The Impact of the Severity of Preeclampsia on Maternal IGF-1 Serum Levels and Fetal Outcomes: A Case–Control Analysis

Anfal Ali Hussein Al-Kaabi[1], Shaymaa Dakhil Jasim[2], Zinah Jabbar Mohammed Al-Rubaye[1,3], Hasanain Qasim Mohammad[4], Ali Abbas Hashim Almusawi[5]

[1]Babylon Maternity and Pediatric Teaching Hospital, Babylon, Iraq, [2]Al-Imam Alsadiq Teaching Hospital, Babylon, Iraq, [3]Department of Gynecology and Obstetrics, Babylon Health Directorate, Babylon, Iraq, [4]Hilla Teaching Hospital, Babylon, Iraq, [5]Hammurabi College of Medicine, University of Babylon, Babylon, Iraq

Abstract

Background: The problem of pre-eclampsia (PE), a life-threatening pregnancy condition, remains poorly understood. Placental growth and fetal development are affected by the presence of insulin-like growth factor 1 (IGF-1). **Objectives:** This case–control study aimed to determine the correlation between maternal IGF-1 levels, PE disease severity, and fetal health outcomes. **Materials and Methods:** This case–control study was conducted over 11 months at the Department of Obstetrics, Babylon Hospital for Maternity and Children. We included 120 pregnant women in their third trimester (28–39 weeks), categorized into three groups: control, moderate PE, and severe PE. Data on maternal age, parity, and obstetric history were collected. Blood pressure was measured using a sphygmomanometer, and urine samples were tested for proteinuria. Serum IGF-1 levels were assessed using an enzyme-linked immunosorbent assay. Doppler ultrasound measures were also utilized to evaluate flow velocity waveforms in the umbilical artery. **Results:** Maternal IGF-1 levels were significantly lower in women with severe PE compared to those with moderate PE and the control group ($P < 0.001$). The study found that 75% of neonates from mothers with severe PE were admitted to the neonatal intensive care unit, while only 30% from the moderate group required admission. Neonatal birth weights were significantly lower in both PE groups than in controls ($P < 0.001$). **Conclusion:** The present study suggests a strong relationship between the severity of PE syndrome and maternal IGF-1 levels. Lower IGF-1 levels may be linked to PE development and adverse fetal outcomes. These findings highlight the potential of IGF-1 as a biomarker for PE severity and as a target for future research aimed at improving pregnancy outcomes.

Keywords: Gestational hypertension, IGF-1, insulin-like growth factor I, parity, preeclampsia, pregnancy

Introduction

Preeclampsia (PE) is a complex and frequent gestation-related disease of genetic predisposition with abnormal placentation that can endanger maternal and fetal lives if not managed.[1-3] The frequency of PE is reported to be approximately 3%–5%.[4] Some of the important risk factors such as delayed maternal age, overweight, and vascular diseases have been linked to the development of PE.[5] Delivery of placental tissue or preterm fetuses is a recent clinical management policy for PE.[6] Nevertheless, the current understanding of the complicated associations among particular PE illness pathways is incomplete, which delays the development of better approaches for effective management and prevention of PE.[5,7,8]

Several growth factors have multifaceted effects and a complex interplay in the regulation of growth, metabolism, angiogenesis, and differentiation. Insulin-like growth factor 1 (IGF-1), interleukins, TGF-β, and TNF-α are well-recognized.[9-12] Specifically, IGF-1, which serves as a mitogenic hormone, has been noted to have several links with biological processes, including placental growth, fetal development, and even postnatal fetal outcomes.[13-15]

Access this article online	
Quick Response Code:	**Website:** https://journals.lww.com/mjby
	DOI: 10.4103/MJBL.MJBL_882_24

Address for correspondence: Dr. Zinah Jabbar Mohammed Al-Rubaye, Department of Gynecology and Obstetrics, Babylon Health Directorate, Babylon 51001, Iraq. E-mail: zinahjabbaralrubaye@gmail.com

Submission: 08-Oct-2024 **Accepted:** 15-Feb-2026 **Published:** 30-Apr-2026

How to cite this article: Al-Kaabi AAH, Jasim SD, Al-Rubaye ZJM, Mohammad HQ, Almusawi AAH. The impact of the severity of preeclampsia on maternal IGF-1 serum levels and fetal outcomes: A case–control analysis. Med J Babylon 2026;23:723-30.

Several studies have indicated that the severity of PE is associated with maternal blood levels of IGF-1.[5,6] The mechanism by which IGF-1 contributes to placental and fetal growth involves several key pathways.

- Placental insulin/IGF-1 signaling: IGF-1, along with insulin, activates the protein kinase B and insulin receptor substrate-1 pathways, which regulate placental function and nutrient transfer to the fetus.[14-16]
- IGF-1 and (mechanistic target of rapamycin) mechanical target of rapamycin (mTOR) signaling: IGF activates the mTOR pathway, which in turn controls protein synthesis, nutrient uptake, and mitochondrial function in the placenta. This pathway is critical for normal trophoblast physiology and fetal growth.[14,17]
- IGF-1 and nutrient transport: IGF-1 stimulates the uptake of amino acids and glucose in placental trophoblasts, promoting nutrient transfer to the fetus.[7,18]
- IGF-1 and placental blood flow: Although the exact role of IGF-1 in regulating placental blood flow is still unclear, studies suggest that IGF-1 may encourage more efficient consumption of nutrients for growth rather than enhance the nutrients accessible from the placenta.[19,20]
- IGF-1 and fetal growth regulation: Low fetal IGF-1 is linked to fetal growth suppression, while high levels promote fetal overgrowth. IGF-1 may also regulate the expressions of amino acid transporters in the placenta, supporting the transfer of nutrients to the fetus.[13,21]

Additional investigation is warranted to explore the underlying mechanisms by which PE severity affects IGF-1 production and how these changes influence fetal development.

To enhance our understanding of fetal growth dynamics, regular ultrasound monitoring during the third trimester was performed. Additionally, Doppler ultrasound assessments were performed to measure flow velocity waveforms (FVWs) in the umbilical artery, providing insights into placental blood flow resistance.

This case–control study aimed to examine the relationship between PE severity and maternal serum IGF-1 levels.

Materials and Methods

Study design and data collection

A case–control design was employed to assess the relationship between the severity of PE and IGF-1 levels, as well as their impact on fetal outcomes. The research was conducted over 11 months, beginning in February 2022 and ending in December 2022, at the Department of Obstetrics, Babylon Hospital for Maternity and Children.

For all women, including those experiencing complications during their current pregnancy, there should be a complete history, including age, parity, gestational age, and obstetric history. Blood pressure measurements were undergone by all mothers during the physical examination to check for edema or other signs suggestive of PE, such as blood pressure.

Participants

This study included 120 pregnant women in their third trimester (28–39 weeks). Participants were classified into three groups according to clinical diagnosis: severe-PE group (n = 40), systolic blood pressure ≥160 mm Hg or diastolic blood pressure ≥110 mm Hg plus significant proteinuria (≥3+ on dipstick or ≥5 g in a 24-h urine collection). The moderate-PE group (n = 40) had a systolic blood pressure of 140–159 mm Hg or diastolic blood pressure of 90–109 mm Hg, with proteinuria (1+ to 2+ on dipstick or 0.3–4.9 g in a 24-h urine collection). The control group (n = 40) included healthy pregnant women with no history of hypertension or proteinuria.

Inclusion and exclusion criteria

Pregnant women aged 16–40 years, with a gestational age range between 28 and 39 weeks and willing to participate and provide informed consent, were included in this study. Females with diabetes mellitus, chronic hypertension, kidney disease, or any other preexisting conditions that could affect blood pressure or pregnancy outcomes; those with multiple pregnancies (twins or more); and females who were using medications that could interfere with arterial blood pressure or IGF-1 levels were excluded.

Laboratory investigations, blood measurements, and fetal growth assessment

Blood pressure was measured using a standardized sphygmomanometer with the participant seated and a rest period of at least 5 min. Two readings were taken at least 6 h apart, and the average was recorded. Urine samples were collected and tested by dipstick analysis. For patients with positive dipstick results, a 24-h urine collection was performed to quantify proteinuria. Blood specimens were collected from all participants after overnight fasting. Serum IGF-1 levels were evaluated using a standardized enzyme-linked immunosorbent assay kit. The assay was performed according to the manufacturer's instructions, and blood samples were analyzed twice to ensure accuracy. Amniotic fluid volume and fetal growth were assessed using ultrasonography to identify signs of intrauterine growth restriction (IUGR). Ultrasonography was conducted every 2–4 weeks during the third trimester to monitor fetal growth and assess for signs of IUGR. Doppler ultrasound was used to measure FVWs in the umbilical artery, evaluating placental blood flow dynamics.

Neonatal outcomes

Data on neonatal birth weight, appearance, pulse, grimace, activity, respiration scores calculated at first and fifth minute, and the requirement for neonatal intensive care unit (NICU) hospital admission were collected immediately after delivery. Statistical analysis was performed on the neonatal outcomes using chi-square tests to assess differences among groups.

Ethical considerations

The study protocol was revised and approved by the Iraqi Medical Specialization Ministry of Health and the Scientific Committee of the Gynecology and Obstetrics Department. Informed verbal consent was obtained from all participants after explaining the study purpose and measures.

Statistical analysis

Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 26.0 (SPSS, IBM Company, Chicago, IL 60606, USA). Descriptive statistics were used to calculate the frequency and percentage distribution of the demographic and clinical details of the subjects enrolled in the study. Analysis of variance (ANOVA) or independent *t* tests were conducted to analyze continuous variables between groups, and chi-square tests were used for categorical variables. Pearson's correlation coefficient test was used to compare the trends of IGF-1 with various clinical factors, such as blood pressure and proteinuria. This was done to create receiver operating characteristic (ROC) curves with which the ability of IGF-1 to identify the severity of PE could be assessed in terms of its predictive accuracy. A *P* value of <0. 05 was regarded as statistically significant for all analyses.

Results

The patients studied were compared based on their age and GA, and there was no significant difference among the three groups ($P = 0.05$). The mean arterial pressure significantly differed among the PE groups compared to the control and between pregnant females with moderate or severe PE ($P < 0.001$), as shown in Table 1.

There was a significant difference in protein urea levels among the studied groups [$P < 0.01$; Table 2].
There was a substantial difference in the parity state among the studied pregnant groups [$P < 0.01$; Table 3].

The mean IGF-1 level was significantly lower in women with moderate and severe PE than in control females ($P < 0.001$), as determined by ANOVA. In addition, the levels of IGF-1 were significantly lower in females with severe PE than in those with moderate PE [$P < 0.001$; Table 4].

The area under the curve (AUC) that corresponds to the ROC curve for IGF-1 levels was compared between control women and those with moderate PE [Table 5]. ROC analysis revealed that IGF-1 values had a significant AUC (0.884), signifying that a threshold of 500 ng/mL provided 95% sensitivity and 65% specificity. Lower IGF-1 levels were associated with an increased frequency of moderate PE.

Table 1: Age, blood pressure, and gestational age differences in studied groups

Variables	Moderate PE *M* ± SD	Severe PE *M* ± SD	Healthy *M* ± SD	Significance
Age (year)	27.4±4.6	27.2±15.0	25.9±5.1	$P > 0.05$
Blood pressure (mm Hg)	113.7±4.3	135.5±8.3	88.6±8.0	$P < 0.01$
Gestational age (weeks)	37.1±1.8	36.3±6.4	37.7±0.9	$P > 0.05$
Neonatal birth weight (kg)	2.9±0.4	2.6±3.2	3.3±0.4	0.001*

PE: preeclampsia.

*Neonatal weight significantly lower in moderate- and severe-PE groups when compared with the control group and also significantly lower in the severe-PE group when compared with the moderate-PE group

Table 2: Severity of protein urea in studied pregnant groups

Protein urea	Groups no (%)			Total
	Control	Moderate	Severe	
Nil	40 (100)	0	0	40
++	0	37 (92.5)	3 (7.5)	40
≥ +++	0	3 (7.5)	37 (92.5)	40
Total	40	40	40	120
P value		<0.001		
Yates' chi-square		200.8		

Table 3: Parity state among the studied pregnant groups

Parity status	Groups			Total
	Control	Moderate	Severe	
Primipara	13 (32.5)	28 (70)	32 (80)	73
Multipara	27 (67.5)	12 (30)	8 (20)	47
Total	40	40	40	120
P value		<0.001		
Yates' chi-square		21.1		

Table 4: Insulin-like growth factor 1 (IGF-1) level in studied groups

	Severe PE mean ± SD	Moderate PE mean ± SD	Control mean ± SD	*P* value
IGF-1 level ng/mL	290.1 ± 119.7	366.7 ± 66.7	475.7 ± 68.4	<0.001*

PE: preeclampsia.
*The difference between moderate and severe PE is significant

Table 5: The receiver operating characteristic curve analyses for insulin-like growth factor 1 (IGF-1) levels to differentiate between the control women and those with moderate preeclampsia

	AUC	Cut off	Sensitivity	Specificity	*P* value	95% CI	
IGF-1 (ng/mL)	0.884	500	95%	65%	0.001	0.770	0.997

AUC: area under the curve

Table 6: The receiver operating characteristic curve analyses for insulin-like growth factor 1 (IGF-1) levels to differentiate between the control women and those with severe preeclampsia

	AUC	Cut off	Sensitivity	Specificity	*P* value	95% CI	
IGF-1 (ng/mL)	0.867	350	80%	65%	0.001	0.745`	0.990

AUC: area under the curve

The AUC analyses for IGF-1 levels were compared between control women and those with severe PE [Table 6]. ROC analysis revealed that IGF-1 values had a significant AUC (0.876), signifying that a threshold of 350 ng/mL provided 80% sensitivity and 65% specificity. Lower IGF-1 levels were associated with an increased frequency of severe PE.

As indicated in Table 7, positive and slightly significant coefficient values representing gestational age, neonatal birth weight, and serum IGF-1 levels in both the control and PE groups were observed. This can be interpreted as indicating a somewhat positive relationship, where subjects with higher IGF-1 levels are likely to have longer gestation periods and higher birth weights. However, it should be noted that the *P* values are marginally below 0.05, and this suggests that they are slightly significant; the results could therefore be due to chance.

The cross-tabulation table also shows a moderate negative association between the mean arterial blood pressure and IGF-1 levels only in the PE group. This finding indicates that high BP is associated with low IGF-1 levels in PE women.

Table 8 provides a comprehensive overview of neonatal outcomes across three groups: control, moderate PE, and severe PE. The data presented in this table highlight significant differences in neonatal health outcomes based on the severity of PE.

1. **Alive and dead counts**: The control group shows that all 40 neonates are alive, which is expected given that this group includes participants with healthy pregnancies. In contrast, the moderate- and severe-PE groups show considerable mortality rates, with 28 (70%) dead in the moderate-PE group and 10 (25%) dead in the severe-PE group. This stark difference underscores the adverse effects of PE on neonatal survival.
2. **Admitted to NICU**: The table indicates that no neonates from the control group were admitted to the NICU, while a significant proportion of neonates from both the moderate (12% or 30%) and severe (30% or 75%) PE groups required NICU admission. This finding highlights the increased risk of complications associated with PE, particularly in severe cases.

Table 7: Correlations of gestational ages (weeks), mean arterial blood pressure (mm Hg), and neonatal birth weight with the concentrations of maternal insulin-like growth factor 1

Variables	Pearsons' correlation	
	Control	Preeclampsia
Gestational age (weeks)	r = 0.201	r = 0.207
	P = 0.059	P = 0.049
Neonatal birth weight (kg)	r = 0.207	r = 0.207
	P = 0.055	P = 0.049
Blood pressure (mm Hg)	r = 0.196	-r = 0.569
	P = 0.054	P = 0.009

Table 8: Neonatal outcomes of all studied groups

Neonatal outcome	Groups no (%)			Total
	Control	Moderate	Severe	
Alive	40 (100)	12 (30)	30 (75%)	82
Dead	0	28 (70%)	10 (25%)	38
Admitted to NICU (preterm)	0	12 (30%)	30 (75%)	42
Discharged	40 (100)	10 (23.8%)	26 (61.9%)	36
Post admission death	0	2 (33.3%)	4 (66.6%)	6

NICU: neonatal intensive care unit

Table 9: Fetal growth assessment via ultrasonography

Parameter	Control group (n = 40)	Moderate PE group (n = 40)	Severe PE group (n = 40)	P value
Average fetal weight (g)	3200±400	2800±500	2500±600	<0.001
Estimated gestational age (weeks)	38.5±1.0	37.0±1.5	36.0±2.0	<0.01
Incidence of IUGR (%)	5%	20%	40%	<0.001
Amniotic fluid index (AFI)	12.5±2.0	10.0±2.5	8.0±3.0	<0.001

IUGR: intrauterine growth restriction, PE: preeclampsia

Table 10: Doppler ultrasound findings in the umbilical artery

Parameter	Control group (n = 40)	Moderate PE group (n = 40)	Severe PE group (n = 40)	Significance (P value)
Umbilical artery PI	1.5±0.3	1.8±0.4	2.5±0.6	<0.001
umbilical artery RI	0.6±0.1	0.7±0.1	1.2±0.2	<0.001
Absent end-diastolic flow (%)	0%	10%	30%	<0.01

PI: pulsatility index, RI: resistance index, PE: preeclampsia

3. **Discharged counts**: The discharge rates also reflect the severity of conditions, with only 10 (25%) of neonates from the severe-PE group discharged, compared to 40 (100%) from the control group. This further emphasizes the challenges faced by infants born to mothers with severe PE.
4. **Post admission deaths**: The table notes that there were post-admission deaths in both the moderate (2% or 33.3%) and severe PE (4% or 66.6%) groups, indicating that even after NICU admission, a significant number of infants did not survive. This raises concerns about the immediate care and outcomes for infants born to mothers with severe forms of PE.
5. **Preterm births**: While specific values for preterm births are not detailed in this table, it is implied through NICU admissions that many infants were likely born preterm, especially in the severe-PE group where 75% were admitted to the NICU.

Fetal growth assessments via ultrasound revealed a higher incidence of IUGR among those with lower IGF-1 levels, corroborated by Doppler ultrasound findings indicating increased resistance in placental blood flow [Tables 9 and 10]. The findings indicated that average fetal weight significantly decreased in both moderate- and severe-PE groups compared to controls, as shown in Table 9. Doppler ultrasound assessments were performed to measure FVWs in the umbilical artery, which reflect placental blood flow resistance. Results demonstrated significantly higher pulsatility indices and resistance indices in the severe-PE

Table 11: Pearson's correlation coefficient of maternal insulin-like growth factor 1 levels with neonatal outcomes, Doppler findings, and ultrasound assessments

Neonatal outcome/parameter	Pearson's correlation coefficient (*r*)	*P* value
Gestational age (weeks)		
Control group	0.201	0.059
Preeclampsia group	0.207	0.049
Neonatal birth weight (kg)		
Control group	0.207	0.055
Preeclampsia group	0.207	0.049
Mean arterial blood pressure (mm Hg)		
Control group	0.196	0.054
Preeclampsia group	−0.569	0.009
Umbilical artery Doppler pulsatility index		
Control group	−0.150	0.045
Preeclampsia group	−0.350	0.002
Fetal growth assessment (ultrasound)		
Control group	0.250	0.031
Preeclampsia group	−0.400	0.001

Table 12: Relationship between maternal insulin-like growth factor 1(IGF-1) levels and preterm deliveries

Groups	Maternal IGF-1 Level (ng/mL)	Preterm deliveries (no.)	Preterm delivery rate (%)	*P* value
Control	475.7±68.4	0	0	
Moderate PE	366.7±66.7	12	30	0.001
Severe PE	290.1±119.7	30	75	0.001
Total		42	35	

PE: preeclampsia

group compared to controls, indicating compromised placental blood flow, as detailed in Table 10.

Table 11 summarizes the Pearson's correlation coefficients analyzing the relationship between maternal IGF-1 levels and various neonatal outcomes, including Doppler ultrasound findings and ultrasound assessments. Higher IGF-1 levels were positively correlated with gestational age and neonatal birth weight, particularly in the PE group ($r = 0.207$, $P = 0.049$), indicating better fetal outcomes. Conversely, a significant negative correlation was observed between IGF-1 levels and mean arterial blood pressure in the PE group ($r = -0.569$, $P = 0.009$), as well as with umbilical artery Doppler findings, suggesting that elevated blood pressure is associated with lower IGF-1 levels.

Table 12 provides valuable insights into the relationship between maternal IGF-1 levels and preterm deliveries, emphasizing the importance of monitoring these levels in pregnant women at risk for PE to improve neonatal outcomes.

Discussion

By analyzing a cohort of pregnant women with varying degrees of PE severity, this study sought to provide further insights into the contribution of IGF-1 in the pathogenesis of PE and its influence on fetal well-being. Understanding the interplay between IGF-1, PE severity, and fetal outcomes may pave the way for personalized interventions and improve pregnancy outcomes for mothers and their babies.

The main outcomes of this cohort were as follows. First, maternal IGF-1 levels were inversely correlated with PE severity. Women with severe PE had significantly lower IGF-1 levels than women with moderate PE and normotensive controls. Second, lower IGF-1 serum levels are associated with adverse fetal outcomes. Specifically, lower IGF-1 serum levels have been linked to elevated rates of preterm births and lower neonatal birth weights. Third, IGF-1 has potential as a biomarker for PE severity. ROC curve analysis showed a high accuracy in distinguishing between moderate and severe PE cases.

Our findings suggest a strong link between the severity of PE and maternal IGF-1 blood levels. This finding supports the hypothesis that IGF-1 plays a crucial role in the pathophysiology of PE, with lower levels potentially contributing to the development and severity of the condition.[1,22–25]

The observed correlation between reduced maternal IGF-1 levels and adverse fetal outcomes, particularly preterm birth and restricted fetal growth, underscores the importance of IGF-1 in supporting optimal fetal development. These results align with those of previous studies, indicating that IGF-1 levels play a vital role in placental and fetal growth.[26-28]

In line with the outcomes of the current study, several lines of evidence suggest that lower IGF-1 serum levels are associated with adverse fetal outcomes. Specifically, lower IGF-1 circulatory levels were linked with higher rates of preterm birth and lower neonatal birth weight. Preterm infants, especially neonates born at ≤28 weeks' gestation or having a birth weight ≤1000 g or ≤1500 g, have significantly reduced IGF-1 levels compared to term infants.[29] After very preterm birth, the serum concentration of IGF-1 declines noticeably to levels reaching 10 ng/mL, in comparison to levels of >50 ng/mL *in utero* at 23–30 weeks of gestational age.[21]

The same explanations were reported for increased mortality among those with severe and moderate PE in the current study. Furthermore, another recent study showed that low levels of IGF-1 despite postnatal age in preterm newborns are correlated with poor general growth, poor brain growth, and increased neonate morbidity, including intraventricular hemorrhage, retinopathy of prematurity, bronchopulmonary dysplasia, and necrotizing enterocolitis, and together, contribute to increased neonatal mortality rates in both human and animal models.[21,30]

The findings from this study are further supported by recent literature, which emphasizes the importance of regular maternal ultrasonography monitoring and Doppler ultrasound assessments in evaluating fetal growth and placental function. For instance, a study by Hernandez-Andrade *et al.*[31] demonstrated that regular ultrasound evaluations significantly evaluate decidual vessels and blood movement and hence identify IUGR and associated adverse neonatal outcomes,[32] reinforcing the critical role of timely monitoring in pregnancies with complications owing to preeclampsia.[31] Moreover, our results indicating a negative correlation between IGF-1 levels and umbilical artery Doppler findings align with those of previous research conducted by Nahar and Islam,[33] which revealed that elevated resistance in placental blood flow, as measured by Doppler ultrasound, is associated with lower maternal IGF-1 levels and poorer fetal outcomes. This underscores the need for comprehensive assessments that include both biochemical markers and imaging techniques to better understand the implications of maternal health on fetal development. Additionally, the significant positive correlation between higher IGF-1 levels and improved neonatal birth weights observed in our study is consistent with findings from Hellström *et al.*[34] who reported similar associations between IGF-1 concentrations and enhanced neonatal health parameters, suggesting that IGF-1 may serve as a vital biomarker for predicting fetal well-being in high-risk pregnancies. Our findings highlight the potential of IGF-1 as a biomarker for PE severity and as a potential target for therapeutic interventions aimed at improving pregnancy outcomes.

Conclusion

The study demonstrates a significant correlation between maternal IGF-1 levels and the severity of PE, revealing that lower IGF-1 levels are associated with adverse fetal outcomes, including increased rates of preterm birth and reduced neonatal weight. The findings underscore IGF-1's potential as a biomarker for assessing PE severity and highlight its critical role in fetal development. These insights could inform targeted interventions to improve pregnancy outcomes in women affected by PE, emphasizing the need for further research into IGF-1's mechanisms in placental and fetal health. Regular maternal ultrasonography monitoring and Doppler ultrasound measures enhance our ability to assess fetal growth accurately and understand the implications of reduced IGF-1 levels on adverse fetal outcomes.

Acknowledgment

The authors would like to express their sincere gratitude to the patients taking part in the study as well as the patients' families for their cooperation in persuading the patients to take part in the study.

Author contributions

Each author contributed equally to the creation of this manuscript.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Lai W, Yu L. Insulin-like growth factor 1 ameliorates preeclampsia by inhibiting zinc finger E-box binding homeobox 1 by up-regulation of microRNA-183. J Cell Mol Med 2023;27:1179-91.
2. Fawzi RQ, Rifat AG. The evaluation of maternal serum glycodelin level as a marker for the presence and severity of preeclampsia. Med J Babylon 2023;20:S95-S100.
3. Haseeb NM, Mohammed EA, Ibrahem S. Significance of maternal serum pentraxin-3 level in assessment of severity of pre-eclampsia and its effect on neonatal outcome. Med J Babylon 2023;20:S88-94.
4. Johnson JD, Louis JM. Does race or ethnicity play a role in the origin, pathophysiology, and outcomes of preeclampsia? An expert review of the literature. Am J Obstet Gynecol 2022;226:S876-85.
5. Phipps E, Prasanna D, Brima W, Jim B. Preeclampsia: Updates in pathogenesis, definitions, and guidelines. Clin J Am Soc Nephrol 2016;11:1102-13.
6. Lemoine E, Thadhani R. Affordable preeclampsia therapeutics. Trends Pharmacol Sci 2019;40:85-7.
7. Sferruzzi-Perri AN, Sandovici I, Constancia M, Fowden AL. Placental phenotype and the insulin-like growth factors: Resource allocation to fetal growth. J Physiol 2017;595:5057-93.
8. Al-Bdairi AAH, Makki Al-Hindy HA-A, Rahmatullah WS, Alshukri WSM. Impact of congenital uterine anomalies on ectopic pregnancy: A cross-sectional observational study of 510 cases. Med J Babylon 2024;21:S52-7.
9. Aldhalmi AK, Al-Athari AJ, Al-Hindy HA. Association of tumor necrosis factor-α and myeloperoxidase enzyme with severe asthma: A comparative study. Rep Biochem Mol Biol 2022;11:238-45.

10. Al-Shimmery AHS A-AM, Chabuck ZAG, Al-Mammori RTO, Mokif TA, Mahdi ZA-A, *et al*. Assessment of tumor necrosis factor-α, interleukin-17, and vitamin D3 levels on a group of gastrointestinal tumor patients in Babylon Provence, Iraq. Med J Babylon 2023;20:362-7.
11. Ramadan GH, Al-Hindy HA, Mousa MJ, Al-Sadi H. Evaluation of transforming growth factor-beta 1 (TGFβ1) levels in cases with multiple myeloma: Case–control study among iraqis. J ReAttach Ther Dev Divers 2022;5:516-23.
12. Mousa MJ, Al-Hindy HA, Al-Mumin AS. Evaluation of serum cystatin C levels in multiple myeloma: Diagnostic significance and clinical implications. Rev Clin Pharmacol Pharmacokinet Int Ed 2024;38:145-47.
13. Banjac L, Kotur-Stevuljević J, Gojković T, Bokan-Mirković V, Banjac G, Banjac G. Relationship between insulin-like growth factor type 1 and intrauterine growth. Acta Clin Croat 2020;59:91-6.
14. Dumolt JH, Powell TL, Jansson T. Placental function and the development of fetal overgrowth and fetal growth restriction. Obstet Gynecol Clin North Am 2021;48:247-66.
15. Keleher MR, Erickson K, Smith HA, Kechris KJ, Yang IV, Dabelea D, *et al*. Placental insulin/IGF-1 signaling, PGC-1α, and inflammatory pathways are associated with metabolic outcomes at 4–6 years of age: The ECHO healthy start cohort. Diabetes 2021;70:745-51.
16. Halhali A, Tovar AR, Torres N, Bourges H, Garabedian M, Larrea F. Preeclampsia is associated with low circulating levels of insulin-like growth factor I and 1,25-dihydroxyvitamin D in maternal and umbilical cord compartments*. J Clin Endocrinol Metab 2000;85:1828-33.
17. Akhaphong B, Baumann DC, Beetch M, Lockridge AD, Jo S, Wong A, *et al*. Alejandro EU. Placental mTOR complex 1 regulates fetal programming of obesity and insulin resistance in mice. JCI Insight 2021;6:e149271.
18. Wilson RL, Lampe K, Gupta MK, Duvall CL, Jones HN. Nanoparticle-mediated transgene expression of insulin-like growth factor 1 in the growth restricted guinea pig placenta increases placenta nutrient transporter expression and fetal glucose concentrations. Mol Reprod Dev 2022;89:540-53.
19. Wilson RL, Troja W, Sumser EK, Maupin A, Lampe K, Jones HN. Insulin-like growth factor 1 signaling in the placenta requires endothelial nitric oxide synthase to support trophoblast function and normal fetal growth. Am J Physiol Regul Integr Comp Physiol 2021;320:R653-62.
20. Davenport BN, Jones HN, Wilson RL. Placental treatment with insulin-like growth factor 1 via nanoparticle differentially impacts vascular remodeling factors in guinea pig sub-placenta/decidua. Front Physiol 2022;13:1055234.
21. Hellström A, Ley D, Hansen-Pupp I, Hallberg B, Ramenghi LA, Löfqvist C, *et al*. Role of insulinlike growth factor 1 in fetal development and in the early postnatal life of premature infants. Am J Perinatol 2016;33:1067-71.
22. Al-Jailawi AHS, Al-Hindy HAAM, Hashim HO. Impact of residence on the association between benzo[a]pyrene-DNA adduct levels and CYP1B1 gene polymorphisms in breast cancer patients. Rev Clin Pharmacol Pharmacokinet Int Ed 2024;38:173-6.
23. Kumar A, Vanamail P, Gupta RK, Husain SA. Prediction of pre-eclampsia in diabetic pregnant women. Indian J Med Res 2023;157:330-44.
24. Wei L, Liping Z, Suya K. Expression of insulin-like growth factor binding protein-3 in HELLP syndrome. BMC Pregnancy Childbirth 2023;23:778.
25. Al-Rubai A-J, Ibraheem MM, Hameed AF, Noel KI, Eleiwi SA. Comparison of placental expression of basic fibroblast growth factor and insulin-like growth factor-1 in placentae of normal, pregnancy-induced hypertension, and preeclamptic pregnancies in Iraqi mothers. Med J Babylon 2023;20:681-8.
26. Szydlowska-Gladysz J, Gorecka AE, Stepien J, Rysz I, Ben-Skowronek I. IGF-1 and IGF-2 as molecules linked to causes and consequences of obesity from fetal life to adulthood: A systematic review. Int J Mol Sci 2024;25:3966.
27. Liao S, Vickers MH, Taylor RS, Jones B, Fraser M, McCowan LME, *et al*. Maternal serum IGF-1, IGFBP-1 and 3, and placental growth hormone at 20 weeks' gestation in pregnancies complicated by preeclampsia. Pregnancy Hypertens 2017;10:149-54.
28. Hivert M-F, White F, Allard C, James K, Majid S, Aguet F, *et al*. Placental IGFBP1 levels during early pregnancy and the risk of insulin resistance and gestational diabetes. Nat Med 2024;30:1689-95.
29. Nagano N, Katayama D, Hara K, Akimoto T, Imaizumi T, Seimiya A, *et al*. Association of umbilical cord insulin-like growth factor 1 levels with severe retinopathy in extremely preterm infants. Pediatr Neonatol 2023;64:126-32.
30. Holgersen K, Rasmussen MB, Carey G, Burrin DG, Thymann T, Sangild PT. Clinical outcome and gut development after insulin-like growth factor-1 supplementation to preterm pigs. Front Pediatr 2022;10:868911.
31. Hernandez-Andrade E, Huntley ES, Bartal MF, Soto-Torres EE, Tirosh D, Jaiman S, *et al*. Doppler evaluation of normal and abnormal placenta. Ultrasound Obstet Gynecol 2022;60:28-41.
32. de Ganzo Suárez T, de Paco Matallana C, Plasencia W. Spiral, uterine artery doppler and placental ultrasound in relation to preeclampsia. Best Pract Res Clin Obstet Gynaecol 2024;92:102426.
33. Nahar D, Islam D. Evaluation of insulin-like growth factor-I (IGF-I) as a predictor of preeclampsia. East Afr Sch J Med Sci 2022;5:301-6.
34. Hellström A, Sigurdsson J, Löfqvist C, Hellgren G, Kistner A. The IGF system and longitudinal growth in preterm infants in relation to gestational age, birth weight and gender. Growth Horm IGF Res 2020;51:46-57.