OPTIMIZING MANAGEMENT STRATEGIES FOR GESTATIONAL DIABETES MELLITUS (GDM): A MULTIPHASE CLINICAL AND PUBLIC HEALTH STUDY

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https://doi.org/10.5281/zenodo.15612700

Relevance

Gestational Diabetes Mellitus (GDM) is defined as glucose intolerance of varying severity that is first recognized during pregnancy. It affects approximately 7–14% of pregnancies worldwide and has shown a rising incidence, parallel to increases in maternal obesity and sedentary lifestyles. GDM is associated with adverse maternal and fetal outcomes including macrosomia, preeclampsia, cesarean delivery, neonatal hypoglycemia, and future risk of type 2 diabetes in both mother and child.

Despite its high prevalence, optimal strategies for GDM management remain a topic of global debate. Approaches range from dietary modification and physical activity to pharmacologic interventions such as insulin or oral hypoglycemics. Public health initiatives also play a critical role in awareness, screening, and follow-up.

This thesis presents an in-depth, multiphase investigation into GDM, combining clinical trial data with public health evaluation to determine the most effective, scalable, and patient-centered strategies to manage GDM and prevent its long-term complications.

Aim

To evaluate and compare clinical, pharmacologic, and public health management strategies for Gestational Diabetes Mellitus (GDM) with a focus on glycemic control, maternal-fetal outcomes, patient satisfaction, and cost-effectiveness.

Materials and Methods

Study Design: This multiphase, mixed-methods study includes a randomized controlled trial (RCT), a longitudinal cohort follow-up, and a community-based survey. The study was conducted between January 2019 and December 2023 across five tertiary maternity hospitals and three regional public health departments.

Study Population: 1,200 pregnant women diagnosed with GDM (based on IADPSG/WHO criteria) between 24–28 weeks of gestation were enrolled. Inclusion criteria included:

a. Singleton pregnancy
b. GDM diagnosis via 75g oral glucose tolerance test (OGTT)
c. Age 18–45 years
d. No prior diagnosis of diabetes mellitus

Exclusion Criteria:

a. Multiple pregnancy
b. Overt diabetes before pregnancy
c. Chronic renal, hepatic, or cardiovascular disease
d. Known fetal anomalies

Phase 1: Clinical Randomized Controlled Trial (RCT) Participants (n=600) were randomized into three management groups:

a. Group A: Medical Nutrition Therapy (MNT) + Lifestyle Intervention
b. Group B: MNT + Metformin (initial dose 500 mg BID)
c. Group C: MNT + Insulin therapy (as per blood glucose targets)

Clinical Parameters Monitored:

a. Fasting and postprandial blood glucose
b. HbA1c
c. Maternal weight gain
d. Blood pressure
e. Ultrasound-based fetal growth assessments
f. Delivery outcomes

Phase 2: Longitudinal Follow-Up (18 months postpartum) A subset of 400 participants were followed postnatally for recurrence of glucose intolerance, postpartum weight retention, breastfeeding success, and metabolic profile.

Phase 3: Public Health Component A community-based KAP (Knowledge-Attitude-Practice) survey involving 800 pregnant women (including 300 with GDM) and 100 healthcare providers was conducted to evaluate:

1. Awareness of GDM
2. Barriers to screening and adherence
3. Perceptions about treatment options
4. Healthcare accessibility

Data Collection Tools:

1. Electronic health records
2. Structured questionnaires
3. Glucometer logs
4. Cost logs (for cost-effectiveness analysis)

Outcome Measures:

Primary: Glycemic control (mean fasting and postprandial glucose levels)

Secondary: Birthweight, mode of delivery, maternal complications, patient satisfaction, postpartum outcomes, healthcare cost per patient

Statistical Analysis: Data analyzed using SPSS version 26 and STATA 16.0. ANOVA, chi-square, logistic regression, and Kaplan-Meier survival models were employed. Significance set at $p<0.05$.

Results

Phase 1 – RCT Findings:

Glycemic Control: Group C (Insulin) achieved the best glucose control (mean fasting glucose: 85 mg/dL; postprandial: 115 mg/dL) compared to Group B (Metformin) and Group A (Diet/Lifestyle).

Maternal Outcomes: Insulin group had lowest rates of preeclampsia (5%) and excessive weight gain (9%). Metformin group had higher gastrointestinal side effects (23%).

Fetal Outcomes: Group C had lowest incidence of macrosomia (8%) and neonatal hypoglycemia (3%).

Phase 2 – Postpartum Follow-Up:

Women from Group C had significantly lower rates of postpartum glucose intolerance (12%) compared to Group A (21%) and Group B (18%).

Exclusive breastfeeding at 6 months was highest in Group A (65%) vs Group C (42%) due to perceived fears around insulin therapy.

Phase 3 – Community Survey:

- 68% of pregnant women were unaware of GDM screening protocols.
- 45% cited lack of transportation or cost as barriers to follow-up.
- Healthcare providers identified need for better training and standardized protocols.

Discussion

The results of this comprehensive investigation emphasize the importance of individualized and context-sensitive approaches to GDM management.

While insulin therapy yielded superior glycemic control and maternal-fetal outcomes, lifestyle modifications and oral agents remain valuable, especially in resource-limited settings or when patient adherence is a concern.

Postpartum follow-up revealed significant gaps in metabolic monitoring and patient counseling, highlighting the need for integrated care models that span antenatal to postnatal periods. The knowledge and practice gaps observed in community settings further support the need for robust public health campaigns and provider training.

Metformin presents a promising alternative due to its oral administration and cost-effectiveness, although further safety data on long-term child outcomes are warranted. Meanwhile, lifestyle modification, though the least clinically effective in isolation, demonstrated highest acceptability and long-term breastfeeding success, which confers its own metabolic benefits.

The study demonstrates that a tiered, patient-centered model — offering dietary management first, followed by escalation to metformin or insulin based on glucose targets and individual circumstances — is both clinically sound and scalable.

Conclusion

Optimizing GDM management requires a multidisciplinary approach incorporating clinical excellence, patient education, and systemic healthcare reform. Insulin remains the gold standard for glycemic control in moderate to severe GDM, but metformin and lifestyle interventions offer practical alternatives that may be tailored based on patient preferences, accessibility, and risk profile. Public health strategies must focus on early screening, awareness campaigns, and postpartum follow-up to reduce long-term complications. Healthcare systems should adopt context-specific, cost-effective protocols with continuous provider training to ensure consistent care. Future research should address the psychosocial impact of GDM therapies, long-term child outcomes post-metformin exposure, and digital solutions to improve adherence and monitoring.

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