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Role of Medical Nutrition Therapy in Gestational Diabetes Mellitus: A Review

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Abstract: ***Gestational diabetes mellitus (GDM), characterized by hyperglycemia during pregnancy, has become a significant health concern for women and is increasingly recognized as a major public health issue in India. Timely detection and strict control of blood glucose levels are essential to improving maternal and neonatal outcomes. Initial management relies on lifestyle modifications, primarily medical nutrition therapy (MNT) along with physical activity. If these measures do not achieve the desired glycemic targets, pharmacological interventions such as insulin are introduced. Consistent monitoring of blood glucose and maintaining records are vital to support treatment adherence and assess effectiveness. MNT in GDM refers to a structured meal plan with controlled carbohydrate intake, designed to provide adequate nutrition, ensure healthy weight gain, and promote both maternal and fetal well-being, while preventing ketosis and achieving normal blood glucose. Emphasis is placed on nutrient-rich carbohydrate sources with low-to-moderate glycemic index and load, as well as the proper quantity and distribution of carbohydrates across meals to reduce postprandial spikes, which represent one of the key challenges in GDM management. Due to increased insulin resistance in the morning, often related to the dawn phenomenon, maintaining glucose control can be difficult at breakfast. Splitting the morning meal has shown effectiveness in lowering post-breakfast glucose levels. This article consolidates evidence from current guidelines and scientific studies on dietary management in GDM, with the objective of achieving normoglycemia, safeguarding maternal and fetal health, and reducing pregnancy-related complications. Literature was sourced from databases including PubMed, Google Scholar, and the Cochrane Database of Systematic Reviews using relevant search terms.***

Keywords: MNT, GDM, Hyperglycemia, maternal fetal

1. Introduction

Gestational diabetes mellitus (GDM), also known as hyperglycemia in pregnancy (HIP), is defined as "glucose intolerance that is first detected or recognized during pregnancy." According to the *International Diabetes Federation (IDF) Atlas, 9th edition, 2019*, there has been a steep global rise in the prevalence of HIP, with GDM alone contributing to nearly 83.6% of cases. In India, the prevalence of GDM is alarmingly high, ranging from 3.8% to 17.9%, which is considerably higher than that reported in Western countries.

The IDF's Women in India with GDM Strategy (WINGS) project, undertaken between 2013 and 2014 in both urban clinics in Chennai and rural antenatal clinics in Tamil Nadu, showed *no significant urban–rural difference* in GDM prevalence. This highlights the growing burden even in rural areas and emphasizes the need to screen all pregnant women regardless of symptoms. Creating awareness and implementing preventive strategies are therefore critical.

Glycemic Goals

Achieving glycemic control in pregnancy is central to reducing complications and ensuring healthy birth outcomes. The primary goal is to maintain the infant's birth weight within normal range for gestational age, which also lowers the child's future risk of non-communicable diseases. Early diagnosis and maintaining maternal glucose levels comparable to those in normal pregnancy significantly lowers adverse outcomes.

The following targets are recommended: HbA1c ≤6% without episodes of hypoglycemia, fasting plasma glucose ≤90 mg/dL (5.0 mmol/L), 1-hour post-meal ≤140 mg/dL (7.8 mmol/L), and 2-hour post-meal ≤120 mg/dL (6.7 mmol/L). Women with GDM should check blood glucose at least four times daily—fasting and after meals. [[6–8]]

Use of continuous glucose monitoring (CGM), along with self-monitoring of blood glucose (SMBG), has proven beneficial in achieving glycemic targets during pregnancy. Recent studies further suggest that stricter goals may improve pregnancy outcomes for women with GDM. The emphasis should be on increasing *time in range* while reducing glycemic fluctuations and time spent in hyperglycemia. However, clear consensus on precise CGM-based targets for women with GDM is still lacking (see **Figure 1** and **Table 1**).

Medical Nutrition Therapy (MNT)

The *American Diabetes Association (ADA) 2021* underscores lifestyle interventions as a crucial component in GDM management. National and international consensus guidelines recommend medical nutrition therapy (MNT) combined with appropriate weight management and physical activity (PA) as the cornerstone of treatment. A Cochrane review confirmed that lifestyle measures—MNT, PA, and SMBG—were the only interventions consistently associated with positive maternal and neonatal health outcomes.

Women diagnosed with GDM should be promptly referred to a trained dietitian for individualized meal planning. Moderate physical activity (at least 30 minutes/day) is also recommended. Lifestyle modification alone is effective for achieving glycemic control in 70–85% of GDM cases. If glucose levels remain above target, insulin or other medications are indicated.

The WINGS Model of Care demonstrated that structured counseling and regular follow-up improved outcomes. The protocol involves two weeks of MNT following diagnosis, after which fasting blood glucose (FBG) and postprandial glucose (PPBG) are measured. If FBG remains <90 mg/dL or 1-hour PPBG <140 mg/dL or 2-hour PPBG <120 mg/dL, MNT is continued. If values exceed targets, initiation of insulin is recommended.

MNT is described as a **carbohydrate-controlled meal plan** that ensures adequate maternal nutrition, fetal health, appropriate weight gain, and prevention of ketosis, while considering cultural dietary patterns. [[16–19]] Monitoring weight gain is important to evaluate nutritional adequacy, and recommendations are outlined in **Table 2**.

For twin pregnancies, the *Institute of Medicine (IOM)* recommends 16.8–24.5 kg for normal-weight women, 14.1–22.7 kg for overweight women, and 11.3–19.1 kg for obese women. Interventions to prevent excessive weight gain should begin as early as the first trimester.

Energy Recommendations

Dietary energy intake should meet the requirements for fetal growth and maternal well-being without leading to excessive maternal weight gain or post-meal hyperglycemia. Energy needs vary by pre-pregnancy body weight, stage of gestation, glucose levels, and physical activity.

The *ICMR-National Institute of Nutrition (2020)* advises no additional calories in the first trimester and an extra 350 kcal/day for the second and third trimesters. Adjustments in energy recommendations according to pre-pregnancy BMI are summarized in **Table 3**.

For obese women, modest calorie restriction (about 30–33% reduction or daily intake of 1600–1800 kcal) is effective for controlling blood glucose and weight gain without inducing ketosis. Severe restriction (<1500 kcal/day or >50% reduction) is inadvisable as it increases the risk of ketosis, which has been linked with impaired neurodevelopment in offspring.

In multiple gestations, energy requirements are higher. Women carrying twins require an average additional intake of 700 kcal/day during the second and third trimesters compared to the first. Luke et al. recommend 20% of calories from protein, 40% from low glycemic index (GI) carbohydrates, and 40% from fats. Adequate protein intake is critical to ensure normal fetal growth in twin pregnancies. [[24–26]]

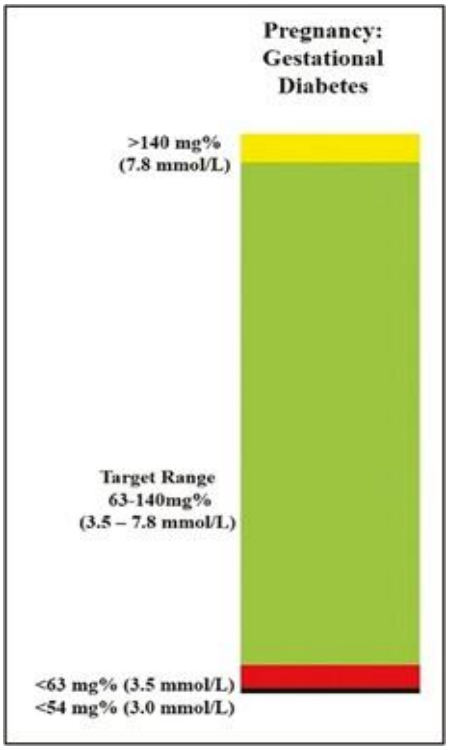

Figure 1: Example CGM Glucose Patterns in GDM

Description:

The following graph illustrates daily interstitial glucose levels in pregnant women, comparing those with normal glucose regulation versus those with gestational diabetes. Glucose levels are lowest in the early morning (around 6 am), rise after breakfast and peak mid-day, and show a second, smaller rise in the evening. Women with GDM have higher and more variable glucose profiles compared to those without GDM.

Table 1: Glycemic Targets for Gestational Diabetes Management

Parameter	Tighter Target	Standard Target	Reference Range
Fasting plasma glucose	≤ 90 mg/dL (≤ 5.0 mmol/L)	< 99 mg/dL (< 5.5 mmol/L)	70–99 mg/dL
1-hour postprandial glucose	≤ 133 mg/dL (≤ 7.4 mmol/L)	< 144 mg/dL (< 8.0 mmol/L)	< 140 mg/dL
2-hour postprandial glucose	≤ 121 mg/dL (≤ 6.7 mmol/L)	≤ 126 mg/dL (≤ 7.0 mmol/L)	< 120 mg/dL
HbA1c	≤ 6.0%	-	< 6.5%
Time In Range (CGM)	≥ 70% (63–140 mg/dL)	-	-

Women should monitor blood glucose four times daily: fasting and after meals.

Table 2: Recommended Gestational Weight Gain According to Prepregnancy BMI (IOM/WHO Guidelines)

Pre- pregnancy BMI Category	Recommended Total Weight Gain	Rate of Gain (2nd/3rd trimester)
Underweight (<18.5 kg/m²)	12.5–18 kg	0.44–0.58 kg/week
Normal (18.5–24.9 kg/m²)	11.5–16 kg	0.35–0.50 kg/week
Overweight (25–29.9 kg/m²)	7–11.5 kg	0.23–0.33 kg/week
Obese (≥30 kg/m²)	5–9 kg	0.17–0.27 kg/week
Twin – Normal BMI	16.8–24.5 kg	-
Twin – Overweight	14.1–22.7 kg	-
Twin – Obese	11.3–19.1 kg	-

Table 3: Energy Requirements for Pregnant Women (ICMR-NIN 2020/WHO)

Pregnancy Trimester	Additional Energy Needed Above Adult Requirement
First	None
Second	+350 kcal/day
Third	+350 kcal/day
Twin Pregnancy	+700 kcal/day (2nd & 3rd trimesters)

Example calculation:
A sedentary pregnant woman (2nd trimester, height 153 cm, pre-pregnancy weight 54 kg)
BMI = 23.06 (normal),
Total energy requirement = Basal Metabolic Rate × Physical Activity Level + Pregnancy increment
= 1213 kcal × 1.53 + 350 kcal = 2206 kcal/day

Maintaining optimal post-meal blood glucose levels is the cornerstone of GDM management, and carbohydrates play a crucial role since they have the strongest impact on these levels. The rise in blood glucose after eating depends on the type, quantity, and absorption rate of carbohydrates in foods consumed.

Carbohydrate intake should be personalized based on individual energy requirements, glycemic targets, and pre-meal glucose readings. Indian guidelines recommend a minimum daily intake of 175 grams of carbohydrates during pregnancy to support both maternal and fetal needs, especially proper brain development in the fetus. Most international recommendations suggest that 33–45% of total calories should come from carbohydrate sources, distributed throughout the day as three main meals and two to four snacks. This pattern helps manage hunger, moderates post-meal blood sugar spikes, and leads to better pregnancy outcomes for women with GDM.

For optimal blood sugar control, nutrient-rich carbohydrates such as non-starchy vegetables, whole fruits, dairy, pulses, sprouts, and whole grains (barley, oats, millets) should be preferred over refined products like polished rice, white bread, sugary foods, and processed snacks.

Fiber is important for both maternal health and glycemic regulation. A daily intake of 25–40 grams of fiber, preferably from whole grains, beans, vegetables, and fruit, is recommended to improve satiety, support digestion, and stabilize blood glucose.
To counter increased insulin resistance seen in the morning due to the 'dawn phenomenon,' a lower carbohydrate, higher-protein breakfast is advised. Splitting carbohydrates across two smaller morning meals can prevent excessive post-breakfast glucose rises. For breakfast, opt for whole grains and protein-rich Indian dishes (such as paneer wraps, pesarattu, dal dosa) and avoid refined flour-based foods. The daily carbohydrate distribution: 10–20% at breakfast (split into two portions two hours apart), 30% each at lunch and dinner, and 10% at each of two snacks. Eating smaller portions at regular intervals helps the body handle carbohydrates better, requiring less insulin and reducing blood sugar swings.

If women with GDM do not reach glycemic targets through diet alone, insulin therapy may be necessary. Rapid-acting insulin can be used before meals with high postprandial glucose, and basal insulin introduced if fasting values remain elevated. Carbohydrate counting, hypoglycemia management, and diligent record-keeping of food intake, activity, and medication are essential for all women using insulin.

Pregnancy raises protein needs for fetal, placental, and maternal tissue growth. Most guidelines recommend that protein makes up about 20% of daily calories, with 1.1 grams per kilogram of ideal body weight (about 60–70 grams/day). High-quality protein from curd, paneer, eggs, pulses, fish, and chicken should be included at each meal. Increasing the ratio of pulses to cereals in the diet (from 1:7 to 1:5 or 1:3 in later trimesters) enhances protein quality. Mixing pulse flour into chapatti flour is a simple way to improve both protein and fiber intake while lowering glycemic index.

Low glycemic index (GI) meals lower not only the immediate post-meal glucose rise but also blunt the increase after subsequent meals. Adding low-GI, protein-rich foods at breakfast, such as eggs, yogurt, or nuts, helps control blood sugar and increase satiety. Eating protein and fiber-rich items before carbohydrates in a meal can further moderate the post-meal glucose spike.

For fats, 35–40% of daily calories is recommended, with at least 20% as a baseline. Unsaturated fats (omega-3, omega-6, and MUFA) from vegetable oils, fish, nuts, and seeds should predominate, while saturated and trans fats from processed foods should be limited. A daily intake of at least 200 mg DHA and regular consumption of low-mercury fatty fish (350 g/week, 200 g as fatty fish) is beneficial for maternal and fetal health. Nuts are a good choice, offering MUFA, protein, fiber, and antioxidants, and may help improve glycemic control if used to replace starchy, sugary snacks.

Sugar substitutes like sucralose and stevia are considered safe during pregnancy, while saccharin should be avoided. There's limited evidence about the long-term effects of artificial sweeteners on gut microbiota, so they should only be used sparingly.
Probiotic supplementation may improve glucose and lipid metabolism, but results are mixed and depend on factors such as strain and quality used.

There are no major differences in micronutrient needs between women with normal pregnancies and those with GDM, but some nutrients require increased intake. Calcium (1.2 g/day), iron (30–60 mg elemental iron/day), and folic acid (~600 µg/day) are especially important, while excess iron could potentially raise the risk of GDM.

Postpartum Care
After delivery, most women who had GDM return to normal blood glucose levels. However, they remain at higher risk for developing GDM in future pregnancies and face a significantly increased likelihood—up to tenfold—of later developing type 2 diabetes. This period presents a unique chance to implement preventive measures for diabetes.

Despite its importance, global rates of postpartum diabetes screening are low. Current recommendations advise women

with a history of GDM to undergo a 2-hour, 75-gram oral glucose tolerance test (OGTT) between six and twelve weeks after giving birth. Regular screening for prediabetes and diabetes should then continue every one to three years.

Innovative reminder strategies, including phone calls, messages, and email, can greatly enhance adherence to follow-up and testing, as shown in recent studies. Structured, proactive systems using mobile technology have demonstrated high rates of postpartum follow-up and testing success.

Lifestyle changes initiated in the postpartum period can be highly effective for preventing or delaying the development of diabetes among women with higher risks due to GDM.

2. Conclusion

Providing comprehensive dietary advice and counseling is essential for every woman who has experienced GDM. The foundation of effective management is sustained lifestyle modification—specifically, following a tailored meal plan that meets pregnancy's increased nutritional demands, achieves stable blood sugar levels, and avoids nutritional ketosis.

A focus on selecting suitable types, portions, and timing of carbohydrate consumption is critical to controlling blood glucose after meals. Other key strategies include engaging in at least 30 minutes of moderate exercise daily, performing regular blood sugar self-checks, and keeping accurate records. These measures can improve adherence and help deliver the best pregnancy outcomes.

Lastly, ongoing screening and continued lifestyle changes after pregnancy are vital to reducing or postponing the onset of type 2 diabetes, supporting both immediate and long-term health for mothers and their children.

"Now is the time to prioritize the health of the next generation."

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