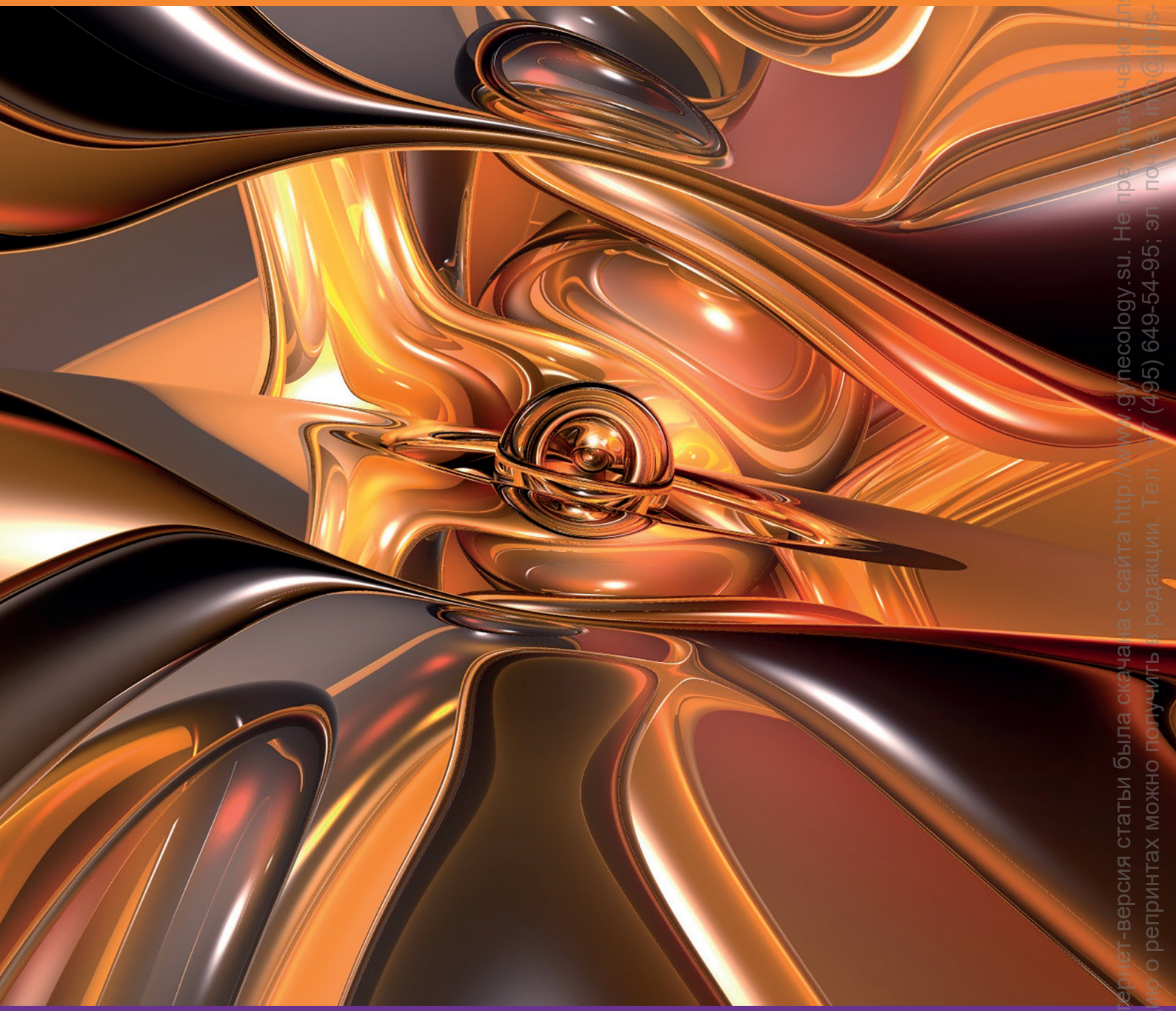
ISSN 2313-7347 (print)
ISSN 2500-3194 (online)

АКУШЕРСТВО ГИНЕКОЛОГИЯ РЕПРОДУКЦИЯ

Включен в перечень ведущих рецензируемых журналов и изданий ВАК

2025 • том 19 • № 3



OBSTETRICS, GYNECOLOGY AND REPRODUCTION

2025 Vol. 19 No 3

https://gynecology.su

ISSN 2313-7347 (print)
ISSN 2500-3194 (online)

https://doi.org/10.17749/2313-7347/ob.gyn.rep.2025.603

The relationship between body mass index in adolescent pregnancy and preeclampsia at Hasan Sadikin Hospital 2019–2023

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Abstract

Introduction. Many risk factors including maternal age especially in adolescence pregnancy, gravidity, parity status, and body mass index (BMI) considered to play role in preeclampsia (PE) pathogenesis.

Aim: to analyze a relationship between numerous risk factors including BMI in adolescent pregnancies with PE, thereby gaining deeper insight into risk factors and PE impact in pregnant adolescents.

Materials and Methods. This was a cross-sectional study conducted in Hasan Sadikin General Hospital Bandung with adolescence pregnant women diagnosed with PE during 2019–2023 as the subject population. The minimum sample size was calculated using unpaired categorical analytical study sample size formula and 310 total research subjects were obtained. Data were analyzed using bivariate analysis with IBM SPSS v28 software.

Results. The results indicate significant differences in the proportions of age, gravida, gestational age, mode of delivery, and low birth weight infant between the preeclampsia and non-preeclampsia groups ($p < 0.05$). There were no significant differences in the proportions of extremely low birth weight, peripartum cardiomyopathy, HELLP syndrome, and pulmonary edema between the two groups ($p > 0.05$). No significant difference was found in the BMI proportions between the two groups (odds ratio (OR) = 1.361; 95 % confidence interval (CI) = 0.828–2.237; $p = 0.223$).

Conclusion. Many risk factors could play role in PE pathogenesis in adolescent pregnancies. BMI alone is not enough to be PE predictor. Further studies are needed regarding risk stratification of adolescent pregnancy in a more comprehensively.

Keywords: pregnancy complications, maternal health, gestational hypertension, risk stratification, birth outcomes

For citation: Syarief S.D.R., Ritonga M.A., Anwar R. The relationship between body mass index in adolescent pregnancy and preeclampsia at Hasan Sadikin Hospital 2019–2023. *Akusherstvo, Ginekologia i Reprodukcia = Obstetrics, Gynecology and Reproduction.* 2025;19(3):369–376. https://doi.org/10.17749/2313-7347/ob.gyn.rep.2025.603.

Взаимосвязь между индексом массы тела при подростковой беременности и преэклампсией в больнице Хасана Садыкина в 2019–2023 гг.

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Резюме

Введение. Считается, что многие факторы риска, включая возраст матери, особенно при подростковой беременности, наличие предыдущих беременностей, количество родов и индекс массы тела (ИМТ), играют роль в патогенезе преэклампсии (ПЭ).

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Цель: проанализировать взаимосвязь между различными факторами риска, включая ИМТ, при беременности у подростков с ПЭ, для углубленного понимания значения факторов риска и влияния ПЭ на беременных подростков.

Материалы и методы. Беременные подросткового возраста, у которых была диагностирована ПЭ в 2019–2023 годах, были включены в настоящее поперечное исследование, проведенное в больнице общего профиля имени доктора Хасана Садыкина. Минимальное количество обследованных лиц было рассчитано с использованием непарной категориальной аналитической формулы для размера выборки исследования, на основании чего были проанализированы результаты обследования 310 человек. Полученные данные оценивали с использованием бивариантного анализа и програмы IBM SPSS v28.

Результаты. Результаты указывают на существенные различия в соотношении возраста, наличия предыдущей беременности, способа родоразрешения, гестационного возраста и низкой массы тела младенца при рождении между группами с ПЭ и без ПЭ ($p < 0,05$). При этом между группами значимых различий не обнаружено между частотой крайне низкой массы тела при рождении, наличия перипартальной кардиомиопатии, HELLP-синдрома и отека легких ($p > 0,05$), а также для уровня ИМТ (отношение шансов (ОШ) = 1,361; 95 % доверительный интервал (ДИ) = 0,828–2,237; $p = 0,223$).

Заключение. В патогенезе ПЭ при подростковой беременности могут играть роль всевозможные факторы риска. Для прогнозирования ПЭ одного лишь ИМТ недостаточно. Для более полной стратификации рисков при подростковой беременности необходимо проведение дальнейших исследований.

Ключевые слова: осложнения беременности, здоровье матери, гестационная гипертензия, стратификация риска, исходы родов

Для цитирования: Сьяриф Ш.Д.Р., Ритонга М.А., Анвар Р. Взаимосвязь между индексом массы тела при подростковой беременности и преэклампсией в больнице Хасана Садыкина в 2019–2023 гг. *Акушерство, Гинекология и Репродукция.* 2025;19(3):369–376. (In English). https://doi.org/10.17749/2313-7347/ob.gyn.rep.2025.603.

Highlights

What is already known about this subject?

- Preeclampsia (PE) is a leading cause of maternal and fetal morbidity and mortality worldwide, affecting 2–8 % of pregnancies.
- Adolescent pregnancy is associated with a higher risk of PE due to immature reproductive organs and increased cardiovascular risk factors.
- Obesity is a well-known risk factor for PE, but its role in adolescent pregnancies remains unclear.

What are the new findings?

- This study found significant differences in age, gravida status, delivery mode, and low birth weight (LBW) between adolescent pregnancies with and without PE.
- PE in adolescent pregnancies is strongly associated with cesarean delivery and higher incidence of LBW neonates.
- Body mass index (BMI) alone is not a reliable predictor of PE in adolescent pregnancies, suggesting the need for further risk stratification.

How might it impact on clinical practice in the foreseeable future?

- Understanding the risk factors for PE in adolescent pregnancies may improve early detection and targeted interventions.
- More comprehensive risk stratification models, beyond BMI alone, are needed for predicting PE in young pregnant women.
- Increased awareness of the impact of PE on neonatal outcomes could guide obstetricians in optimizing prenatal care for adolescent pregnancies.

Основные моменты

Что уже известно об этой теме?

- Преэклампсия (ПЭ) является одной из основных причин материнской и перинатальной заболеваемости и смертности во всем мире в 2–8 % беременностей.
- Подростковая беременность связана с повышенным риском развития ПЭ из-за незрелости репродуктивных органов и повышенных сердечно-сосудистых рисков.
- Ожирение считается важным фактором риска ПЭ, но его влияние на подростковую беременность остается неясным.

Что нового дает статья?

- Выявлены значимые различия по возрасту, гравидарному статусу, способу родоразрешения и частоте рождения детей с низкой массой тела (НМТ) между подростками с ПЭ и без нее.
- ПЭ у беременных подростков значительно чаще приводит к кесареву сечению и рождению детей с НМТ.
- Индекс массы тела (ИМТ) не является самостоятельным надежным предиктором ПЭ у подростков, что подчеркивает необходимость проведения дальнейшей стратификации рисков.

Как это может повлиять на клиническую практику в обозримом будущем?

- Понимание факторов риска ПЭ у подростков может способствовать ее раннему выявлению и целенаправленным вмешательствам.
- Для прогнозирования ПЭ у беременных подростков необходимы более углубленные модели стратификации риска, учитывающие не только ИМТ.
- Повышение осведомленности о влиянии ПЭ на неонатальные исходы поможет акушерам оптимизировать ведение подростковой беременности.

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Introduction / Введение

Preeclampsia (PE) is a hypertensive disorder of pregnancy suffered by 2–8 % of pregnancies worldwide. PE contributes as the second highest cause of maternal death in Indonesia. PE incidence in Indonesia is 24 %. PE is also one of the highest causes of West Java Provinces maternal death in Indonesiathat comprises as much as 25 % in 2022 in West Java [1–4]. Based on data obtained from the Hasan Sadikin Hospital Bandung, 274 PE cases were recorded in 2018, 245 – in 2021 and 136 – in 2023 [5].

Preeclampsia is one of the high-risk pregnancies that has an impact on maternal and infant mortality [6]. The serious impact caused by the condition of maternal PE results in premature birth which can cause death of up to 28 % of newborns [7]. This is because PE is a disease in pregnancy that causes reduced blood perfusion to organs due to vasospasm and decreased endothelial cell activity [8].

Preeclampsia leads to multiple complications such as kidney failure, pulmonary edema, peripartum cardiomyopathy (PPCM), hemolysis, elevated liver enzyme, and low platelet count (HELLP syndrome), heart disorders and thrombosis. It was reported that PE patients are at risk of experiencing pulmonary edema by 2–7 %, PPCM – 22 %, HELLP syndrome – 15.1 %, heart disorders – 2–8 % and thrombosis – 2–5 % [9–13]. Complications of HELLP syndrome in pregnant women with PE often result in poor baby conditions such as low birth weight and low Apgar scores [14]. In addition, this condition is at greater risk of pulmonary edema complications which is one of the risk factors for hypoxemia and hypercapnia increasing infant mortality [15].

According to the United Nations International Children's Emergency Fund (UNICEF), 700 million women worldwide have given birth by the age of 18, and approximately 250 million were married before turning 15, contributing to a higher adolescent pregnancy rate. In Indonesia, the adolescent pregnancy rate has generally decreased by 3.5 % over the past decade. However, the prevalence increased slightly from 11.1 % in 2016 to 11.2 % in 2018 [16]. Several factors contribute to adolescent pregnancy, including low education levels and early sexual activity before the age of 15 [17]. Adolescent pregnancy has an impact on increasing the risk of pregnancy complications such as PE, maternal and infant mortality and morbidity, as well as divorce rates [18]. In addition, adolescents need to receive socialization regarding obesity prevention strategies through innovative approaches to preventing adolescent pregnancy [19].

Adolescent gestational age also increases the risk factor for PE [20] due to the immaturity of reproductive organs in adolescents. Second, the relationship between obesity and the benefits of weight loss for dietary interventions in women prevents pregnancy-related complications such as PE. Third, there is a relationship between cardiovascular risk factors in young women and early-onset PE associated with uteroplacental artery atherosclerosis. Finally, infrequent menstruation can prolong uterine immaturity due to the lack of menstrual pre-conditioning [20].

According to the World Health Organization (WHO), body mass index (BMI) is classified into underweight (< 18.5 kg/m^2), normal (18.5–22.9 kg/m^2), overweight (23.0–24.9 kg/m^2), obesity (25.0–29.9 kg/m^2) [21]. Obesity in pregnancy is suggested to increase PE risk four times. These risk factors may affect pharmacological or hormonal pre-conditioning before conception in obesity [22]. Furthermore, obesity is a significant health issue and a major contributing factor to mortality associated with cardiovascular disease, PE, gestational hypertension, and type 2 diabetes mellitus worldwide [23]. In 1996 and 2010 there was an increase in excess weight during pregnancy accompanied by higher number of pregnancy complications, such as PE and gestational hypertension which increased by 25 and 184 % respectively, gestational diabetes (from 2.7 to 5.6 %), pregestational diabetes (from 0.7 to 1.5 %) [24]. The WHO also reported that 39 % of women aged 18 years and above were overweight and 13 % were obese. Mothers with BMI exceeding 30 kg/m^2 or obese have a risk factor for PE incidence increased by 2.5 times [25].

Due to such issues, the current study was aimed to assess of how characteristics in adolescent pregnancies with PE and without PE differed. These findings can be local data that can support global data so that they can provide an overview of the factors that play a role in the pathogenesis and pathophysiology of PE in adolescent pregnancies.

Aim: to analyze a relationship between numerous risk factors including BMI in adolescent pregnancies with PE, thereby gaining deeper insight into risk factors and PE impact in pregnant adolescents.

Materials and Methods / Материалы и методы

Study Design and Subject Criteria / Дизайн исследования и критерии включения

This research is a cross-sectional study carried out at Dr. Hasan Sadikin General Hospital, Bandung in the period 2019–2023. *Inclusion criteria* for the following study are: (1) adolescent pregnant patients aged 10–19 years; (2) pregnant women from Hasan Sadikin Hospital in 2019–2023; (3) complete medical record data consisting of maternal weight, maternal height, blood pressure, urine protein levels, and (4) verified PE diagnosis based on the criteria of the American College of Obstetrician and Gynecologist (ACOG) and the Panduan Praktis Klinis of the Department of Obstetrics and Gynecology, Faculty of Medicine, University of Padjadjaran. *Exclusion criteria:* patients with incomplete medical record data..

Sampling Methods / Критерии формирования групп исследования

Based on the calculation results, the minimum sample size was 30. The researcher identified patient biodata through the medical records retrieved from the Dr. Hasan Sadikin Hospital in 2019–2023. Researchers filtered age data (10–19 years) on pregnant women to determine the category of adolescent pregnant women. Non-researchers transferred all data to Microsoft Excel and then calculated BMI data based on the patient's weight and height. Researchers classified BMI data, namely:

- underweight (< 18.5 kg/m^2);
- normal (18.5–22.9 kg/m^2);
- overweight (23.0–24.9 kg/m^2),
- obese I (25.0–29.9 kg/m^2);
- obese II (≥ 30.0 kg/m^2).

Data Analysis / Анализ данных

This study used a descriptive and bivariate analysis approach. A descriptive analysis was performed to identify the characteristics of the study subjects who served as the research samples. Data analysis was performed to assess the proportion of each variable that would be presented descriptively that could be used for descriptive analysis and hypothesis testing. Numerical data, such as patient age, were presented using the mean, standard deviation, median, and range. Meanwhile, categorical data representing sample characteristics were coded and displayed as frequency and percentage distributions. Statistical calculations were carried out in a descriptive univariate manner on the dependent variable (PE) and the independent variables such as socio-demographic factors, maternal factors (BMI, delivery method), neonatal factors (birth weight, term/preterm conditions, single or multiple fetuses, and vaginal or abdominal delivery methods). Univariate analyses were utilized to assess PE incidence in adolescent pregnant women. The analysis carried out must be in accordance with the type of research issue and the data used. Before conducting statistical analysis, numerical data underwent a normality assessment. The Shapiro–Wilk test was used for datasets with fewer than 50 samples, while the Kolmogorov–Smirnov test was applied for datasets exceeding 50, depending on the data distribution pattern.

Furthermore, statistical analysis was according to the research objectives and hypotheses. The significance test for comparing the characteristics between two study groups was conducted using an unpaired t-test for normally distributed data, while the Mann–Whitney test was applied as an alternative for non-normally distributed data. Statistical analysis for categorical data was performed using the chi-square test if its assumptions were met. Otherwise, Fisher's exact test was used for 2×2 tables, and the Kolmogorov–Smirnov test was applied for tables larger than 2×2. The chi-square test assumption required that no more than 20 % of the expected values in the table be less than 5. A p-value of ≤ 0.05 was considered statistically significant, while a p-value > 0.05 was not. All collected data were recorded in a designated form and analyzed using SPSS version 26.0 for Windows.

Results / Результаты

The findings indicated significant differences in the distribution of age, maternal status, and gestational age between the preeclampsia and non-preeclampsia groups (**Table 1**).

The odds ratio (OR) value above allows to conclude that the possibility of early adolescent patients to experience PE is 0.218 times compared to late adolescent patients with 95 % confidence interval (CI) of 0.094–0.504. The possibility of primiparous vs. multiparous patients to experience PE is 1.986 times (95 % CI = 1.006–3.921). In addition, the possibility of preterm gestational age patients to experience PE is 1.524 times compared to term gestational age patients (95 % CI = 0.910–2.555). No significant inter-group difference in the proportion of very low birth weight, PPCM, HELLP syndrome, and pulmonary edema was found.

In addition, this study showed that PE and non-PE groups differed in the mode of delivery (**Table 2**) and outcomes of low birth weight (LBW) neonates (**Table 3**).

Table 4 shows the possibility of overweight BMI to experience PE is 1.361 times compared to patients with normal BMI (95 % CI = 0.828–2.237). However, no significant difference was found in the proportion of BMI between the preeclampsia and non-preeclampsia groups.

Discussion / Обсуждение

Preeclampsia incidence in young pregnant women and the method of delivery of adolescent pregnant women with preeclampsia / Частота преэклампсии у молодых беременных и методы родоразрешения беременных подросткового возраста с преэклампсией

This study found that out of 310 adolescent pregnant women at the Hasan Sadikin Hospital between 2019 and 2023, 122 experienced PE, while the remaining 188 did not. In addition, the number of primigravida was higher in the group of adolescent pregnancies with PE compared to those who did not experience PE. This is quite high considering that PE has a negative impact on pregnant women, namely being a complicating factor in 2–8 % of pregnancies and is one of the main causes of maternal and fetal morbidity and mortality worldwide [26]. This finding is supported by previous research by J.G.B. Alvez et al., showing a significant difference in the number of antenatal care (ANC) visits from early adolescent mothers who are generally primigravida, aged 10–14 years compared to older adolescents aged 15–19 years [27]. This can be correlated with the study findings reporting that 90.8 %

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Table 1. Comparison of research patient characteristics based on the incidence of preeclampsia.

Таблица 1. Характеристики пациентов на основе частоты развития преэклампсии.

Variable Показатель	Group / Группа		p	OR (95 % CI) ОШ (95 % ДИ)
	Preeclampsia Преэклампсия n = 122	Non-preeclampsia Без преэклампсии n = 188		
Age / Возраст:			0.0001	0.218 (0.094–0.504)
Early adolescence, n (%) Ранний подростковый возраст, n (%)	7 (5.7)	41 (21.8)		
Late adolescence, n (%) Поздний подростковый возраст, n (%)	115 (94.3)	147 (78.2)		
Parity / Роды в анамнезе:			0.045	1.986 (1.006–3.921)
Primipara, n (%) / Первородящие, n (%)	109 (89.3)	152 (80.9)		
Multipara, n (%) / Повторнородящие, n (%)	13 (10.7)	36 (19.1)		
Gestational age / Гестационный возраст:	n = 122	n = 131	0.109	0.109 (0.910–2.555)
Premature, n (%) / Недоношенный, n (%)	50 (41.0)	41 (31.3)		
Mature, n (%) / Доношенный, n (%)	72 (59.0)	90 (68.7)		
Maternal complications / Осложнения у матери:				
PPCM, n (%) / ППКМ, n (%)	2 (1.6)	0 (0.0)	0.154	
HELLP syndrome, n (%) / HELLP-синдром, n (%)	1 (0.8)	0 (0.0)	0.394	
Pulmonary edema, n (%) / Отек легких, n (%)	0 (0.0)	0 (0.0)	1.000	

Note: *OR – odds ratio; CI – 95 % confidence interval; PPCM – peripartum cardiomyopathy.*

Примечание: *ОШ – отношение шансов; 95 % ДИ – 95 % доверительный интервал; ППКМ – перипартальная кардиомиопатия.*

Table 2. Comparison of preeclampsia incidence based on delivery mode.

Таблица 2. Способ родоразрешения в зависимости от частоты развития преэклампсии.

Group Группа	Delivery mode / Способ родоразрешения		p	OR (95 % CI) ОШ (95 % ДИ)
	Per abdominal Через брюшную полость n = 111	Per vaginal Вагинальный n = 199		
Preeclampsia, n (%) / Преэклампсия, n (%)	72 (64.9)	50 (25.1)	0.0001	5.502 (3.322–9.111)
Non-preeclampsia, n (%) / Без преэклампсии, n (%)	39 (35.1)	149 (74.9)		

Note: *OR – odds ratio; CI – 95 % confidence interval.*

Примечание: *ОШ – отношение шансов; 95 % ДИ – 95 % доверительный интервал.*

Table 3. Comparison of preeclampsia incidence based on birth weight.

Таблица 3. Масса тела при рождении в зависимости от частоты развития преэклампсии.

Group Группа	LBW / НМТ n = 69	VLBW / ОНМТ n = 16	p	OR (95 % CI) ОШ (95 % ДИ)
Preeclampsia, n (%) / Преэклампсия, n (%)	56 (81.2)	9 (56.3)	0.05	3.350 (1.053–10.660)
Non-preeclampsia, n (%) / Без преэклампсии, n (%)	13 (18.8)	7 (43.8)		

Note: *LBW – low birth weight; VLBW – very low birth weigh; OR – odds ratio; CI – 95 % confidence interval.*

Примечание: *НМТ – низкая масса тела; ОНМТ – очень низкая масса тела; ОШ – отношение шансов; 95 % ДИ – 95 % доверительный интервал.*

of pregnant adolescents have a negative attitude towards their pregnancy such as anxiety, disappointment, sadness, and indifference towards pregnancy due to the high rate of unplanned pregnancies in adolescents.This unfavorable perception may lead to delays in maternal ANC visits and hinder early identification of risk factors, ultimately having adverse effects on pregnancy, including an increased PE incidence [28]. Primigravida has been linked to a threefold higher risk of developing PE, potentially due to immune maladaptation and maternal alloimmune responses

Table 4. Comparison of body mass index (BMI) based on preeclampsia incidence.

Таблица 4. Частота развития преэклампсии в зависимости от индекса массы тела (ИМТ).

Group Группа	Preeclampsia Преэклампсия n = 121	Non-preeclampsia Без преэклампсии n = 178	p	OR (95 % CI) ОШ (95 % ДИ)
Overweight, n (%) / Избыточный вес, n (%)	42 (34.7)	50 (28.1)	0.223	1.361 (0.828–2.237)
Normal BMI, n (%) / Нормальный ИМТ, n (%)	79 (65.3)	128 (71.9)		

Note: *OR – odds ratio; CI – 95 % confidence interval.*

Примечание: *ОШ – отношение шансов; 95 % ДИ – 95 % доверительный интервал.*

triggered by the rejection of paternally derived antigens in fetal allograft [29].

In addition, we also found that in adolescent pregnancies, especially those experiencing PE, the dominant mode of delivery was through the abdomen and showing high statistical significance ($p < 0.01$). This is in line with research conducted by K. Pasokpuckdee and D. Boriboonhirunsarn (2023), which showed that PE significantly increased the overall abdominal birth rate [30].

Regarding adverse fetal and neonatal outcomes, our findings are consistent with most previous studies, especially that adolescent pregnancies with PE result in more LBW neonates. This can occur due to placental and fetal vascularization defects resulting in PE-related fetal biological immaturity [31].

Body mass index in adolescent pregnant women and the incidence of preeclampsia / Индекс массы тела у беременных подросткового возраста и частота преэклампсии

The results of this study showed no positive relation between abnormal BMI in adolescent pregnant women and PE incidence. This shows that pregnant women in adolescence with excess body weight, grade 1 obesity, and grade 2 obesity tended to have a higher insignificant risk of experiencing PE. However, this finding is still controversial because it differs from the study by A. Talitha and A.M.P. Romani (2022) showing that obesity in pregnant women has a significant negative effect on pregnancy, directly and indirectly [32]. This condition can be caused by metabolic dysfunction occurring in pregnant women with obesity and increased basal inflammation. Both conditions can lead to several obstetric complications, including gestational diabetes and hypertension, which elevate PE risk in pregnant women. Based on the study by I. Brosens et al. (2019), adolescents with a high body mass index (≥ 30) are at greater risk of developing PE because obesity contributes to endothelial dysfunction and systemic inflammation that can trigger hypertension. In addition, excessive weight gain during pregnancy in obese adolescents may worsen PE risk, because it can cause additional stress on the cardiovascular system and increase blood pressure [33].

Increased BMI is not the only factor that causes PE in adolescents. There are several causes that trigger PE in adolescent subjects, which include uterine immaturity, obesity, and cardiovascular risk factors. Uterine immaturity in adolescents can lead to improper placental placement, which contributes to PE risk. Factors such as obesity and cardiovascular risk also play a role in increasing PE likelihood in pregnant adolescents. Uterine immaturity in adolescents causes placentation that is not deep enough because it exerts insufficient adaptive capacity to support pregnancy including vascular remodeling required for optimal blood flow to the placenta. This condition triggers an inflammatory response due to endothelial dysfunction and increased vascular resistance, which triggers hypertension and PE risk symptoms [33].

Another study that is in line with our data was conducted retrospectively in 2014 at the King Khalid University Hospital in Saudi Arabia showed that pregnant women were categorized based on BMI levels and the presence of gestational diabetes to evaluate the independent impact of such factors on adverse pregnancy outcomes. The analysis of around 2700 women demonstrated the detrimental effects of both obesity and gestational diabetes mellitus on pregnancy outcomes, including PE. Furthermore, PE risk was found to be higher when obesity and gestational diabetes coexisted compared to when only one of these conditions was present [34].

Although previous studies have shown that obesity increases PE risk, only about 10 % of women identified as obese based on BMI actually develop PE [35, 36]. This condition suggests that estimating PE risk using BMI alone is still very limited. Therefore, other markers are still needed to provide clinical risk stratification and new insights into the pathophysiology underlying the relationship between BMI and PE. In addition, this may occur because the sample grouping with the definition of obesity in Indonesia (≥ 25 kg/m^2) differs from that used globally (≥ 30 kg/m^2) [37].

The incidence of adolescent pregnant women experiencing PE with complications / Частота беременных подросткового возраста с преэклампсией и осложнениями

This study found that there were 2 adolescent pregnant women who experienced complications of PPCM and 1 pregnant woman who experienced HELLP syndrome. Although not statistically significant, both conditions

remain hazardous, as their prognosis and complications can elevate maternal mortality and morbidity risks [38]. Previous research has indicated that PE-related complications occur in approximately 3 % of pregnancies, while hypertensive disorders overall affect around 5–10 % of pregnancies. These hypertensive disorders are linked to high maternal, fetal, and infant mortality rates, along with severe morbidity, particularly in cases of severe PE, eclampsia, hemolysis, elevated liver enzymes, and HELLP syndrome [39].

Study limitations / Ограничения исследования

This study used a retrospective design that could lead to selection bias (e.g., incomplete records). The results of this study were limited to the subject groups at the Dr. Hasan Sadikin General Hospital. Therefore, in the future, additional data from the community is needed to complete the results of the current study. Homogeneous data conditions allow for data collection bias from potential complications such as HELLP syndrome in adolescent pregnancy. Generalization may be limited to hospital-based populations so that community data can complement the findings.

Future research directions / Будущие направления исследований

Researchers recommend conducting further research by using longitudinal studies to explore the trajectory of BMI during pregnancy and its association with PE; investigating biomarkers (e.g., angiogenic factors) to improve risk stratification.

Conclusion / Заключение

There are significant differences between the variables of age, gravida, mode of delivery, and LBW in the pre-eclampsia and non-preeclampsia groups. There are many risk factors suggested to play roles in PE pathogenesis and outcomes in adolescent pregnancy. Moreover, BMI alone is not sufficient to be a PE predictor, so further research is needed on the risk stratification of adolescent pregnancy more comprehensively.

ARTICLE INFORMATION	ИНФОРМАЦИЯ О СТАТЬЕ
Received: 11.01.2025. **Revision received:** 23.04.2025. **Accepted:** 22.05.2025. **Published online:** 26.05.2025.	**Поступила:** 11.01.2025. **В доработанном виде:** 23.04.2025. **Принята к печати:** 22.05.2025. **Опубликована онлайн:** 26.05.2025.
Author's contribution	**Вклад авторов**
All authors contributed equally to the article.	Все авторы внесли равный вклад в написание и подготовку рукописи.
All authors have read and approved the final version of the manuscript.	Все авторы прочитали и утвердили окончательный вариант рукописи.
Conflict of interests	**Конфликт интересов**
The authors declare no potential conflict of interest.	Авторы заявляют об отсутствии конфликта интересов.
Funding	**Финансирование**
We declare that we do not receive external funding for this study.	Авторы заявляют об отсутствии финансирования.
Patient consent	**Согласие пациентов**
Obtained.	Получено.
Ethics declarations	**Этические аспекты**
The study was conducted in accordance with the Declaration of Helsinki requirements. The study was approved by the Ethics Committee Review Board of Hasan Sadikin General Hospital, by the Institutional Review Board of Faculty of Medicine, Universitas Padjadjaran, Protocol DP.04.03/D.XIV.6.5/172/2024, dated of 21.05.2024.	Исследование проводилось в соответствии с требованиями Хельсинкской декларации Всемирной медицинской ассоциации. Исследование одобрено Наблюдательным советом комитета по этике больницы имени Хасана Садыкина, Институциональным наблюдательным советом медицинского факультета Университета Паджаджаран, протокол DP.04.03/D.XIV.6.5/172/2024 от 21.05.2024.
Data sharing	**Раскрытие данных**
The dataset used and/or analysed during the current study available from the corresponding author on reasonable request.	Массив данных, использованный и/или проанализированный в ходе настоящего исследования, может быть предоставлен корреспондирующим автором по обоснованному запросу.
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