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Gestational Diabetes and Preeclampsia in Adolescent Pregnancy: Neonatal and Obstetric Outcomes

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Abstract

Background: Adolescent pregnancies complicated by gestational diabetes mellitus (GDM) or preeclampsia represent high-risk scenarios with understudied perinatal implications.

Objectives: To evaluate and compare the impact of gestational diabetes mellitus and preeclampsia on neonatal and obstetric outcomes among pregnant adolescents in a prospective cohort from Baghdad.

Methods: This 6-year prospective cohort study (2019–2025) enrolled 461 pregnant adolescents (≤19 years) stratified into gestational diabetes (GDM) (n=143), preeclampsia (n=157), and healthy controls (n=161). Outcomes were compared separately: GDM vs controls and preeclampsia vs controls using ANOVA, chi-square tests, and multivariate logistic regression.

Results: Versus controls, preeclampsia showed higher preterm birth (aOR=7.1; 95% CI:3.6–14.2), cesarean delivery (aOR=4.6; 95% CI:2.7–7.9), and neonatal intensive care unit (NICU) admission (aOR=4.7; 95% CI:2.4–9.3). GDM demonstrated intermediate risks, preterm birth (aOR=3.3; 95% CI:1.6–6.8) and NICU admission (aOR=2.9; 95% CI:1.5–5.8).

Conclusion: Both conditions independently amplify perinatal risks in adolescents, with preeclampsia conferring the most severe outcomes.

Keywords: Adolescent pregnancy; gestational diabetes mellitus; preeclampsia; perinatal morbidity; prospective cohort study; Iraq.

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INTRODUCTION

Adolescent pregnancy, defined as conception occurring ≤19 years of age, remains a persistent global health challenge accounting for approximately 21 million annual births worldwide[1]. In Iraq, adolescent mothers represent 9.3% of all pregnancies with elevated risks of adverse outcomes due to biological immaturity and healthcare barriers[2]. Physiological adaptations in adolescent pregnancy including ongoing endocrine development and incomplete pelvic growth creating unique vulnerabilities for metabolic and hypertensive disorders[3]. Gestational diabetes mellitus (GDM), characterized by glucose intolerance first diagnosed during pregnancy, affects 7–10% of adolescent pregnancies and potentiates risks of fetal macrosomia, birth trauma, and neonatal hypoglycemia[4-7]. Concurrently, preeclampsia – defined by new-onset hypertension and end-organ dysfunction after 20 weeks' gestation – complicates 5–8% of adolescent pregnancies and drives placental insufficiency, preterm delivery, and intrauterine growth restriction[8-10].

While extensive literature examines these conditions in adult populations, adolescent-specific data remain strikingly limited. The ongoing metabolic and vascular development in teenagers suggests distinct pathophysiological mechanisms: adolescents exhibit 30% higher insulin resistance during pregnancy compared to adults, while their endothelial function demonstrates heightened sensitivity to angiogenic imbalances[11-14]. Current screening paradigms derived from adult studies may fail to detect adolescent-specific manifestations, as evidenced by delayed GDM diagnosis in 38% of teenage pregnancies in Middle Eastern populations[15,16]. Furthermore, the compounded effects of biological immaturity and pathological processes create synergistic risks of adolescent preeclampsia cases demonstrate 2.3-fold higher rates of neonatal complications compared to adult counterparts[17-20].

This critical knowledge gap impedes evidence-based management in regions like Iraq where adolescent pregnancy rates exceed global averages[2,3]. Existing adolescent studies suffer from retrospective designs, inadequate controls, and heterogeneous diagnostic criteria[21]. Our prospective cohort study addresses these limitations through rigorous phenotyping and contemporaneous matched controls. This study aims to determine the independent effects of gestational diabetes mellitus and preeclampsia on perinatal outcomes in adolescent pregnancies, and to compare these outcomes with those of matched healthy adolescent controls.

MATERIALS AND METHODS

Study Design and Setting

A prospective cohort study was conducted at Medical City (tertiary referral center serving Baghdad) from January 2019 to December 2025. Ethical approval was obtained from University of Baghdad, College of Medicine, and Al-Kindy College of Medicine Research Ethics Committee (Ref no.: 216, and 109, respectively), with written informed consent from all participants and guardians.

Participants

Inclusion criteria:
Singleton pregnancies
Maternal age 13–19 years
Gestational age confirmed by first-trimester ultrasound
Exclusion criteria:
Pre-existing diabetes/chronic hypertension
Multifetal gestation
Major fetal anomalies
Incomplete outcome data
Final cohort stratification:

GDM group (n=143): Diagnosed via 75g oral glucose tolerance test (OGTT) using International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria (fasting ≥92 mg/dL, 1-hour ≥180 mg/dL, or 2-hour ≥153 mg/dL)[22].

Preeclampsia group (n=157): Defined by American College of Obstetricians and Gynecologists (ACOG) criteria (systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg after 20 weeks with proteinuria ≥300 mg/24h, thrombocytopenia, renal insufficiency, pulmonary edema, or cerebral/visual symptoms)[23].

Control group (n=161): Normotensive pregnancies with normal OGTT results, matched for age (±1 year), parity, and pre-pregnancy body mass index (BMI) (±2 kg/m²).

Data Collection

Maternal variables: Demographics, obstetric history, prenatal visits, BMI, blood pressure, glucose values

Delivery outcomes: Gestational age (weeks), mode of delivery, placental abruption, and postpartum hemorrhage (PPH).

Neonatal parameters: Birth weight, Apgar scores, neonatal hypoglycemia, neonatal intensive care unit (NICU) admission, birth weight (g), and respiratory distress syndrome (RDS).

Statistical Analysis

Primary comparisons:

GDM group vs control group

Preeclampsia group vs control group

Continuous variables reported as mean±SD analyzed with ANOVA and Tukey post-hoc tests. Categorical variables as percentages analyzed with chi-square or Fisher's exact tests. Multivariate logistic regression adjusted for confounders (BMI, parity, prenatal visits) generated adjusted odds ratios (aOR) with 95% confidence intervals (CI) for each exposure group versus controls. Significance set at $p<0.05$ using Statistical Package for the Social Sciences (IBM SPSS) version 28.0.

Study Workflow

Screened Adolescents in Baghdad (n=520)

├── Excluded (n=59):
- Multifetal gestation (n=22)
- Preexisting conditions (n=28)
- Lost to follow-up (n=9)

└── Analyzed Cohort (n=461)

├── GDM Group (n=143) → Compared to controls

├── Preeclampsia Group (n=157) → Compared to controls

└── Control Group (n=161)

└── Outcome Assessment

RESULTS

In table 1, groups were age/parity matched. Pre-pregnancy BMI was higher in GDM (28.4 kg/m^2) and preeclampsia (29.1 kg/m^2) vs controls (25.9 kg/m^2). Fewer prenatal visits occurred in both.

Table 1. Baseline Characteristics

Characteristic	GDM (n=143)	Preeclampsia (n=157)	Controls (n=161)	*p-value
Age (years)	17.4 ± 1.3	17.5 ± 1.1	17.3 ± 1.2	0.32
Primiparity	122 (85.3%)	130 (82.8%)	137 (85.1%)	0.79
Pre-pregnancy BMI (kg/m^2)	28.4 ± 3.8*	29.1 ± 4.3*	25.9 ± 2.9	<0.001
Prenatal visits	5.9 ± 1.7*	5.3 ± 2.1*†	8.4 ± 1.3	<0.001

*Data: mean ± SD or n (%). BMI = body mass index. P<0.01 vs controls; †p<0.01 GDM vs preeclampsia.

Preeclampsia showed significantly higher rates across all adverse outcomes versus controls. GDM demonstrated elevated preterm birth and cesarean delivery versus controls. Please see table 2.

Table 2. Obstetric Outcomes, Comparisons vs Controls

Outcome	GDM vs Controls	Preeclampsia vs Controls
Preterm birth (<37w)	26/143 (18.2%) vs 11/161 (6.8%)*	51/157 (32.5%) vs 11/161 (6.8%)*
Cesarean delivery	41/143 (28.7%) vs 25/161 (15.5%)*	71/157 (45.2%) vs 25/161 (15.5%)*
Postpartum hemorrhage	9/143 (6.3%) vs 5/161 (3.1%)	18/157 (11.5%) vs 5/161 (3.1%)*
Placental abruption	2/143 (1.4%) vs 1/161 (0.6%)	9/157 (5.7%) vs 1/161 (0.6%)*

*p<0.01 (chi-square test).

Regarding table 3, preeclampsia neonates had significantly lower birth weights (570g difference) and higher morbidity versus controls. GDM neonates showed elevated birth weights and hypoglycemia rates versus controls.

Table 3. Neonatal Outcomes – Comparisons vs Controls

Parameter	GDM vs Controls	Preeclampsia vs Controls
Birth weight (g)	3,180±420 vs 3,020±340*	2,450±510 vs 3,020±340*
Low birth weight (<2500g)	21/143 (14.7%) vs 12/161 (7.5%)*	63/157 (40.1%) vs 12/161 (7.5%)*
NICU admission	29/143 (20.3%) vs 13/161 (8.1%)*	45/157 (28.7%) vs 13/161 (8.1%)*
Respiratory distress syndrome	11/143 (7.7%) vs 4/161 (2.5%)*	24/157 (15.3%) vs 4/161 (2.5%)*
Neonatal hypoglycemia	19/143 (13.3%) vs 3/161 (1.9%)*	8/157 (5.1%) vs 3/161 (1.9%)

*NICU = neonatal intensive care unit. *p<0.01 (ANOVA/chi-square).

In table 4 After adjustment, preeclampsia conferred substantially higher independent risks than GDM for all adverse outcomes versus controls.

Table 4. Adjusted Risks for Adverse Outcomes vs Controls

Outcome	GDM: aOR (95% CI)*	Preeclampsia: aOR (95% CI)*
Preterm birth	3.3 (1.6–6.8)	7.1 (3.6–14.2)
Cesarean delivery	2.2 (1.2–4.0)	4.6 (2.7–7.9)
NICU admission	2.9 (1.5–5.8)	4.7 (2.4–9.3)
Low birth weight	2.1 (1.0–4.4)	8.9 (4.6–17.2)

*Adjusted for body mass index, parity, prenatal visits; all p<0.001.

DISCUSSION

This prospective cohort study provides robust evidence that adolescent pregnancies complicated by GDM, or preeclampsia suffer significantly worse perinatal outcomes compared to healthy adolescent controls, with preeclampsia demonstrating particularly severe consequences. Our statistical approach – comparing each exposure group separately to matched controls – revealed condition-specific risk profiles that illuminate distinct pathophysiological impacts in this vulnerable population.

Condition-Specific Risk Profiles Preeclampsia vs Controls: The 7.1-fold higher preterm birth risk (32.5% vs 6.8%) aligns with recent Iraqi data showing adolescent preeclampsia increases early delivery risk by 6.8-fold[24]. This exceeds adult preeclampsia studies (4.5–5.2-fold risk)[25], suggesting adolescents experience amplified placental dysfunction. The 8.9-fold elevated low birth weight risk (40.1% vs 7.5%) reflects severe fetal growth restriction, consistent with Jordanian cohorts where preeclampsia reduced neonatal weight by 550g[26].

GDM vs Controls: The 3.3-fold higher preterm birth risk (18.2% vs 6.8%) exceeds adult GDM studies (1.8–2.1-fold)[27], indicating adolescent-specific metabolic vulnerabilities. Neonatal hypoglycemia was 7-fold more common in GDM offspring (13.3% vs 1.9%), surpassing rates in adult GDM neonates (8–10%), likely due to immature hepatic gluconeogenesis in adolescents.[28]

Comparative Pathophysiology in Adolescents

The divergent outcomes reflect distinct mechanisms:

Preeclampsia disproportionately affects adolescents due to ongoing vascular development. Teenage endothelial cells show 40% reduced reparative capacity[29], exacerbating placental ischemia and explaining the severe fetal growth restriction (mean birth weight 2,450g vs 3,020g controls).

GDM reflects an intersection of physiologic insulin resistance and underdeveloped pancreatic beta-cell reserve, creating postprandial hyperglycemia that drives macrosomia (mean birth weight 3,180g vs 3,020g controls) and neonatal hypoglycemia[30,31].

Regional Context

Our Baghdad cohort demonstrated higher morbidity than Western populations:

Preeclampsia-associated NICU admission (28.7% vs 15–20% in U.S. studies)[32]

GDM-related cesarean rates (28.7% vs 18–22% in European cohorts)[33]

These disparities likely reflect regional challenges: delayed prenatal care initiation (mean gestational age at diagnosis: 28.3 weeks for preeclampsia vs 24–26 weeks globally, and limited access to continuous glucose monitoring (utilized in only 12% of GDM cases).[34]

STRENGTHS AND LIMITATIONS

Strengths: Prospective design, condition-specific comparisons to matched controls, standardized diagnostic criteria, multivariate adjustment. To the best of our knowledge, it is the first Iraqi prospective cohort comparing GDM/preeclampsia outcomes against matched adolescent controls. Also, it involved quantification of condition-specific morbidity burdens: preeclampsia vs GDM vs controls. In addition to the framework for adolescent-focused clinical pathways in resource-limited settings

Limitations: Single-center recruitment; limited long-term neonatal follow-up; potential residual confounding by socioeconomic factors.

CONCLUSION

Adolescent pregnancies with GDM or preeclampsia exhibit dramatically worse outcomes than healthy adolescent pregnancies. Our findings provide evidence for Iraqi clinical guidelines to adopt adolescent-specific management protocols for these conditions.

Ethics Statement and Conflict of Interest Disclosures

Financial support and sponsorship: All authors have declared that no financial support was received from any organization for the submitted work.

Ethics Consideration: The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national laws. Written informed consent was provided by the

patient participant in this study.
This study was approved by the Institutional Research Board and Ethics Committee.

Conflict of interest: No known conflict of interest correlated with this publication.

Availability of data and materials: The data used and/ or analyzed throughout this study are available from the corresponding authors upon reasonable request.

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The use of generative AI and AI-assisted technologies: The authors did not use in this article generative AI and AI-assisted technologies.

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