RESEARCH PAPER

Effectiveness of Medical Nutrition Therapy in Improving Glycemic Outcomes in Overt Diabetes Mellitus and Gestational Diabetes Mellitus: A Prospective Interventional Study

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ABSTRACT

Introduction: Hyperglycemia in pregnancy, including gestational diabetes mellitus (GDM) and overt diabetes mellitus, is associated with significant maternal and fetal complications. Medical nutrition therapy (MNT) is recommended as first-line management; however, comparative data on its effectiveness in GDM and overt diabetes are limited. This study evaluated the impact of meal nutrition therapy on glycemic parameters in both conditions.

Methodology: A prospective interventional study was conducted among 200 antenatal women diagnosed with hyperglycemia during pregnancy at a tertiary care center in Chennai. Of these, 150 had GDM and 50 had overt diabetes. Baseline fasting blood sugar (FBS) and two-hour postprandial blood sugar (PPBS) levels were recorded. All participants received individualized meal nutrition therapy, and post-intervention glycemic values were reassessed. Statistical analysis was performed to compare pre- and post-intervention outcomes.

Results: Baseline mean FBS and PPBS were significantly higher in the overt diabetes group (138.4 ± 14.2 mg/dL and 242.6 ± 28.7 mg/dL) compared to the GDM group (104.6 ± 8.5 mg/dL and 156.8 ± 18.4 mg/dL; $p < 0.001$). Following MNT, significant reductions were observed in both groups ($p < 0.001$). Target FBS was achieved in 84% of GDM and 56% of overt diabetes patients. Additional pharmacotherapy was required in 16% of GDM and 44% of overt diabetes cases.

Conclusion: Meal nutrition therapy significantly improves glycemic control in both GDM and overt diabetes, with greater target achievement in GDM, reinforcing its role as cornerstone management in hyperglycemia during pregnancy.

Keywords: Gestational diabetes mellitus; Overt diabetes mellitus; Hyperglycemia in pregnancy; Glycemic control; Fasting blood sugar; Postprandial blood sugar; Pregnancy outcomes.

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Introduction

Hyperglycemia in pregnancy (HIP), which includes gestational diabetes mellitus (GDM) and overt diabetes first recognized during pregnancy, is one of the most common metabolic disorders complicating gestation worldwide. Recent global estimates indicate that approximately one in six pregnancies is affected by some degree of hyperglycemia, reflecting a substantial and growing public health burden [1]. The increasing prevalence is attributed to rising maternal age, obesity, sedentary lifestyle, and genetic predisposition. HIP significantly contributes to maternal and neonatal morbidity, particularly in low- and middle-income countries.

Gestational diabetes mellitus is defined as glucose intolerance first detected during pregnancy that does not meet criteria for overt diabetes outside pregnancy [2]. In contrast, overt diabetes in pregnancy refers to hyperglycemia meeting standard non-pregnant diagnostic thresholds and is associated with more severe metabolic derangements [3]. Women with overt diabetes are at higher risk for adverse outcomes including congenital anomalies, preeclampsia, macrosomia, neonatal hypoglycemia, and long-term metabolic disorders in offspring [3,4]. Even GDM, though often transient, is strongly associated with increased risk of cesarean delivery, birth trauma, and

future development of type 2 diabetes in both mother and child [5].

The pathophysiology of HIP involves progressive insulin resistance mediated by placental hormones such as human placental lactogen, progesterone, cortisol, and growth hormone, combined with inadequate pancreatic β-cell compensation [6]. Nutritional status and dietary patterns play a critical role in modulating glycemic responses during pregnancy. Carbohydrate quantity, quality, and distribution directly influence fasting and postprandial glucose levels, which are key determinants of maternal and fetal outcomes [7].

Medical nutrition therapy (MNT) is universally recommended as the first-line management strategy for both GDM and overt diabetes in pregnancy [2,8]. MNT encompasses individualized calorie planning, appropriate macronutrient distribution, glycemic index consideration, meal timing, and patient education. Evidence suggests that dietary interventions focusing on low-glycemic index foods, balanced carbohydrate intake, and adequate protein distribution can significantly improve glycemic control and reduce the need for pharmacotherapy [9,10]. Furthermore, structured nutritional counseling and regular follow-up enhance adherence and optimize metabolic outcomes [11].

Despite its established importance, variability exists in nutritional recommendations across different international guidelines, particularly regarding optimal carbohydrate proportion and meal frequency [8]. Moreover, most studies focus predominantly on GDM, with comparatively limited data evaluating the differential impact of MNT on overt diabetes diagnosed during pregnancy. Given the higher baseline glycemic levels and metabolic severity in overt diabetes, response to dietary therapy may differ compared to GDM.

Recent literature emphasizes the growing importance of precision nutrition and individualized dietary strategies in managing pregnancy-related hyperglycemia [12]. Understanding the comparative effectiveness of meal-based nutritional interventions in overt and gestational diabetes is therefore clinically relevant.

The present study aims to evaluate the impact of meal nutrition therapy on fasting blood sugar (FBS) and two-hour postprandial blood sugar (PPBS) levels among pregnant women diagnosed with overt diabetes mellitus and gestational diabetes mellitus, thereby contributing to evidence-based optimization of dietary management in hyperglycemia during pregnancy.

Aim of the Study

To evaluate the effectiveness of medical nutrition therapy (MNT) in improving glycemic outcomes among antenatal women diagnosed with gestational diabetes mellitus (GDM) and overt diabetes mellitus.

Objectives of the Study

Primary Objectives:

- To assess the change in fasting blood sugar (FBS) levels before and after medical nutrition therapy in women with GDM and overt diabetes mellitus.
- To evaluate the change in two-hour postprandial blood sugar (PPBS) levels before and after medical nutrition therapy in both groups.

Secondary Objectives:

- To compare the effectiveness of medical nutrition therapy between gestational diabetes mellitus and overt diabetes mellitus.
- To determine the proportion of patients achieving target glycemic control after implementation of medical nutrition therapy.
- To assess the requirement of additional pharmacotherapy in both groups following medical nutrition therapy.
- To analyze the association of demographic and clinical factors (age, BMI, parity, family history) with glycemic outcomes.

Methodology

A prospective interventional study was conducted at Saveetha Medical College and Hospital in Chennai among antenatal women attending the outpatient department of Obstetrics and Gynecology in collaboration with the Department of General Medicine. The study was designed to evaluate the impact of meal nutrition therapy (MNT) on the glycemic profile of pregnant women diagnosed with overt diabetes mellitus (DM) and gestational diabetes mellitus (GDM). Ethical approval was obtained from the Institutional Ethics Committee prior to commencement of the study. Written informed consent was obtained from all participants. Confidentiality and privacy of patient data were strictly maintained throughout the study period. A total sample size of 200 antenatal women diagnosed with hyperglycemia during pregnancy was included in the study. Pregnant women aged more than 18 years who met the diagnostic criteria for hyperglycemia in pregnancy were enrolled after obtaining informed consent. Participants were categorized into two groups based on their diagnosis. Women diagnosed with gestational diabetes mellitus had fasting blood sugar (FBS) levels ≥92 mg/dL and/or two-hour postprandial blood sugar

(PPBS) levels ≥120 mg/dL. Women diagnosed with overt diabetes mellitus had fasting blood sugar ≥126 mg/dL and/or two-hour postprandial blood sugar ≥200 mg/dL at the time of evaluation.

Baseline demographic details, obstetric history, and clinical parameters were recorded at enrollment. Initial fasting and two-hour postprandial blood glucose levels were measured prior to initiation of meal nutrition therapy. These baseline values were documented for comparison with post-intervention values.

All enrolled participants received structured meal nutrition therapy as the primary intervention. The dietary plan was individualized according to caloric requirements, gestational age, and glycemic status. The nutrition therapy focused on appropriate carbohydrate distribution throughout the day, reduction of simple sugars and refined carbohydrates, increased intake of dietary fiber, adequate protein supplementation, and balanced fat consumption. Emphasis was placed on portion control, meal timing, and consumption of low glycemic index foods to minimize postprandial glucose excursions. Patients received dietary counseling and education regarding adherence to prescribed meal plans.

Participants were followed up periodically, and repeat fasting and two-hour postprandial blood glucose levels were measured after implementation of meal nutrition therapy. The primary outcome measure was the change in fasting blood sugar and postprandial blood sugar levels before and after the intervention. The mean reduction in glycemic values was calculated separately for women with gestational diabetes and those with overt diabetes.

Data were entered into a structured database and analyzed using descriptive statistical methods. Continuous variables such as blood glucose levels were expressed as mean values and standard deviations. The difference between pre-intervention and post-intervention glycemic values was assessed to determine the effectiveness of meal nutrition therapy. Comparative analysis was performed between the GDM and overt diabetes groups to evaluate differential response to the intervention.

Results

The present was conducted among 200 antenatal women attending a tertiary care center in Chennai. Among them, 150 women (75%) were diagnosed with Gestational Diabetes Mellitus (GDM), while 50 women (25%) were diagnosed with overt diabetes mellitus. (Table 1)

Table 1: Distribution of Study Participants

Diagnosis Group	Number (n)	Percentage (%)
Gestational Diabetes Mellitus (GDM)	150	75
Overt Diabetes Mellitus	50	25
Total	200	100

32% of women with GDM were aged 18–25 years compared to 16% in the overt diabetes group. In the 26–30 year age group, 41.3% had GDM and 32% had overt diabetes. Among women aged 31–35 years, 20% had GDM and 28% had overt diabetes. Notably, 24% of women with overt diabetes were older than 35 years compared to only 6.7% in the GDM group. The mean age was significantly higher in the overt diabetes group (31.8 ± 5.1 years) compared to the GDM group (28.4 ± 4.3 years), with a p-value of 0.021, indicating a statistically significant association.

53.3% of women with GDM were primigravida compared to 36% in the overt diabetes group. Multigravida women constituted 46.7% of the GDM group and 64% of the overt diabetes group. However, this difference was not statistically significant (p = 0.087). When body mass index (BMI) was analyzed, 33.3% of women with GDM had normal BMI compared to 20% in the overt diabetes group. Overweight women constituted 45.3% in the GDM group and 40% in the overt diabetes group. Obesity (BMI ≥30 kg/m²) was more common in the overt diabetes group (40%) compared to the GDM group (21.3%), although this difference was not statistically significant (p = 0.095).

Socioeconomic status distribution was similar in both groups. Lower socioeconomic status was seen in 26.7% of GDM and 24% of overt diabetes cases. Middle socioeconomic status constituted 56% in both groups, and upper socioeconomic status was seen in 17.3% of GDM and 20% of overt diabetes cases (p = 0.725). A family history of diabetes was present in 44% of women with GDM and 52% of women with overt diabetes (p = 0.317). (Table 2)

Table 2: Socio-Demographic Characteristics of Study Participants (n = 200)

Variable	GDM (n=150)	Overt DM (n=50)	Total (n=200)	p-value
Age (years)				
18–25	48 (32%)	8 (16%)	56 (28%)	0.035 *

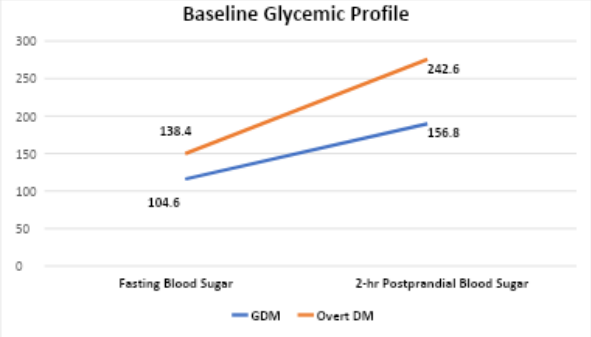
26–30	62 (41.3%)	16 (32%)	78 (39%)	
31–35	30 (20%)	14 (28%)	44 (22%)	
>35	10 (6.7%)	12 (24%)	22 (11%)	
Mean Age (years)	28.4 ± 4.3	31.8 ± 5.1	29.3 ± 4.8	0.021 *
Parity				
Primigravida	80 (53.3%)	18 (36%)	98 (49%)	0.087
Multigravida	70 (46.7%)	32 (64%)	102 (51%)	
Body Mass Index (kg/m²)				
Normal (18.5–24.9)	50 (33.3%)	10 (20%)	60 (30%)	0.095
Overweight (25–29.9)	68 (45.3%)	20 (40%)	88 (44%)	
Obese (≥30)	32 (21.3%)	20 (40%)	52 (26%)	
Socioeconomic Status				
Lower	40 (26.7%)	12 (24%)	52 (26%)	0.725
Middle	84 (56%)	28 (56%)	112 (56%)	
Upper	26 (17.3%)	10 (20%)	36 (18%)	
Family History of Diabetes				
Present	66 (44%)	26 (52%)	92 (46%)	0.317
Absent	84 (56%)	24 (48%)	108 (54%)	

At baseline, the mean fasting blood sugar (FBS) in the GDM group was 104.6 ± 8.5 mg/dL, whereas it was significantly higher at 138.4 ± 14.2 mg/dL in the overt diabetes group ($p < 0.001$). Similarly, the mean two-hour postprandial blood sugar (PPBS) was 156.8 ± 18.4 mg/dL in the GDM group and 242.6 ± 28.7 mg/dL in the overt diabetes group ($p < 0.001$), indicating markedly higher glycemic levels in overt diabetes. (Table 3, Figure 1)

Table 3: Baseline Glycemic Profile of Study Participants

Parameter	GDM (n=150) Mean ± SD	Overt DM (n=50) Mean ± SD	p-value
Fasting Blood Sugar (mg/dL)	104.6 ± 8.5	138.4 ± 14.2	<0.001*
2-hr Postprandial Blood Sugar (mg/dL)	156.8 ± 18.4	242.6 ± 28.7	<0.001*

Figure 1: Baseline Glycemic Profile



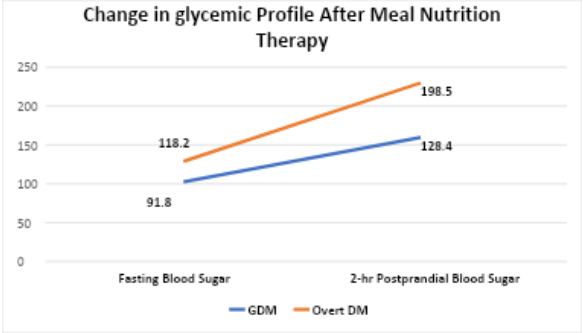
After meal nutrition therapy, significant reductions were observed in both groups. The mean FBS decreased to 91.8 ± 6.4 mg/dL in the GDM group and to 118.2 ± 12.6 mg/dL in the overt diabetes group ($p < 0.001$). The mean PPBS decreased to 128.4 ± 14.7 mg/dL in GDM and to 198.5 ± 24.3 mg/dL in overt diabetes ($p < 0.001$). (Table 4, Figure 2)

Table 4: Post-Intervention Glycemic Profile After Meal Nutrition Therapy

Parameter	GDM (n=150) Mean ± SD	Overt DM (n=50) Mean ± SD	p-value
Fasting Blood Sugar (mg/dL)	91.8 ± 6.4	118.2 ± 12.6	<0.001*

2-hr Postprandial Blood Sugar (mg/dL)	128.4 ± 14.7	198.5 ± 24.3	<0.001*

Figure 2: Change in Glycemic Profile After Meal Nutrition Therapy

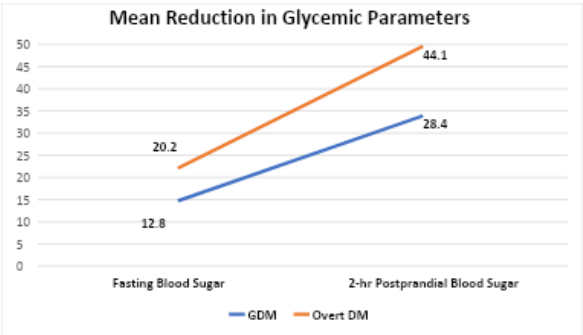


The mean reduction in fasting blood sugar was 12.8 ± 5.2 mg/dL in the GDM group compared to 20.2 ± 8.4 mg/dL in the overt diabetes group ($p < 0.001$). Similarly, the mean reduction in postprandial blood sugar was 28.4 ± 10.6 mg/dL in GDM and 44.1 ± 15.8 mg/dL in overt diabetes ($p < 0.001$), showing a greater absolute reduction in the overt diabetes group. (Table 5, Figure 3)

Table 5: Mean Reduction in Glycemic Parameters After Meal Nutrition Therapy

Parameter	GDM (Mean Reduction ± SD)	Overt DM (Mean Reduction ± SD)	p-value
Fasting Blood Sugar (mg/dL)	12.8 ± 5.2	20.2 ± 8.4	<0.001*
2-hr Postprandial Blood Sugar (mg/dL)	28.4 ± 10.6	44.1 ± 15.8	<0.001*

Figure 3: Mean Reduction in Glycemic Parameters After Meal Nutrition Therapy



Regarding target achievement, 84% of women with GDM achieved target fasting blood sugar compared to 56% in the overt diabetes group ($p < 0.001$). Target postprandial blood sugar was achieved in 78.7% of GDM patients compared to 44% of overt diabetes patients ($p < 0.001$). Additionally, 16% of women with GDM required additional pharmacotherapy, whereas 44% of women with overt diabetes required further medical treatment ($p < 0.001$). (Table 6)

Table 6: Proportion of Patients Achieving Target Glycemic Control After Intervention

Outcome	GDM (n=150)	Overt DM (n=50)	p-value
Achieved Target FBS	126 (84)	28 (56)	<0.001
Achieved Target PPBS	118 (78.7)	22 (44)	<0.001
Required Additional Pharmacotherapy	24 (16)	22 (44)	<0.001

Discussion

The present study evaluated the impact of meal nutrition therapy (MNT) on glycemic parameters among antenatal women diagnosed with gestational diabetes mellitus (GDM) and overt diabetes mellitus. Out of 200 participants, 75% had GDM and 25% had overt diabetes, which is consistent with global epidemiological data indicating that GDM is more prevalent than overt diabetes in pregnancy [1]. The higher proportion of GDM in our study reflects the broader burden of hyperglycemia in pregnancy reported in international estimates.

Maternal age showed a significant association with overt diabetes in our study. The mean age in the overt diabetes group was 31.8 ± 5.1 years compared to 28.4 ± 4.3 years in the GDM group ($p = 0.021$). A higher percentage of women aged >35 years were observed in the overt diabetes group (24%) compared to the GDM group (6.7%). This finding aligns with the observations of Goyal et al. [3], who reported that increasing maternal age is strongly associated with overt diabetes and more severe hyperglycemia during pregnancy. Similarly, the American Diabetes Association emphasizes advanced maternal age as a significant risk factor for overt diabetes diagnosed during pregnancy [2].

Although obesity was more prevalent in the overt diabetes group (40%) compared to the GDM group (21.3%), the association did not reach statistical significance ($p = 0.095$). Previous literature has consistently demonstrated a strong link between obesity and both GDM and overt diabetes [6,7]. Buchanan and Xiang [6] described obesity as a major

contributor to insulin resistance during pregnancy, thereby increasing the risk of severe hyperglycemia. The lack of statistical significance in our study may be attributed to sample size distribution, particularly the smaller overt diabetes group.

Baseline glycemic values were significantly higher in the overt diabetes group, with mean fasting blood sugar (FBS) of 138.4 ± 14.2 mg/dL compared to 104.6 ± 8.5 mg/dL in GDM ($p < 0.001$). Similarly, mean postprandial blood sugar (PPBS) was 242.6 ± 28.7 mg/dL in overt diabetes versus 156.8 ± 18.4 mg/dL in GDM ($p < 0.001$). These findings are consistent with diagnostic thresholds defined by the American Diabetes Association [2] and clinical observations reported by Metzger et al. [4], which highlight that overt diabetes presents with more severe metabolic derangements compared to GDM.

Following meal nutrition therapy, both groups demonstrated statistically significant reductions in glycemic parameters. In the GDM group, mean FBS reduced from 104.6 mg/dL to 91.8 mg/dL, and PPBS reduced from 156.8 mg/dL to 128.4 mg/dL ($p < 0.001$). In the overt diabetes group, FBS decreased from 138.4 mg/dL to 118.2 mg/dL, and PPBS decreased from 242.6 mg/dL to 198.5 mg/dL ($p < 0.001$). These results corroborate findings from Yamamoto et al. [10], who demonstrated significant improvements in maternal glucose levels with structured dietary interventions in GDM. Similarly, Wei et al. [7] emphasized that individualized MNT effectively reduces both fasting and postprandial glucose levels in pregnancy.

Interestingly, the mean reduction in glycemic values was greater in the overt diabetes group, with FBS reduction of 20.2 ± 8.4 mg/dL and PPBS reduction of 44.1 ± 15.8 mg/dL, compared to 12.8 ± 5.2 mg/dL and 28.4 ± 10.6 mg/dL in the GDM group ($p < 0.001$). This greater absolute reduction may be explained by the higher baseline glucose levels, allowing more measurable decline. However, despite greater reductions, a smaller proportion of overt diabetes patients achieved target glycemic control.

In our study, 84% of women with GDM achieved target FBS compared to 56% in the overt diabetes group ($p < 0.001$). Similarly, 78.7% of GDM patients achieved target PPBS compared to 44% of overt diabetes patients. Additionally, 44% of women with overt diabetes required additional pharmacotherapy compared to only 16% in the GDM group. These findings are consistent with Farrar et al. [5], who reported that while dietary therapy is effective as first-line management, a substantial proportion of women—particularly those with more severe hyperglycemia—require pharmacological intervention. Reader [11] also emphasized that MNT is effective in achieving glycemic control in the majority of GDM cases, but overt diabetes often necessitates adjunctive insulin therapy.

Our findings reinforce existing evidence that meal nutrition therapy is an effective first-line intervention for hyperglycemia in pregnancy. While both GDM and overt diabetes benefit significantly from dietary modification, GDM demonstrates higher rates of target achievement with MNT alone. Overt diabetes, though responsive to dietary intervention, frequently requires additional pharmacotherapy due to greater baseline metabolic severity. These results support current guideline recommendations advocating early nutritional counseling and individualized dietary planning as foundational management strategies in hyperglycemia during pregnancy [2,8].

Limitations

This study has certain limitations. It was conducted at a single tertiary care center, which may limit generalizability to other populations. The sample size of the overt diabetes group was relatively small compared to the GDM group, potentially affecting subgroup comparisons. The duration of follow-up was short, and long-term maternal and neonatal outcomes were not assessed. Dietary adherence was based on counseling without objective monitoring tools, which may have influenced the accuracy of evaluating the true impact of meal nutrition therapy.

Future Directions

Future research should focus on long-term maternal and neonatal outcomes following medical nutrition therapy (MNT), including postpartum diabetes risk and offspring health. Large multicentric studies are needed to improve generalizability across diverse populations. Standardization of dietary protocols, including optimal macronutrient distribution and glycemic index-based diets, should be explored. Integration of digital health tools such as mobile applications and continuous glucose monitoring may enhance adherence and glycemic control. Further studies on personalized nutrition, behavioral interventions, and early initiation of MNT are essential. These approaches may optimize management strategies and improve outcomes in gestational and overt diabetes during pregnancy.

Conclusion

The present study demonstrates that meal nutrition therapy (MNT) is an effective first-line intervention for managing hyperglycemia in pregnancy, including both gestational diabetes mellitus (GDM) and overt diabetes mellitus. Significant reductions in fasting blood sugar

and postprandial blood sugar levels were observed in both groups following dietary intervention. Although women with overt diabetes had higher baseline glycemic values and showed greater absolute reductions, a higher proportion of women with GDM achieved target glycemic control with nutrition therapy alone. In contrast, a considerable percentage of women with overt diabetes required additional pharmacotherapy, reflecting greater metabolic severity. Maternal age was significantly associated with overt diabetes, emphasizing the importance of early screening in older pregnant women. Overall, individualized meal planning, dietary counseling, and structured follow-up play a crucial role in optimizing glycemic outcomes and should remain the cornerstone of management in hyperglycemia during pregnancy.

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