

Original Article

Factors associated with pre eclampsia: A cross-sectional study

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Abstract

Background: Preeclampsia remains a major cause of maternal and perinatal morbidity and mortality. Routine data from Musi Banyuasin Regency indicate an increase in reported cases from 460 in 2021 to 753 in 2025, while local evidence on factors associated with preeclampsia in referral hospitals remains limited.

Objective: To examine the associations of maternal age, parity, history of preeclampsia, obesity, and knowledge with preeclampsia and to estimate the independent associations of parity and obesity after adjustment in a multivariable model.

Methods: An analytical cross-sectional study was conducted at Sekayu Regional General Hospital, Musi Banyuasin Regency, from February to May 2026. A purposive sample of 97 pregnant women was included. Clinical variables were obtained from medical records, and knowledge was assessed using a structured questionnaire. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for bivariable analyses; Fisher's exact test was applied when a zero cell occurred. Binary logistic regression was used for the multivariable model. Reporting was guided by STROBE.

Results: Of 97 participants, 38 (39.2%) had preeclampsia. In bivariable analysis, multiparous women had a higher proportion of preeclampsia than primiparous women; with primiparity as the exposure category, the OR was 0.245 (95% CI 0.101–0.596; $p=0.002$). A history of preeclampsia showed a very strong association, but the OR could not be estimated because of complete separation (Fisher's exact $p<0.001$). Obesity was associated with higher odds of preeclampsia (OR=6.000; 95% CI 2.394–15.036; $p<0.001$). Low knowledge was also associated with preeclampsia in bivariable analysis (OR=2.339; 95% CI 1.011–5.412; $p=0.047$), whereas maternal age was not significantly associated (OR=2.014; 95% CI 0.781–5.193; $p=0.147$). In the final model, obesity (aOR=5.848; 95% CI 2.218–15.423; $p<0.001$) and parity (aOR=0.253; 95% CI 0.096–0.663; $p=0.005$) remained associated with preeclampsia.

Conclusion: Obesity and parity were independently associated with preeclampsia in this hospital-based sample. A history of preeclampsia showed a strong association but could not be modeled using standard logistic regression because of complete separation. Interpretation should account for the cross-sectional design, purposive sampling, small sample size, and measurement limitations affecting several variables.

Background

Preeclampsia is a multisystem hypertensive disorder of pregnancy that arises after 20 weeks of gestation and may be accompanied by proteinuria or signs of maternal or uteroplacental organ dysfunction. Current understanding identifies impaired placental perfusion, the release of antiangiogenic and inflammatory factors, and maternal endothelial dysfunction as important components of its pathogenesis (American College of Obstetricians and Gynecologists, 2020; Brown et al., 2018; Chappell et al., 2021; Erez et al., 2022; Jung et al., 2022; Magee et al., 2022; Phipps et al., 2019). Its clinical spectrum ranges from hypertension without severe features to eclampsia, HELLP syndrome, acute kidney injury, pulmonary edema, hepatic dysfunction, fetal growth restriction, and maternal or perinatal death (Cífková, 2023; Duley et al., 2019; Fox et al., 2019; Gestational Hypertension and Preeclampsia, 2020; Sharma et al., 2024).

Epidemiologically, preeclampsia remains a global health concern and contributes substantially to the burden of hypertensive disorders of pregnancy, particularly in low- and middle-income countries (Hutcheon et al., 2019; Melamed et al., 2019; Say et al., 2018; Steegers et al., 2019; World Health Organization, 2022). In Indonesia, the 2020 Population Census Long Form estimated a maternal mortality ratio of 189 per 100,000 live births nationally and 175 per 100,000 live births in South Sumatra (Badan Pusat Statistik, 2023). The 2023 Indonesia Health Profile also identified hypertension in pregnancy as the most frequently classified cause of maternal death that year, accounting for 412 deaths (Kementerian Kesehatan Republik Indonesia, 2024). These figures underscore the importance of early detection and management of hypertensive pregnancy risks in strategies to reduce maternal mortality (Direktorat Kesehatan Keluarga, 2023; Kementerian Kesehatan Republik Indonesia, 2022; Ministry of Health Republic of Indonesia, 2020; World Health Organization, 2019).

In Musi Banyuasin Regency, the local health profile data used in this study showed an increase in preeclampsia cases from 460 in 2021 to 525 in 2022, 652 in 2023, 715 in 2024, and 753 in 2025. At Sekayu Regional General Hospital, recorded cases also increased from 456 in 2023 to 501 in 2024 and 632 in 2025. As Sekayu Regional General Hospital is a referral hospital, these figures should be interpreted as the case burden within referral services rather than estimates of prevalence in the general population. Hospital-based studies in Indonesia have similarly demonstrated variations in the proportions and determinants of preeclampsia across regions, reflecting differences in clinical profiles, referral patterns, and healthcare contexts (Kunawati Tungga Dewi, 2025; Mahendra et al., 2021; Pratiwi et al., 2024; Putri Ariyan et al., 2022; Rohaeni & Simanjuntak, 2024; Sari et al., 2023; Umairo et al., 2025; Utami & Handayani, 2020).

Risk factors for preeclampsia are multifactorial. Extremes of maternal age, parity, previous preeclampsia, obesity, chronic hypertension, diabetes, kidney disease, and other obstetric factors have repeatedly been associated with increased risk (Bartsch et al., 2016; Macedo et al., 2020; Siregar & Nasution, 2021; Wulandari & Putri, 2020; Yulianti et al., 2023). A history of preeclampsia is among the strongest clinical markers of recurrence, while higher body mass index before or early in pregnancy exhibits a dose-response relationship with hypertensive disorders of pregnancy (Bartsch et al., 2016; Sun et al., 2024; Xiong et al., 2025). Potential biological mechanisms linking obesity to preeclampsia include chronic low-grade inflammation, insulin resistance, oxidative stress, adipokine imbalance, and endothelial dysfunction (Abdalla et al., 2025; Adu-Bonsaffoh et al., 2017; Aouache et al., 2018; Gupta et al., 2005; Haram et al., 2019; Laresgoiti-Servitje & Gomez-Lopez, 2012; Possomato-Vieira & Khalil, 2016; Roberts & Hubel, 2019).

Findings from Indonesian studies on maternal age and parity have not always been consistent, especially in referral hospital samples that may be enriched with high-risk cases (Lestari, 2024; Rahayu & Lestari, 2022; Sari & Handayani, 2022). Maternal knowledge is relevant to recognizing warning signs and seeking care; however, a direct relationship between knowledge measured after diagnosis and the occurrence of preeclampsia is difficult to interpret because of potential reverse causality and measurement bias (Hasnah, 2019; Rahmawati et al., 2023). Accordingly, the more specific local research gap concerns how maternal age, parity, history of preeclampsia, obesity, and

knowledge are associated with preeclampsia among patients at Sekayu Regional General Hospital, rather than the full range of unmeasured social or healthcare factors.

This study aimed to examine the associations between maternal age, parity, history of preeclampsia, obesity, and knowledge and the occurrence of preeclampsia among pregnant women at Sekayu Regional General Hospital in 2026, and to estimate the independent associations of variables that could appropriately be included in a logistic regression model. The findings are expected to inform clinical risk stratification and antenatal service planning without interpreting cross-sectional associations as causal relationships.

Methods

Study Design

This was a quantitative analytical study with a cross-sectional design. Reporting was guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement, which specifically covers cross-sectional studies (von Elm et al., 2007). The design was used to assess the associations of maternal age, parity, history of preeclampsia, obesity, and knowledge with preeclampsia status during the same observation period; therefore, temporality and causality cannot be established.

Setting and Study Period

The study was conducted at Sekayu Regional General Hospital (RSUD Sekayu), Musi Banyuasin Regency, South Sumatra, from February to May 2026. Participant recruitment and questionnaire administration took place during this period. Clinical variables were extracted from medical records for index pregnancies documented during the study period. Thus, the study combined primary data collected during the research period with previously documented clinical information from the same patients' medical records.

Population, Sampling, and Eligibility Criteria

The source population documented in the study records comprised 3,205 pregnant women who received care and/or delivered at Sekayu Regional General Hospital. The analytical sample consisted of 97 participants selected through purposive sampling according to predefined criteria. Inclusion criteria were pregnant women who

received inpatient care or delivered at the hospital and had medical records in 2026, had a gestational age of ≥ 20 weeks, and had the information required for analysis. Exclusion criteria in the original protocol were incomplete medical records and the presence of severe chronic diseases considered likely to influence the outcomes. The available source documentation did not specify individual diagnoses within the severe chronic disease category; therefore, specific diagnoses were not reconstructed retrospectively.

The sample size of 97 was predetermined in the original study protocol using a population-based approach (Slovin's formula). Because this approach was not based on effect size, proportions in two groups, statistical power, or the number of regression parameters, the sample size calculation was not replaced post hoc. This limitation was taken into account during interpretation. There were 38 preeclampsia outcomes, equivalent to 7.6 events per candidate predictor for five predictors; the final model with two parameters had approximately 19 events per parameter. Parsimonious modeling was adopted to avoid an overly complex model in this small sample (Dahlan, 2022; Grove & Gray, 2021; Polit & Beck, 2021).

Participant Flow

All 97 participants in the analytical dataset were included in the analysis. The source documentation did not separately record the numbers of patients screened but found ineligible, declining participation, or excluded because of incomplete data; these counts were not reconstructed to avoid fabrication. The participant flow that could be confirmed from the available source documents is shown in Figure 1.

Variables and Measurements

The dependent variable was the occurrence of preeclampsia. Preeclampsia status was extracted from clinical diagnoses documented in medical records for pregnancies at ≥ 20 weeks of gestation. Contemporary ACOG and ISSHP definitions include new-onset hypertension during pregnancy accompanied by proteinuria or, in the absence of proteinuria, evidence of maternal and/or uteroplacental organ dysfunction. These definitions were used as an interpretive framework, but patient diagnoses were not retrospectively reclassified beyond the

information available in the medical records (American College of Obstetricians and Gynecologists, 2020; Brown et al., 2018; Magee et al., 2022; Peck Palmer & Das, 2020; Sibai, 2020).

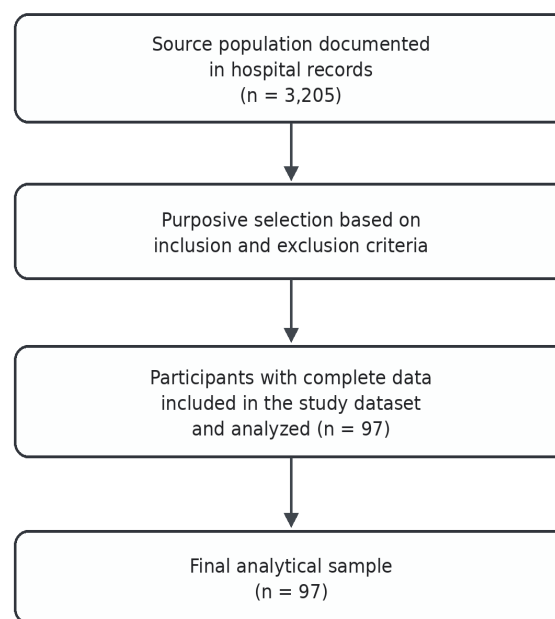


Figure 1. Participant flow based on the available source documentation

Maternal age was categorized as higher risk at < 20 or ≥ 35 years and lower risk at 20–34 years. Parity was categorized as primiparous or multiparous. History of preeclampsia was categorized according to the presence or absence of preeclampsia in a previous pregnancy. Obesity was defined by a body mass index (BMI) of ≥ 30 kg/m². The source documents did not specify whether the weight used to calculate BMI was obtained before pregnancy, during the first trimester, or at the time of care. Because gestational weight gain and edema may affect classification, uncertainty regarding measurement timing was considered a measurement limitation (Cunningham et al., 2022; Xiong et al., 2025).

Knowledge of preeclampsia was assessed using a structured questionnaire and categorized as high or low according to the study dataset. The questionnaire was administered between February and May 2026, after clinical pregnancy status was already available in the course of care. The source documents available for revision did not provide the instrument's name, number of items, score range, categorical cutoff, or validity and reliability testing results; these details were not retrospectively invented. Consequently, findings regarding knowledge were interpreted

cautiously because of possible measurement error and reverse causality.

Data Collection

Secondary data on preeclampsia diagnosis, age, parity, history of preeclampsia, and obesity status were obtained from medical records, whereas primary data on knowledge were collected using a structured questionnaire. Information was then transcribed to a checklist organized by study variable and checked for completeness before analysis. Using medical records for clinical variables reduced reliance on participant recall but did not eliminate the possibility of misclassification when clinical documentation or the timing of anthropometric measurements was inconsistent.

Bias and Strategies to Limit Bias

Potential biases were considered during interpretation. First, purposive sampling at a referral hospital may introduce selection bias and increase the proportion of preeclampsia cases relative to the general population; therefore, the results were not interpreted as community prevalence. Second, information bias may arise from the completeness and accuracy of medical records, particularly for obstetric history and BMI. Third, recall bias was relatively limited for clinical variables because medical records were the primary source, although knowledge data came from participants' direct responses. Fourth, because knowledge was measured after the clinical diagnosis was available, women who had received a diagnosis or education may have had different knowledge as a consequence of that experience; this possibility of reverse causality precludes temporal interpretation. Fifth, residual confounding remains possible because factors such as chronic hypertension, diabetes, kidney disease, interpregnancy interval, socioeconomic status, and antenatal care (ANC) characteristics were not consistently available in the analytical dataset.

Data Analysis

Univariable analyses summarized frequencies and percentages. For 2×2 tables, unadjusted odds ratios (ORs) and 95% confidence intervals (CIs) were used to quantify associations. The p-values in the bivariable table were aligned with OR estimates using simple binary logistic regression/Wald tests. For history of

preeclampsia, a zero cell led to complete separation under ordinary maximum-likelihood logistic regression. Therefore, Fisher's exact test was used for the bivariable test, and a conventional OR was not reported for this variable (Heinze & Schemper, 2002).

Multivariable analysis used binary logistic regression based on the final model in the original analytical output, retaining parity and obesity. History of preeclampsia was not included in conventional logistic regression because of complete separation. Penalized/Firth logistic regression would be appropriate if individual-level data were available, but it could not be reconstructed from the aggregate tables alone in the revision documents (Heinze & Schemper, 2002; Hosmer et al., 2021). The B coefficients, standard errors (SEs), Wald statistics, adjusted ORs (aORs), 95% CIs, and p-values of the final model are reported consistently. The two-sided significance threshold was $p < 0.05$. The available source output did not include diagnostics for multicollinearity, interactions, goodness of fit, or influential observations. These results were therefore not retrospectively invented, and their absence is explicitly acknowledged as a limitation

Results

The analytical sample comprised 97 pregnant women, of whom 38 (39.2%) had preeclampsia and 59 (60.8%) did not. Most participants were aged 20–34 years (76.3%), were multiparous (53.6%), had no history of preeclampsia (81.4%), were not obese (66.0%), and had high knowledge (59.8%) (Table 1).

Maternal age was not significantly associated with preeclampsia (OR=2.014; 95% CI 0.781–5.193; $p=0.147$). The proportion with preeclampsia was higher among multiparous women (53.8%) than among primiparous women (22.2%); for primiparous versus multiparous women, the OR was 0.245 (95% CI 0.101–0.596; $p=0.002$). All 18 participants with a history of preeclampsia experienced preeclampsia in the index pregnancy, producing a zero cell in the non-preeclampsia group. Fisher's exact test yielded $p < 0.001$, and the standard maximum-likelihood OR could not be estimated. Obesity was associated with sixfold higher odds of preeclampsia (OR=6.000; 95% CI 2.394–15.036; $p < 0.001$). Low knowledge was associated with preeclampsia in bivariable

analysis (OR=2.339; 95% CI 1.011–5.412; p=0.047) (Table 2)

Table 1. Distribution of participant characteristics and preeclampsia status (n=97)

Variable	Category	n	%
Preeclampsia status	Preeclampsia	38	39.2
	No preeclampsia	59	60.8
Maternal age	Lower risk (20–34 years)	74	76.3
	Higher risk (<20 or ≥35 years)	23	23.7
Parity	Multiparous	52	53.6
	Primiparous	45	46.4
History of preeclampsia	No history	79	81.4
	History present	18	18.6
Obesity	Not obese	64	66.0
	Obesity	33	34.0
Knowledge	High	58	59.8
	Low	39	40.2

Table 2. Bivariable associations between maternal factors and preeclampsia

Variable	Category	Preeclampsia n (%)	No preeclampsia n (%)	Total n (%)	OR (95% CI)	p-value
Maternal age	Higher risk	12 (52.2)	11 (47.8)	23 (100)	2.014 (0.781–5.193)	0.147
	Lower risk	26 (35.1)	48 (64.9)	74 (100)	Reference	
Parity	Primiparous	10 (22.2)	35 (77.8)	45 (100)	0.245 (0.101–0.596)	0.002
	Multiparous	28 (53.8)	24 (46.2)	52 (100)	Reference	
History of preeclampsia	Yes	18 (100)	0 (0)	18 (100)	Not estimable	<0.001*
	No	20 (25.3)	59 (74.7)	79 (100)	Reference	
Obesity	Obesity	22 (66.7)	11 (33.3)	33 (100)	6.000 (2.394–15.036)	<0.001
	Not obese	16 (25.0)	48 (75.0)	64 (100)	Reference	
Knowledge	Low	20 (51.3)	19 (48.7)	39 (100)	2.339 (1.011–5.412)	0.047
	High	18 (31.0)	40 (69.0)	58 (100)	Reference	

The final logistic regression model retained parity and obesity. Obesity was associated with higher odds of preeclampsia after adjustment for parity (aOR=5.848; 95% CI 2.218–15.423; p<0.001). With multiparous women as the reference category, primiparous women had an aOR of 0.253

(95% CI 0.096–0.663; p=0.005). History of preeclampsia was not estimated in the conventional logistic regression model because of complete separation in the bivariable data (Table 3).

Table 3. Multivariable logistic regression model of factors associated with preeclampsia

Variable	B	SE	Wald	aOR	95% CI	p-value
Parity (primiparous vs multiparous)	-1.374	0.493	7.773	0.253	0.096–0.663	0.005
Obesity (obese vs not obese)	1.766	0.495	12.745	5.848	2.218–15.423	<0.001

Discussion

This study found that obesity and parity remained associated with preeclampsia status in the final regression model. History of preeclampsia showed a very strong association in bivariable analysis; however, all participants with this history were in the preeclampsia group, resulting in complete

separation and preventing reliable estimation of the OR using standard logistic regression. Low knowledge showed a bivariable association after the p-value was calculated consistently with the OR and 95% CI, whereas age was not significantly associated. Given the cross-sectional design, all

findings must be interpreted as associations rather than causal relationships.

Maternal age categorized as higher risk (<20 or ≥35 years) was not statistically associated with preeclampsia in this sample. The literature indicates that extremes of age may contribute to the risk of hypertension during pregnancy, but the magnitude of association is strongly influenced by the distribution of comorbidities, parity, and characteristics of the study population (Macedo et al., 2020; Rahayu & Lestari, 2022; Zhang et al., 2019). In a small referral hospital sample, the clinical case mix and variation in other risk factors may reduce the ability to detect an independent association with age. This finding does not imply that age is clinically irrelevant; rather, the dataset did not provide sufficiently precise evidence of an association.

The direction of the association with parity in this study differs from the original manuscript's narrative and from some literature identifying nulliparity or first pregnancy as a risk factor. The observed data showed preeclampsia in 53.8% of multiparous women versus 22.2% of primiparous women, with an OR of 0.245 for primiparous versus multiparous women. This finding should be reported as observed and should not be explained by assuming that primiparous women are less experienced. Previous systematic reviews suggest that nulliparity may increase risk in the general population, but the direction of association may differ in referral samples because of case mix, obstetric history, interpregnancy intervals, comorbidities, or incompletely measured confounding (Bartsch et al., 2016; Rahayu & Lestari, 2022; Sari & Handayani, 2022). Therefore, the parity finding in this study is best regarded as a locally observed association requiring confirmation in larger samples with more comprehensive confounder measurement.

A history of preeclampsia demonstrated a very strong association: all 18 women with a previous history experienced preeclampsia during the index pregnancy. The direction of this finding is consistent with evidence that previous preeclampsia is among the strongest predictors of recurrence (Bartsch et al., 2016; American College of Obstetricians and Gynecologists, 2020; Magee et al., 2022). However, the zero cell caused complete separation, so reporting an extremely large OR or p-value from standard regression

could be misleading. Fisher's exact test was therefore used for bivariable testing, and the multivariable effect of previous preeclampsia was not forced into an ordinary logistic regression model. Future studies with individual-level data and larger samples could use penalized/Firth logistic regression to obtain more stable estimates under separation (Heinze & Schemper, 2002).

Obesity was the factor with the clearest independent association in the final model: women with obesity had an aOR of 5.848 for preeclampsia after adjustment for parity. The direction of this association is consistent with evidence showing that obesity before or early in pregnancy increases the risk of preeclampsia and other hypertensive disorders of pregnancy (Siregar & Nasution, 2021; Sun et al., 2024; Xiong et al., 2025). Biologically, excess adipose tissue may be linked to insulin resistance, inflammatory activation, oxidative stress, angiogenic imbalance, and endothelial dysfunction, all of which are important pathways in preeclampsia pathogenesis (Abdalla et al., 2025; Adu-Bonsaffoh et al., 2017; Aouache et al., 2018; Gupta et al., 2005; Haram et al., 2019; Mustary et al., 2024; Possomato-Vieira & Khalil, 2016). Nevertheless, this study did not measure dietary patterns, physical activity, adipokines, insulin resistance, or inflammatory biomarkers; these mechanisms are explanations supported by the literature rather than direct findings of the present study.

Low knowledge was associated with preeclampsia in bivariable analysis after correction of the statistical inconsistency (OR=2.339; 95% CI 1.011–5.412; $p=0.047$), but its interpretation differs from that of biological factors. The questionnaire was administered during care after clinical status was known, so the diagnosis, counseling, or exposure to information from health professionals may have influenced knowledge scores. This creates the possibility of reverse causality and prevents determination of the temporal relationship. Knowledge therefore should not be interpreted as a direct cause of preeclampsia based on these data. Instead, this finding highlights the need for longitudinal research that measures knowledge before the outcome occurs using a validated instrument (Hasnah, 2019; Rahmawati et al., 2023).

More broadly, these findings are consistent with the understanding that preeclampsia is a

heterogeneous syndrome involving interactions among maternal, placental, vascular, metabolic, and immunological factors (Al-Jameil, 2013; Chelli et al., 2024; Erez et al., 2022; Jung et al., 2022; Laresgoiti-Servitje & Gomez-Lopez, 2012; Roberts & Hubel, 2019). National and regional evidence also indicates that risk profiles may vary across hospitals and populations (Kunawati Tungga Dewi, 2025; Lestari, 2024; Mahendra et al., 2021; Rohaeni & Simanjuntak, 2024; Sari et al., 2023; Umaiyo et al., 2025; Yulianti et al., 2023). Consequently, prediction models and screening strategies should not rely on a single factor but should incorporate structured risk assessment and the broader clinical context.

From a practice perspective, obesity and previous preeclampsia are factors that can be identified at the first healthcare contact. International and national clinical guidelines support assessment of risk factors early in pregnancy, adequate blood pressure monitoring, and strengthened ANC for high-risk groups (American College of Obstetricians and Gynecologists, 2020; Direktorat Kesehatan Keluarga, 2023; Kementerian Kesehatan Republik Indonesia, 2023; Magee et al., 2022; World Health Organization, 2019, 2022). This study did not evaluate the effectiveness of any particular intervention; thus, its practical implications concern risk stratification and guideline-concordant care, not claims that a particular intervention would reduce the incidence of preeclampsia in this population.

Several clinical and methodological references underpinning the manuscript also emphasize the importance of consistent outcome definitions, effect estimates accompanied by measures of precision, and interpretation appropriate to the observational design (Cunningham et al., 2022; Fox et al., 2019; Grove & Gray, 2021; Hosmer et al., 2021; Karrar, 2024; Magee et al., 2022; Polit & Beck, 2021). The literature on maternal and perinatal consequences and advances in diagnosis further supports viewing preeclampsia as a complex clinical condition rather than simply elevated blood pressure (Peck Palmer & Das, 2020; Putri Ariyan et al., 2022; Sharma et al., 2024; Sibai, 2020).

Strengths and Limitations

This study's strengths include the use of hospital clinical data and questionnaires in a local referral population, reporting of association estimates

with 95% CIs, and appropriate modification of analytical methods when a zero cell was encountered. The revision also explicitly distinguishes bivariable associations, adjusted associations, and limits to causal inference. Several important limitations remain. First, the cross-sectional design cannot establish temporality. Second, purposive sampling in a single referral hospital increases the potential for selection bias and limits generalizability to the general population. Third, the sample was relatively small, and the original sample size was calculated using a population-based formula rather than a power-based approach for an analytical study. Fourth, history of preeclampsia produced a zero cell and complete separation, precluding a conventional OR estimate. Fifth, the timing of BMI measurement was not documented, so obesity status may have been misclassified because of gestational weight gain or edema. Sixth, psychometric details of the knowledge instrument were unavailable, and knowledge was measured after clinical status was known, introducing potential measurement bias and reverse causality. Seventh, the specific diagnoses underlying the severe chronic disease exclusion category were not documented in detail. Eighth, several important confounders—including chronic hypertension, diabetes, kidney disease, interpregnancy interval, socioeconomic status, and regularity of ANC—were not consistently available. Ninth, diagnostic output for multicollinearity, interactions, goodness of fit, and influential observations was absent from the source records and could not be retrospectively verified.

Implications for Practice and Research

In clinical practice, BMI should be assessed before pregnancy or as early as possible during pregnancy, obstetric history including previous preeclampsia should be documented, and ANC risk stratification should be conducted consistently in accordance with guidelines. Within referral services, risk-factor data can guide monitoring intensity and referral needs without treating any identified factor as the sole cause. Future research would benefit from prospective cohort designs using consecutive or population-based sampling, BMI measurement before or early in pregnancy, validated knowledge instruments administered before diagnosis, and comprehensive recording of clinical confounders.

These improvements would strengthen temporal validity and enable more complete adjustment. If separation persists, penalized logistic regression could be considered.

Conclusion and Recommendation

Among pregnant women studied at Sekayu Regional General Hospital in 2026, obesity and parity were independently associated with preeclampsia in the final model. A history of preeclampsia showed a very strong bivariable association but could not be estimated using conventional logistic regression because of complete separation. Low knowledge was associated with preeclampsia in bivariable analysis, whereas age showed no significant association. These findings apply to a referral hospital sample and cannot be directly generalized to the general population or interpreted as causal relationships.

Sekayu Regional General Hospital and related healthcare facilities are encouraged to strengthen preconception or early-pregnancy BMI screening, systematic assessment of previous preeclampsia and obstetric risk factors, and risk-stratified ANC monitoring in accordance with clinical guidelines. Future studies should use prospective designs, more representative sampling, power-based sample size calculations, standardized anthropometric measurements, and validated knowledge instruments

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The authors declare no competing interests.

Declaration on the Use of AI

No AI tools were used in the preparation of this manuscript.

Data Availability Statement

Data sharing is not applicable to this article.

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