrier is disrupted, allowing it to pass through the glomerulus and appear in the urine. Albuminuria is classified into three stages:

   a) ***Normoalbuminuria***: <30 mg/day

   b) ***Microalbuminuria***: 30-300 mg/day

   c) ***Macroalbuminuria***: >300 mg/day

   Microalbuminuria is the earliest sign of DKD and is considered as a marker of early glomerular dysfunction and cardiovascular morbidity. If left untreated, microalbuminuria may progress to macroalbuminuria (proteinuria >300 mg/g). Macroalbuminuria is associated with more advanced DKD and a risk of progression to ESRD.

   - ***Clinical Utility***: Urinary albumin measurement, typically using the urine albumin-to-creatinine ratio (uACR), is an important diagnostic and prognostic marker. The urine albumin-to-creatinine ratio is preferred because it accounts for variations in urine concentration, providing a reliable estimate of albumin excretion (10). The ADA recommends screening for albuminuria annually in all patients with diabetes, starting at 5 years after diagnosis for T1DM and at the time of diagnosis for T2DM (10).
   - ***Guidelines***: The Kidney Disease: Improving Global Outcomes (KDIGO) 2020 guidelines emphasize the importance of annual screening for albuminuria and estimation of renal function using eGFR in patients with diabetes (11). The guidelines recommend using RAAS inhibitors to reduce albuminuria and slow the disease progression in patients with elevated urinary albumin levels (11).

2. **Kidney Injury Molecule-1 (KIM-1)**

   The kidney injury molecule-1 (KIM-1) is a transmembrane glycoprotein expressed in the proximal tubular cells following kidney injury. The KIM-1 levels in urine have been shown to rise early in DKD, often before changes in albuminuria or eGFR are detectable. The KIM-1 has been considered a reliable biomarker for tubular injury and is a promising candidate for early detection of DKD (12).

   - ***Clinical Utility***: Kidney injury molecule-1 is detected in the urine using immunoassays and has been associated with glomerular and tubular injury. Elevated urinary KIM-1 levels correlate with histological findings of tubular injury and can also predict the onset of DKD, even in the absence of albuminuria (13). It has the potential to identify DKD at its earliest stages.
   - ***Research***: Studies have demonstrated that urinary KIM-1 levels correlate with the progression of diabetic nephropathy and are useful for assessing the effectiveness of therapeutic interventions.

3. **N-acetyl-β-D-glucosaminidase (NAG)**

   A lysosomal enzyme is released into the urine when renal tubular cells are injured. Elevated urinary NAG levels indicate tubular dysfunction and are associated with the early stages of DKD, specifically when glomerular filtration remains relatively preserved.

- ***Clinical Utility***: N-acetyl-β-D-glucosaminidase is a sensitive marker of tubular injury and its urinary levels rise in response to acute and chronic tubular damage. It is especially useful for detecting tubulointerstitial fibrosis, which is a hallmark of early DKD (14).
- ***Research***: Studies have shown that urinary NAG levels can predict the onset of microalbuminuria in diabetes mellitus patients, making it a valuable early biomarker for the detection of DKD.

4. Cystatin C

It is a low-molecular-weight protease inhibitor that is filtered by the glomerulus and reabsorbed by the renal tubules. It is freely filtered at the glomerulus and its urinary excretion is influenced by both glomerular and tubular function. Cystatin C is a potential biomarker for detecting early-stage kidney dysfunction in patients with diabetes, particularly in those with normal eGFR and minimal albuminuria.

- ***Research***: Elevated urinary cystatin C levels have been shown to be associated with the early stages of DKD and they provide additional information when used in conjunction with other biomarkers like urinary albumin (15).

5. Endocan

Endocan is an endothelial-specific proteoglycan that is shown to be elevated in different inflammatory conditions, including DKD. Urinary endocan levels are thought to reflect endothelial dysfunction and inflammatory processes that contribute to kidney injury in diabetic patients.

- ***Research***: Elevated urinary endocan levels have been associated with the presence of early renal damage in diabetic patients, making it a promising biomarker for early detection of DKD (16).

6. Others

a) ***Urinalysis***: This general test can detect protein, glucose, blood and other substances in the urine. A positive urinalysis for protein, especially in diabetes, warrants further investigation to evaluate for albuminuria.

b) ***24-hour Urine Collection for Albumin or Protein***: Although not commonly used due to its cumbersome nature, a 24-hour urine collection provides the most accurate measurement of total protein excretion. This test is often reserved to confirm results when albuminuria is detected or when UACR results are inconclusive.

GUIDELINES FOR DIAGNOSING AND MANAGING DKD USING URINARY BIOMARKERS

The Kidney Disease: Improving Global Outcomes (KDIGO) 2020 guidelines for diabetes management in chronic kidney disease recommend regularly monitoring urinary albumin levels and eGFR in patients with diabetes (9). Specific recommendations include:

- Annual screening for albuminuria using urinary ACR in all patients with diabetes.
- Use of RAAS inhibitors (ACE inhibitors or ARBs) in patients with elevated albuminuria to reduce the risk of progression to ESRD.
- SGLT2 inhibitors have shown promise in slowing the progression of DKD and reducing the risk of cardiovascular and renal events in diabetic patients (9).

The American Diabetes Association (ADA) 2024 guidelines emphasize early detection through urinary albumin testing and advocate for interventions such as blood pressure control and RAAS inhibition to prevent or slow the progression of DKD (9).

CONCLUSION

Diabetic kidney disease (DKD) is one of the leading causes of chronic kidney disease (CKD)

which results in end-stage kidney disease (ESKD) worldwide. Early detection of DKD is crucial for preventing its progression and improving patient outcomes. Traditional markers such as serum creatinine and glomerular filtration rate (GFR) often fail to detect early kidney damage in patients with diabetes mellitus. Urinary biomarkers offer a non-invasive and reliable tool for early diagnosis, monitoring disease progression and assessing treatment efficacy. This article reviews the role of urinary lab tests in DKD, focusing on key biomarkers like albuminuria, kidney injury molecule-1 (KIM-1), N-acetyl-β-D-glucosaminidase (NAG), cystatin C and others. The article also highlights clinical guidelines, current research and future directions in utilizing urinary biomarkers for better management of DKD.

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CAMPS FOR TYPE 1 DIABETES MELLITUS: AN APPROACH TO EDUCATION AND SUPPORT

Aspi J. Irani*, Anushree Mehta**

Type 1 diabetes mellitus (T1DM) is the only medical condition in which the patients (child/ adolescent/young adult) and/or their parents must perform medical procedures (injecting insulin a minimum of 3-4 times a day, testing blood glucose 6-10 times a day) and learn to estimate insulin doses to match their meals and physical activity. They need to do this lifelong, with no break. Hence they live in constant fear of hypoglycemia, which further adds to their stress.

It is evident that intensive and ongoing education in diabetes self-management is mandatory for persons with T1DM. Unfortunately for people with diabetes (PwD), good knowledge often does not translate into good diabetes control, to quote an old proverb, "knowing and not doing is not knowing". Potential barriers to the application of knowledge should be identified and addressed to narrow the gap between knowledge and action. For this, ongoing counselling and psychosocial support are essential. These comprise the foundation with its four pillars of optimum diabetes control – insulin therapy, medical nutritional therapy (MNT), therapeutic monitoring and planned physical activity. To achieve this goal, one needs a devoted team, adequate time, a conducive and relaxed environment.

With this aim of providing both practical education in T1DM self-management as well as psychosocial support and counselling, the first 4-day residential camp in India for people with T1DM and their parents was organized by the Juvenile Diabetes Foundation (JDF), Maharashtra Chapter, in December 1983. Since then, we have organized 40 annual 3 to 4-day residential camps and innumerable one-day camps. During the COVID pandemic, camps were conducted online. The purpose of writing this article is to share our philosophy, experience, protocol and observations. Followed by a brief account of camps held in other parts of the world.

The JDF residential camps are attended by PwD with onset in the pediatric age group and the parents of those below 18 years of age. The camp staff includes doctors (pediatricians, diabetologists and a psychiatrist), clinical psychologists, nutritionists, certified diabetes educators and social workers. The camp is held over 3-4 days at a holiday resort in a hill station near Mumbai. The site selected must have 4-5 halls for conducting concurrent sessions, sufficient play areas and a facility to prepare meals appropriate for people with T1DM. These camps are run on a no-profit-no-loss basis. The staff at the camp have been providing voluntary and free service for over 40 years.

The camp begins with an introductory counselling session "Tackling the disturbed mind" or "Answering your unasked questions and doubts". In this session, certain concerns that are common to all PwDs and their parents are addressed. These include denial, sense of guilt – is my diabetes due to any act of omission or commission?, resentment – why me?, false hopes – fueled by misleading reports in social media about "alternatives to insulin therapy" and "imminent cure", worries about finances and concerns about the child's future – career, employment, marriage, procreation, long term complications and life span. Meeting many others who are sailing in the same boat gives the

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satisfaction that "I am not alone" and hearing the success stories of some "senior" PwDs who are now married and have healthy children and/or a successful career gives the confidence that "all is not lost" and "I too can have a bright future". Long-term complications are discussed in a sensitive manner, painting a positive picture by emphasizing that these can often be prevented by good control and the fact that every patient with T1DM may not develop all the complications described. Thus, encouraging cooperation for compliance with treatment, regular follow up and screening**.** False hopes are replaced with genuine hopes, "Someday a cure will be available and till then we need to work hard to control our diabetes well so that we can avail of the cure when it becomes a reality". An emphasis is laid on treating the child like any other child, keeping T1DM in the background – "child with diabetes" rather than "diabetic child". Parents are counselled that in the quest for perfect control, the child should not be deprived of his/her normal childhood pleasures; that, whereas perfect control of T1DM is not always possible, near perfection is desirable. This crucial introductory session puts the participant's minds at ease and makes them more receptive to the formal education that follows.

Subsequent counselling sessions in the camp focus on "coping with diabetes at home, during social outings, in school/college/at the workplace". The T1DM is not a visible handicap, but the importance of revealing it to relevant people such as friends, school authorities and before finalizing marriage is stressed, along with tips on how this should be done. The child's skills and achievements must be highlighted, keeping T1DM in the background and not forgotten. These sessions conducted by our mental health team are unique to our camps.

EDUCATION SESSIONS

Patients are divided into groups based on age, perceived ability to learn and present treatment modality such as multiple daily injections (MDI) or continuous subcutaneous insulin infusion (CSII). These are interactive sessions; everyone is encouraged to put forth the practical difficulties they face and some solutions that may have found. Our mental health team then offers suggestions/possible solutions. Education sessions cover the following topics:

1. ***Procedures*****:** Insulin injection technique, site rotation, SMBG, urine and blood test for ketones and administration of glucagon are taught during a live demonstration on the first day, followed by "learn as you perform under supervision" and "learn from other's mistakes" sessions before each major meal.
2. ***Insulin Dose Calculation*****:** Patients are taught how to calculate pre-meal insulin boluses using the insulin sensitivity factor (ISF) and insulin carb ratio (ICR), how to calibrate insulin dose using "pattern adjustment algorithms" and how to manage exercise sessions and unaccustomed activities by adjusting insulin doses and/or consuming additional snacks (before and/or after exercise) coupled with frequent monitoring.
3. ***Medical Nutrition Therapy (MNT)*****:** We have a session on "healthy eating" (how to improve the quality of food routinely consumed by the family with stress on eating low glycemic index carbohydrates increasing protein content and quality, moderating salt content and switching to healthy fat) and a session on "carb exchanges" and "advanced carb counting". Common barriers to good nutrition in many Indian households and issues with meals/snacks/tiffin sharing/celebrations in school are discussed.
4. ***Emergencies*****:** Prevention, early recognition, first aid management of hypoglycemia and "sick day management" to prevent diabetic ketoacidosis (DKA) are explained in detail and printed handouts are provided for future reference. We have found a very significant decline in severe hypoglycemia and in hospitalizations owing to DKA during intercurrent illnesses in those who have attended our camps.

5. ***Introduction to Newer Technologies*:** The camp is a great opportunity to introduce new technology in diabetes management. We shared knowledge about CGMS, insulin pumps, automated insulin delivery systems, connected glucometers and so on during the camps. This allows for the quick dissemination of correct information regarding technology to many PwDs.

ENTERTAINMENT SESSIONS

These sessions are held each night at the camp, where children can display their varied skills (singing, dancing and so on), thus driving home the point that they are no different from children without diabetes. They also prepare skits and short plays with T1DM-related messages, such as on "hypo". Before breakfast, we may have a meditation session and a brief sporting event (such as Zumba or a running race) in the morning. A quiz contest is a penultimate event to judge whether the participants have understood what was taught and simultaneously, to clarify doubts and reinforce education. Finally, we have a brainstorming session with parents and young adult PwD discussing their unmet needs, advocacy and how they can help each other. A mixed group attending the camps is beneficial as the rich may offer to finance the poor, the influential may help others obtain school admissions or jobs and the very intelligent may continue to offer telephonic guidance in DM management post-camp to those who cannot cope independently. Parents (and children) stay in touch after the camp, making for an excellent support system. Marriages, besides being "made in heaven", are sometimes made at our camps! Unlike several camps in other countries, discussed below, we do not include formal sports activities in our residential camps because of time and space constraints. However, we compensate for this by organizing hikes/treks and sporting events all around the year under medical guidance and supervision.

After the camp, patients stay in touch on WhatsApp with each other and our T1DM team.

We conduct one-day camps and online camps in Mumbai at periodic intervals, focused camps covering a single topic such as "mental health issues" or "carb counting" or a miniature version of our residential camps, addressing all aspects in brief.

Camps can provide a very conducive setting for conducting research. In a study undertaken some years ago, we noted that an average HbA1c of a group of 20 PwDs who attended two simultaneous camps in December 2014 and December 2015 improved after 3 months of the first camp, then rose slightly but not exceeding the pre-camp level at the end of 12 months post-camp. Their HbA1c, 3 months after the second camp, was even lower than that after the 1st camp. Further, the number of PwD with HbA1c <7.5% was only 2/20 at the start of the 1st camp; this figure rose to 9/20, 3 months after the second camp as shown in Table 1. These observations support the commonly held belief that acquired knowledge and the resolve to change needs to be reinforced at periodic intervals so that the outcomes are not merely improved but also sustained.

Table 1

HbA1c of 20 PwDs Attending Two Consecutive Winter Camps

Month & Year	Mean HbA1c	No. with HbA1c ≤7.5%	No. with HbA1c ≤8.5%
At the camp: Dec. 2014	8.7%	2	8
Post-camp: Mar. 2015	8.1%	4	14
At the camp: Dec. 2015	8.3%	6	12
Post-camp: Mar. 2016	7.9%	9	10

Table 1 shows progressive improvement in HbA1c in 20 PwD who attended two consecutive JDF camps in 2014 and 2015. Data shown here is taken from a paper "Influence of intensive education coupled with counselling on glycosylated haemoglobin levels and other parameters of diabetes control in paediatric patients with Type 1 diabetes mellitus in India" presented by Dr. Vineeti Dalal and Dr. A. Irani at the ISPAD annual conference, 2018, Hyderabad, India.

CAMPS IN OTHER COUNTRIES

The concept of diabetes camps is almost as old as insulin. Even during the 1920s, healthcare professionals treating patients with T1DM understood the importance of diabetes camps. Soon after insulin was discovered, the first diabetes camp was conducted in 1925 in Michigan by Dr. Leonard F. C. Wendt, with four children in attendance. Elizabeth Devine, a nurse with Joslin Clinic, also started her camping activities in the same year by taking one child to her summer house. Over the next 7 years, the number of children attending her annual summer camp increased to 50. Since then, camps for T1DM have evolved and grown manifold worldwide. (1,2,3,4,5).

These camps have a common aim, which is to educate PwD in managing their T1DM and give them the opportunities, knowledge, motivation and confidence needed to safely participate in and enjoy all age-appropriate sporting activities.

There are different types of diabetes camps being conducted worldwide and they can be classified based on their aims and targets. The same is elaborated below:

1. ***Traditional Summer Camps with a Focus on Diabetes*:** These traditional camps involve fun activities like hiking, swimming and arts and crafts, catering to children and teens, but with focus on managing T1DM. A medical team is an integral part of such camps. e.g. Conducted by Camp Sweet Life, Camp Hopewell.
2. ***Diabetes Education Camps*:** Diabetes Education Camps are attended by individuals of all age groups as well as families living with T1DM. The main purpose is diabetes education on various topics, including the basics of T1DM, insulin injection techniques, glucose monitoring, insulin dose adjustments and diet workshops. They impart a structured education. These are akin to the residential camps that we have been conducting in India. In India, the most popular type of diabetes camps are the educational camps. e.g. Conducted by American Diabetes Association Family Camp.
3. ***Age Group-Specific Diabetes Camps*:** These are camps catering to specific age groups to deal with specific topics and issues related to those age groups. e.g. Conducted by ADA teen camps, Adult Diabetes Camps.
4. ***Diabetes Camps with Focus on a Specific Sport*:** These camps are specifically meant for people with T1DM who are interested in sports and athletics. The camp provides an appropriate setting for them to enjoy and at the same time, learn how to manage their blood glucose during intense activities and training. e.g. Conducted by Diabetes Training Camps, Team Novo Nordisk talent ID
5. ***Leadership and Mentorship Camps*:** These camps train PwDs who want to become future diabetes advocates and mentors for others living with T1DM. They focus on building leadership skills and creating mentors. e.g. Conducted by Young Leaders Programme of IDF.
6. ***Virtual Diabetes Camps*:** The COVID-19 pandemic has given birth to virtual diabetes camps and helped PwD connect from all over the world. These can be educational or just fun and interactive. They can be a short camp for discussion of a specific topic or just a motivational session for those living with T1DM. We conducted several such camps during the COVID period.

There is a dearth of literature related to the effect of camps on the lives of people with T1DM and the available research has shown mixed results. Alessandra Mauri and colleagues have shown that structured education and diabetes summer camps can help improve knowledge in young persons with T1DM (6). A study conducted in 2016 by Margaret W Bultas et al. reported an improved attitude towards T1DM and improved self-efficacy after a “camping experience” in 38 parent-child dyads (7). Jill Weissbery-Benchell and KarenRychlik studied parents, teenagers and children from 42 diabetes-specific summer

camps across the USA. They analyzed self-reports before and after attending a diabetes camp on diabetes-specific emotional distress, diabetes-specific quality of life (QOL) and self-care behaviours. In their study, everyone reported improved self-care skills as well as significant improvement in levels of diabetes-specific distress. The participants also reported that they saw "camp as a place where youth feel they are with peers who really understand what it is like to live with diabetes." The camp is also regarded by many participants as a great place for youth to learn about new technologies and try new self-care skills (8). A meta-analysis studied the benefits of attending camps, reported short-term improvements in glycemic control, diabetes knowledge, QOL, anxiety, diabetes self-management and self-esteem. However, the improvement seen in QOL and anxiety was not statistically significant (9). It has been seen that repeatedly attending diabetes camps has a positive impact on glycemic control. The camp experience leads to improved self-esteem, independence, self-sufficiency and creates a positive identity for the campers. It helps youth with T1DM achieve autonomy and independence. Most parents, as well as children, report high satisfaction levels after attending a camp and show a desire to attend more camps in the future (10).

In contrast, a study, reported no beneficial effects of the camp on glycemic control, nor was there any significant improvement seen in psychosocial measures in children or parents (11). Another study showed that attending camps helped patients achieve high levels of diabetes management self-efficacy, but these participants continued to have high levels of diabetes-related stress as well as moderate depression. Further, the number of years attending camps did not have any impact on the above findings (12). Camps may not always lead to improved HbA1c levels; although some studies have shown a short-term benefit, most studies have failed to show a positive impact on HbA1c levels. Even if attending camps improves the knowledge of people/children living with T1DM, not everyone may be able to translate this into good glycemic management.

It has been our observation that post-camp, most of the participants show a positive attitude towards their diabetes and also show an overall improvement in their mental well-being. Not everyone shows a sustained improvement in HbA1c and reinforcement is vital for long-term glycemic management. More research is needed to study the impact of the camps. All in all, diabetes camps are an important part of the management of T1DM as the goal is not just to live with T1DM but to live and thrive with T1DM.

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QUESTION AND ANSWER

Q. How to integrate mental health support into diabetes education to reduce diabetes distress and burnout?

A. Integrating mental health support into diabetes education is essential for addressing the emotional aspects of managing the condition, such as diabetes distress and burnout. Diabetes patients face a burden related to the impact of diabetes on the quality of life – physical, psychological, social and economic consequences. Diabetes-related distress is an emotional burden experienced by individuals. These include depression, tension, guilt related to fear of deterioration of health and fear of disease-related complications. It also includes social stigma related to the disease and lack of support from loved ones. Diabetes distress occurs when there is an imbalance between what diabetes management requires and someone's ability to take care of them.

Mental health support can be effectively integrated into diabetes education:

1. ***Incorporating Mental Health Awareness into the Curriculum*:** Recognizing and openly discussing feelings of frustration, anxiety and fear common in diabetes patients. It is important to teach about diabetes distress and burnout and how to recognize and tackle them effectively.
2. ***Include Psychologists, Therapists or Counsellors in the Diabetes Care Team*:** This will ensure that patients receive immediate assistance when dealing with issues such as fear, anxiety, frustration and stress related to management of disease. Cognitive behavioural therapy helps patients manage the emotional burden of diabetes.
3. ***Create Peer Networks*:** Encourage patients to join support groups, either in-person or online, where they can connect individuals having the same disease and facing similar challenges. This can help to receive more emotional and moral support, reduce feelings of isolation and better learning about the disease.
4. ***Personalized Care Plan:*** Each plan and therapy should be tailored to the individual, as each person has different health requirements and mental capabilities. Along with monitoring blood glucose levels, diet and physical activity patterns, regular checks should also be curated as per patients mental and emotional well-being.
5. ***Technology*:** Applications that help with managing stress, such as yoga and meditation, can be utilized. Cognitive behavioural therapy services can be offered online if in-person support is not feasible.
6. ***Continuous Follow-up*:** Ensure slating regular follow-ups with patient and make sure patients are provided information on where to seek help in case they are having difficulties or struggling – provide contact details of therapists, support groups and hospitals.

By integrating mental health support into diabetes education, individuals with diabetes can receive a holistic support to manage their condition, reduce distress, and prevent burnout. This approach not only focuses on physical health but also addresses the emotional challenges that can affect adherence to diabetes management and overall quality of life.

Rima Ved

Q. When is it Appropriate to Inform a Patient That Diabetes Reversal is Possible?

A. Reversal generally refers to significant improvement in glucose metabolism, often due to weight loss, lifestyle changes or the use of medications. However, it does not necessarily imply that the improvement will persist without continued intervention. Studies show that early intervention is critical, as the likelihood of reversal declines with disease progression. These interventions are

effective in individuals with impaired glucose tolerance (IGT) or a history of gestational diabetes mellitus (GDM), conditions linked to reversible of insulin resistance.

Key Patient Groups:

1. ***Newly Diagnosed Patients (0–5 Years)*:** Diabetes reversal is most successful within the first 2–5 years of Type 2 diabetes mellitus (T2DM) diagnosis where pancreatic beta-cell function and insulin production remain sufficient. Patients diagnosed within the first few years have the highest chance of remission. Remission, as defined by the American Diabetes Association (ADA), requires maintaining HbA1c to ≤6.5% without the use of glucose-lowering medications for at least three months. Studies emphasize that aggressive management in the first two years significantly reduces long-term complications. The legacy effect in UKPDS underscores the importance of early intervention for sustained benefits. Thus, providing individualized guidance based on patient profiles can maximize the likelihood of long-term diabetes remission. The participants in the Diabetes Remission Clinical Trial (DiRECT) with less than 6 years of T2DM demonstrated that 46% of participants achieved remission at 12 months through structured weight loss and sustained remissions at 24 months occurred in more than one-third of people with T2DM. This shows the importance of informing patients about reversal potential early in their diagnosis.

2. ***Patients with Obesity and Insulin Resistance*:** Men often exhibit better outcomes of reversal compared to women, likely due to differences in fat distribution, muscle mass and insulin sensitivity. Obesity and central adiposity (visceral fat), as indicated by waist circumference (WC), play a crucial role in the development of insulin resistance. The Look AHEAD trial found that >10% weight loss significantly improved glycemic control. Furthermore, the DiRECT study demonstrated that subjects who maintained a 10 kg weight loss achieved a 64% remission. The extent of sustained weight loss was linked to sustained remission.

   The Role of Bariatric Surgery: For individuals with severe obesity, bariatric surgery offers a high likelihood of remission compared to non-surgical interventions, as demonstrated in a meta-analysis by Zhou et al., 2023 who reported a significant reduction in HbA1c levels. In another randomized control trial at 2 years, the average baseline HbA1c level (8.65±1.45%) decreased to 6.35±1.42% in the gastric-bypass group. Furthermore, the type of bariatric surgery performed, such as Roux-en-Y gastric bypass and sleeve gastrectomy, also influences the remission rate. Additionally, patients with younger age, shorter duration of T2DM, lower pre-operative fasting blood glucose and HbA1c, higher pre-operative C-peptide levels, higher BMI, who were not on insulin therapy and not having a family history of obesity are the best candidates to achieve a prolonged diabetes remission. Thereafter, the degree of post-surgical improvements in incretin activity (GLP-1), insulin sensitivity and glucose homeostasis determine the possibility of long-term remission. However, weight regain may lead to recurrence of diabetes.

3. ***Motivated Patients Willing to Implement Lifestyle Changes*:** The American Heart Association (AHA) recommends implemention of behaviour change techniques for promoting lifestyle change. Individuals willingly undertaking structured lifestyle interventions, including low-calorie and Mediterranean diets combined with exercise, significantly experienced with remission rate.

4. ***Gestational Diabetes and High-Risk Individuals*:** Studies show that preventing excessive weight gain (<12kg) during pregnancy reduces the risk of developing T2DM. Through education on postpartum weight management, individuals with a history of GDM can be driven to reverse diabetes and achieve better health outcomes.

5. ***Pharmacological Advances in Diabetes Reversal*:** Recent trials suggest that high-dose GLP-1 receptor agonists and GLP-1/GIP dual

agonists, such as semaglutide and tirzepatide, may induce remission in T2DM patients. The SURPASS-1 trial found that at 40 weeks, the mean HbA1c of 7·9% decreased by 2.07% with 15 mg tirzepatide. The study also reported tirzepatide induced body weight loss ranging from 7·0 to 9·5 kg, which was dose-dependent and had its own benefits. However, whether remission can be sustained without continued medication remains unclear.

6. ***Medication-Induced Diabetes and Reversibility*:** Individuals on certain medications can induce hyperglycemia or diabetes, including corticosteroids, cancer drugs (e.g. mTOR inhibitors, targeted therapies) and immunosuppressants. Steroid-induced diabetes, particularly during COVID-19 treatment, often resolved upon discontinuation of medication. Similarly, some cancer treatments cause transient diabetes, which can be reversed post-treatment. Patients with acute pancreatitis from gallstones leading to pancreatic diabetes can be considered for reversal once the gallstones are addressed medically. However, patients with drug-induced pancreatic damage may suffer permanent insulin deficiency.

Thus, it is essential to communicate the possibilities of diabetes reversal with the patients by setting realistic expectations at diagnosis. Emphasis should be on the fact that reversal is not a cure but a state of prolonged remission dependent on sustained lifestyle changes. By proactively educating patients, healthcare providers can empower patients to take decisive steps toward diabetes remission.

Blasee R Fernaandes

Q. What is the role of circadian rhythm in diabetes management?

A. Circadian rhythm refers to the internal clock in the brain that operates on a 24-hour basis producing natural rhythm, managing cycles of wakefulness and sleep in response to environmental light changes. There are many other bodily functions regulated by long circadian rhythms like menstrual cycle in women.

This circadian system maintains healthy bodily functions and regulates the timing of various physiological processes, such as glucose metabolism. Activities that desynchronise or misalign these rhythms can have negative effects on health, as explained below.

According to the National Institute of Medical Sciences, light and dark have the most influence on circadian rhythms. However, food intake, stress, physical activity, social environment and temperature also affect them. Numerous epidemiological studies show a strong correlation between circadian disruption related to lifestyle and a higher risk of Type 2 diabetes mellitus (T2DM). For, e.g. shift employment has been linked to a 10–40% increased risk of diabetes. In another study by Manodpitipong et al. regardless of whether they work rotating or non-rotating shifts, regardless of age, BMI, insulin use, sleep length and morning/evening preference, individuals with diabetes who work night shifts had higher HbA1c levels than those who do not. One form of behavioural misalignment for individuals with diabetes is the mistiming of eating.

Circadian rhythm significantly affects hormone cortisol secretion and growth hormone production, which usually occurs after sleep. These hormones follow a daily rhythm, affecting insulin sensitivity and glucose regulation. It also influences liver metabolism demonstrating a substantial role in diabetes management. The liver's control of glucose production, lipid metabolism and overall metabolic functions further impacts blood glucose levels in the body. Disruptions to these rhythms can impair metabolic processes, highlighting the importance of circadian alignment in effective diabetes management.

A better understanding of the circadian disruption mechanisms may help impact the progression of impaired insulin secretion and sensitivity, thus, improving glycemic control for better health outcomes.

Jaishri Jain

RECIPES

SHREDDED CABBAGE SALAD

INGREDIENTS

- 50 gm shredded Purple Cabbage
- 50 gm shredded Green Cabbage
- 50 gm shredded Carrots
- 50 gm Shredded Green Capsicum
- 10 gm mixed seeds (Pumpkin, Watermelon and Sunflower)
- 20 gm fresh Parsley

FOR DRESSING

- 1 tbsp Skim Hung curd
- 1 tsp Extra Virgin Olive oil
- 2 tbsp Lemon Juice
- 1 tsp Black pepper
- 1 clove Garlic
- 1 tsp Chilli flakes

METHOD

1. In a serving bowl, combine the prepared purple and green cabbage, carrot, capsicum and parsley. Set it aside.
2. Toast the seeds in a small skillet over medium heat, stirring frequently until fragrant and popping. Add to the bowl and mix.
3. For the dressing, whisk together olive oil, lemon juice, hung curd, garlic, cumin, black pepper and salt until smooth.
4. Drizzle over the shredded vegetables and toss to coat evenly. Adjust with more lemon juice if needed. Refrigerate to cool or serve immediately.

PROVIDES 2 SERVINGS

Nutritional Information Per Serving

Energy (Kcal)	Carbohydrate (gm)	Protein (gm)	Fat (gm)
67	2	2	2

SPECIAL FEATURES

- Fiber-rich
- Low Glycemic Index

SAVOURY OATS

INGREDIENTS

- 60 gm Steel-cut Oats
- 30 gm Moong Dal
- 50 gm Tomato
- 50 gm Capsicum
- 50 gm Onion
- 1 tsp Olive oil
- 1 tsp Cumin
- 1 tsp Red Chili powder
- 1 tsp Chilli flakes
- ½ tsp Garlic powder
- ½ tsp Ginger
- ¼ tsp Asafoetida
- 2 Bay leaves

METHOD

1. Wash and soak the steel-cut oats and yellow moong dal for 2 hours.
2. Finely chop all the vegetables.
3. Heat oil in a cooker. Add cumin seeds and bay leaves.
4. When cumin seeds splutters, add asafoetida. Add onions and cook till it turns pink.
5. Once the cumin splutters, add asafoetida and onions. Sauté until onions turn pink.
6. Add grated ginger and sauté for a minute.
7. Mix in tomatoes, capsicum, turmeric, chili powder and salt. Cook for a minute.
8. Add soaked oats and dal. Sauté for 2 minutes.
9. Pour in water, cover and pressure cook for 3-4 whistles.
10. Serve warm with curd and salad.

PROVIDES 2 SERVINGS

Nutritional Information Per Serving

Energy (Kcal)	Carbohydrate (gm)	Protein (gm)	Fat (gm)
133	20	5	3

SPECIAL FEATURES

- Protein-rich
- Low Glycemic Index

HOW KNOWLEDGEABLE ARE YOU?

1. Gestational diabetes mellitus is usually diagnosed around?

a) 1st month of pregnancy
b) 10 weeks of pregnancy
c) 24-28 weeks of pregnancy
d) 15 weeks of pregnancy

2. Which of the following is the widely used clinical indicator of diabetic nephropathy?

a) Serum creatinine
b) Estimated glomerular filtration rate (eGFR)
c) Microalbuminuria
d) Hematuria

3. Fetal malformations in uncontrolled, pregnant diabetics are usually

a) Hare lip and cleft palate
b) Osteogenesis imperfecta
c) Sacral regression
d) Hepato renal cysts

4. Drug that has shown positive effect on lipid profile is

a) Metformin
b) Glibenclamide
c) Glimepiride
d) Vildagliptin

5. How frequently should patients with diabetes undergo urinary albumin testing?

a) Every 3 months
b) Every 6 months
c) Every 5 years
d) Annually

6. Prevention of DKA is best done by

a) Use of insulin pump
b) Education of patient
c) Use of DPP IV inhibitors
d) Use of metformin

7. What type of plastic is generally considered safer and less likely to contain phthalates?

a) High-density polyethylene or HDPE
b) Polycarbonate
c) Polyvinyl chloride (PVC)
d) Polystyrene

8. All of the following are true about Type 1 diabetes mellitus except

a) Family History present in 90% of cases
b) Use Presence of antibodies against islet cells of Pancreas
c) Prone to Diabetic Ketoacidosis (DKA)
d) Insulin is required for management

9. Which metabolic effect of phthalates has been observed in research studies?

a) Lower LDL cholesterol
b) Enhanced insulin sensitivity
c) Reduced blood pressure
d) Increased insulin resistance

10. Adipose tissue inflammation in obese subjects is characterized by all of the following except

a) Accumulation of macrophages
b) Elevated adiponectin concentrations
c) Elevated free fatty acids in serum
d) Elevated leptin concentrations

ANSWERS:

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

MYTHS AND FACTS

Myth: If you have diabetes mellitus, you are bound to get complications.

Fact: Not all people with diabetes (PWD) develop complications. If one has uncontrolled diabetes for a longer period, there is a higher risk of complications. Chances of complications get lowered as long as blood sugar is within normal range, weight is controlled and comorbidities such as hypertension, hyperlipidemia are prevented or treated. Therefore, it is important to keep blood pressure and cholesterol in the diabetic normal range. The blood pressure goal in PWD is <140/80 mm/ Hg and the goal for LDL cholesterol is less than or equal to 75 mg/ dL. Sometimes ACE inhibitors or ARB inhibitors may be required for the prevention of blood pressure or kidney problems. A statin could also be required to keep cholesterol down and aspirin may be required to prevent heart attacks.

Effective modifiable strategies include managing one's diabetes well, i.e. regular physical check-up and eye check-up and watching for factors for increased risk of heart disease. Check ABC, i.e. A1c levels and control blood pressure, keep the goal below 135/85 mm/hg and check cholesterol levels to keep LDL cholesterol ≤ 70 mg/dl. One needs to have good teeth and oral hygiene, check feet regularly and wear diabetes-friendly shoes. Lose weight if obese or overweight and / or have increased waist circumference. Exercise and stay active. Stop smoking. Drink alcohol responsibly. Manage stress by practice of yoga and meditation. Take care of wounds, especially feet. Choose carbohydrates carefully and reduce salt intake. Pick healthy food choices and stay up to date with vaccinations.

Dina Mithani

Myth: Fruits are undesirable for individuals with Diabetes Mellitus.

Fact: Medical Nutrition Therapy (MNT) is an important aspect of diabetes management. Most of the guidelines recommend a high-fibre and nutrient-rich diet. Fruits are considered to be rich in antioxidants and fibre. Fruit and vegetable consumption has been associated with decreased incidence of mortality from a various health issues including obesity, hypertension, cardiovascular diseases and cancer.

Managing diabetes involves dietary choices which stabilize blood sugar levels. Fruits are rich in fibre and antioxidants, but the form in which they are consumed can lead to a rapid increase in sugar based on the glycemic index and sugar content. Although fruit juices may have antioxidant activity, they lack fibre and are less satiating. Hence, individuals with diabetes should avoid fruit juice. Understanding which fruits to limit or avoid is crucial for effective diabetes management. Fruits to limit are watermelon, banana, sapota, pineapple, mango, grapes, custard apple, papaya and jackfruit. Whereas, fruits to include are apple, pear, citrus fruits, strawberry, peach, grapefruit, plum and pomegranate.

Even low-glycemic index fruits can increase blood sugar levels if consumed in large quantities. Fruits can be combined with good dietary fat and protein sources such as curd or nuts to stabilize blood glucose levels. Incorporating fruits into a diabetic diet can be beneficial when chosen wisely and consumed in prescribed amounts.

Rima Ved

Myth: Gestational Diabetes Mellitus affects women during pregnancy and has no long-term impact.

Fact: Gestational diabetes mellitus (GDM) is associated with long-term metabolic concerns and increased risk of pregnancy problems for the mother and her child. Gestational diabetes mellitus is diagnosed when random blood glucose levels are elevated based on predetermined thresholds (≥200 mg/dL for non-fasting, ≥92 mg/dL for fasting). A cross-sectional study analyzed the fourth National Family Health Survey (NFHS) included 32,428 women

between the ages of 15 and 49 years. They found significant variation in the frequency of GDM by geographic state of residence, individual socioeconomic, demographic and clinical characteristics. The prevalence of GDM increases with an increase in age and body mass index.

Insulin resistance and glucose intolerance are diagnosed first in pregnancy to characterize GDM. In women with GDM, within 5 years of delivery, up to 50% of women progress to Type 2 diabetes mellitus (T2DM). Hence, GDM is one of the strongest risk factors for T2DM. In a meta-analysis, 675,455 women were followed up for 28 years. It showed that the risk of developing T2DM is more than seven times higher for women with GDM as compared to those who did not have GDM.

Chronic diseases such as liver disease, stroke and cardiovascular disease are more common post GDM. Some of the maternal adverse effects in women with GDM include chronic kidney disease, cancer and many more. The pooled analysis of several cohort studies showed that women with previous GDM had a 1.74-fold higher risk of CVD than those without. Another meta-analysis in 2019 by Caroline et al., reported that pregnant women with GDM have a twofold increased risk of cardiovascular events after giving birth. Other long term follow-up studies show women with GDM had a higher chance of having elevated eGFR scores at 9–16 years after giving birth, which may lead to early glomerular hyper-filtration and renal injury. There is also a significant association of GDM between cancer - ovarian, endometrial, breast and pancreatic cancer.

Some of the fetal adverse effects in women with GDM include obesity, glucose intolerance, endocrine morbidity, cardiovascular morbidity, neurodevelopment morbidity, congenital abnormalities and several other complications. A recent meta-analysis in 2019 by Zhao et al. combined nine studies with 7,218,903 participants and documented that the child of diabetic mother had increased risk of attention-deficit or hyperactivity disorder. Furthermore, children of mothers with a history of GDM are at least five times more likely to experience reduced glucose tolerance. Many studies have also shown an association between maternal abnormal glucose levels during pregnancy and adiposity in childhood. Therefore, GDM not only impacts women during pregnancy but also has long-term effects on the health of the offspring.

Tanvi Gala

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(For eligibility criteria: Check Website www.diabeteseducatorsindia.com)
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- Update my knowledge and skills
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