ONLINE FIRST

ORIGINAL ARTICLE

Maternal Risk Factors in Predicting Pregnancy Risk Levels Using the PRESMIL Application

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doi: 10.22442/jlumhs.2026.01434

ABSTRACT
OBJECTIVE: To analyze various factors related to pregnancy risks among pregnant women.
METHODOLOGY: This study was conducted at six health centres (Sungai Besar Community, Guntung Manggis Community, Landasan Ulin Timur Community, Cempaka Community Health Centre, Pemulangan Dalam Community Health Centre, Tambarangan Community Health Centre) in South Kalimantan from April to November 2025, and used a cross-sectional design. The study area had a total of 133 pregnant women. Sampling used simple random sampling. Using the Slovin formula, 100 participants were selected as samples. SPSS and the chi-square test were used to analyze data collected via a questionnaire. PRESMIL is a scientifically validated mobile pregnancy risk screening application (S-CVI/Mean 0.94; Cronbach's alpha 0.75). This application effectively identifies risk factors for pregnancy complications, is easily accessible, integrates with community health centre documentation systems, and is evidence-based, supporting early detection of high-risk pregnancies in Indonesia.
RESULTS: The findings show that various factors are closely related to pregnancy, including age, parity, and pregnancy interval, each with the same p value of 0.000. This is not much different from factors such as a history of cesarean delivery, miscarriage, fetal abnormalities, and anemia, with p-values of (0.003; 0.001; 0.007 and 0.005) respectively.
CONCLUSION: It was concluded that the PRESMIL application could assess the risk of pregnancy and provide preventive measures to reduce the risk of pregnancy.

KEYWORDS: PRESMIL, Risk Prediction, Risk Prevention, Pregnant Women, Maternal Health

INTRODUCTION

Pregnancy complications remain a significant public health challenge worldwide, with maternal mortality (MMR) and infant mortality (IMR) rates remaining high in many countries [1]. Early identification of pregnant women at risk of complications during delivery is a fundamental aspect of antenatal care and a key strategy in preventing maternal mortality [2]. Research shows that the prevalence of high-risk pregnancies reaches 14.4%, with mothers with high-risk pregnancies being 4.2 times more likely to experience severe maternal morbidity during delivery [3].

Risk assessment is a key component of antenatal care (ANC) services and has been proven to improve maternal and perinatal outcomes [4]. Comprehensive prenatal screening includes observation of specific outcomes for high-risk pregnancies, therapeutic interventions, and education about health emergencies and appropriate responses [5].

Although the importance of pregnancy risk screening is widely recognized, its implementation continues to face various challenges. The checklist-based screening method used by the National Institute for Health and Care Excellence (NICE) only achieves a 30% detection rate for all preeclampsia and 40% for preterm preeclampsia, with a 10% screen-positive rate[6]. The sensitivity and specificity of this checklist-based system are low because the individual risks of each risk factor are not accounted for in proportion to their relative importance[7].

The need for this research is based on the understanding that interpregnancy spacing is a modifiable risk factor for neonatal and maternal morbidity[8,9]. High rates of short interpregnancy spacing across several cohorts (ranging from 25.93% to 46%) point to an imminent neefor an integrated pregnancy risk prediction system[8,9]. The use of PRESMIL to identify high-risk groups at an early stage can help prevent adverse neonatal outcomes and identify deliveries that require specialized care.

This research is important for addressing a gap in the existing literature of integrating mobile health technology with comprehensive pregnancy risk assessment in resource-constrained settings. Although previous studies have established that high-risk pregnancies significantly increase maternal morbidity, with affected mothers 4.2 times more likely to experience severe complications during delivery, current screening methodologies exhibit substantial limitations. Specifically, checklist-based screening methods, as recommended by the National Institute for Health and Care Excellence (NICE), achieve only 30% detection rate for all cases of preeclampsia and 40% for preterm preeclampsia, with low sensitivity and specificity due to inadequate accounting for individual risk factors.

The study aims to analyze various risk factors associated with pregnancy. The variables examined in this study are parity, pregnancy spacing, maternal age, and birth history, which are related to pregnancy risk and miscarriage history. This study offers a novel, comprehensive analysis of various variables related to pregnancy.

METHODOLOGY

Research Design

This study was conducted in six health centres in South Kalimantan (Sungai Besar Community, Guntung Manggis Community, Landasan Ulin Timur Community, Cempaka Community Health Centre, Pemulangan Dalam Community Health Centre, Tambarangan Community Health Centre) from April to November 2025, using a quantitative cross-sectional design. The reason for selecting six community health centres in South Kalimantan as the locations of this research is that community health centres are primary health care facilities in Indonesia that provide direct access to the pregnant population and maternal and child health documentation, which is already available, enabling the collection of primary and secondary data. Twelve facilities were used to identify a population of 133 pregnant women, which was sufficient to achieve statistical power.

Population and Sample

Simple random sampling was used. The Slovin formula was used in the sample calculation, with a population of 133 pregnant women, yielding a sample size of 99,812, rounded up to 100. All pregnant women registered in the ANC register at 6 community health centres during the period March 2025.

Randomization Procedure

A simple random sample was used to ensure equal opportunity of selection of all pregnant women who registered for Antenatal Care (ANC) at six community health centres. The entirety of the sampling frame was constructed from ANC registration lists registered at all six healthcare centres in March 2025, resulting in 133 eligible pregnant women registered. Unique numbers were assigned to each registered pregnant woman. Using SPSS software, a computer-generated random number sequence was used to select 100 participants from the sampling frame, based on the sample size calculated using the Slovin formula. This approach reduced selection bias and enhanced the external validity of the findings.

Management of Missing Data

All collected information was verified for completeness and accuracy before statistical analysis. The PRESMIL application includes mandatory response fields for the critical variables, ensuring a minimum amount of missing data during the collection process. Where missing responses were detected, cross-checks against secondary data sources, namely pregnancy registration books and maternal and child health records available at community health centres, were performed. Cases with permanently missing data exceeding 10% of the total variables were removed from analysis by listwise deletion to preserve data integrity and analytic validity.

Tools and materials

Through various devices, such as laptops, Android and iPhones that are directly connected to the internet, the PRESMIL application can be accessed and used of collect samples. A specifically designed questionnaire was distributed to participants. The research team collaborated with the IT team to ensure successful data collection.

The PRESMIL (Pregnancy Risk Screening Mobile Application) application is a significant health technology innovation in efforts to improve maternal health services in Indonesia, which has gone through a rigorous scientific validation process with excellent results shown by the S-CVI/Mean value of 0.94 and Cronbach's alpha of 0.75, and proven effective in identifying risk factors that statistically significantly affect pregnancy complications including pregnancy spacing, maternal age, parity, history of miscarriage, history of cesarean section delivery, anemia, and fetal position abnormalities. This application has the advantage of high accessibility because it can be accessed through various digital devices in various primary health care settings, is designed to be integrated with existing maternal health

documentation systems in community health centers, and is evidence-based using clinical thresholds based on Indonesian maternal health guidelines and international standards, so it is expected to contribute significantly to reducing maternal mortality and morbidity through early detection, timely intervention, and more effective management of high-risk pregnancies at the primary health care level in Indonesia.

Data collection technique

Primary data were collected through a questionnaire using the PRESMIL application, while secondary data were obtained from existing pregnancy registration books at community health centres and maternal and child health documentation. The questionnaire was designed to collect key information, including demographics, medical history, and environmental factors that may influence pregnancy risk.

Instrument Validation

Content validity was established through expert assessment by a panel of 5 (2 obstetricians, 2 midwives, and 1 public health expert specializing in maternal health). Items 1–3 are assessed by experts using the Content Validity Index (CVI), with each item evaluated for relevance, clarity, and appropriateness for measuring risk factors for pregnancy. Items were rated on a 4-point scale (1=not relevant to 4=very relevant). The Item-Level Content Validity Index (I-CVI) was then calculated for each item and used to assess overall content validity. It yielded 0.81. Scale-Level Content Validity Index (S-CVI/Mean) was determined by averaging all of the I-CVI values. It was found to have an average value of 0.94, indicating very good content validity. Cronbach's alpha coefficient demonstrates internal consistency reliability. To assess instrument reliability, a pilot study was conducted with 30 pregnant women (excluded from the primary study). Cronbach's alpha coefficient of the questionnaire was 0.75, indicating acceptable internal consistency.

Variable Definition

The maternal risk factors operationalized as demographic, obstetric, and medical risks linked to adverse pregnancy outcomes in this study were dichotomized at defined clinical thresholds (based on Indonesia's maternal health guidelines and international standards). Demographic factors were maternal age (< 20 or >35 years vs 20-35 years) and height (< 145 cm vs ≥145 cm); obstetric factors were parity (1 or >3 versus 2-3), pregnancy spacing (< 2 or >5 years vs 2-5 years), known history of miscarriage, cesarean delivery, assisted delivery, previous intrauterine fetal death. The PRESMIL (Pregnancy Risk Screening Mobile Application) algorithm classifies pregnancy risk into the following categories of risk: low, high, or very high.

Statistical Analysis

Statistical analysis using SPSS software and the Chi-Square test was used to assess the relationship between independent and dependent variables: maternal risk factors and pregnancy risk categories predicted by the PRESMIL application (low, high, or very high).

Ethical permission

This research has received ethical approval from the Banjarmasin Ministry of Health Polytechnic with number 008/KEPK-BJM/02/2025

RESULTS

Table I shows the relative frequencies of risk predictions among pregnant women across several categories. Pregnancy spacing was found to be 39%, maternal age (20%), hemoglobin levels indicating anemia was associated with 18%, history of miscarriage comprised 17%, parity and height 14%, history of cesarean section delivery accounted for 10%, history of childbirth with fourth-degree perineal tear or fourth-degree hemorrhoids was estimated at 8%, age at first pregnancy accounted for 7%, abnormal fetal position and autoimmune disease with routine treatment accounted for for 5%, history of intrauterine fetal death accounted for 4%, history of childbirth with intervention and polyhydramnios each made up 3%, post-term pregnancy accounted for 2%. The history of twin pregnancy (gemelli) accounted for 1%.

Table I: Frequency distribution of pregnancy risk factors in pregnant women

Variables	High Risk/Low Risk Criteria	Total	Percentage
Parity	1& >3	14	14
	2 - 3	86	86
Height	Too short < 145 cm	14	14
	≥ 145 cm	86	86
First pregnancy	Too late to get pregnant ≥ 4 years	7	7
	< 4 years	93	93
Pregnancy spacing	Too early pregnancy < 2 and too late pregnancy > 5 years	39	39
	2-5 years	61	61
Age	< 20 and >35 years	20	20
	20-35 years	80	80
History of miscarriage	Ever had a miscarriage	17	17
	Never	83	83
Birth history with Action	Ever had a vacuum/urine dug/blood transfusion	3	3
	Never	97	97
History of delivery by CS	Ever been to SC	10	10
	Never	90	90
Anemia	Suffering from anemia	18	18
	No	82	82
Malaria	Having malaria	0	0
	No	100	100
Pulmonary TB	Suffering from Pulmonary TB	0	0
	No	100	100
Heart Failure	Suffering from Heart Failure	0	0
	No	100	100
Diabetes	Suffering from Diabetes	0	0
	No	100	100
HIV/AIDS	Suffering from HIV/AIDS	0	0
	No	100	100
Syphilis	Suffering from Syphilis	0	0
	No	100	100
Hepatitis	Suffering from Hepatitis	0	0

	No	100	100
Gemeli	Twins/twin pregnancy	1	1
	No	99	99
IUFD History	Once	4	4
	Never	96	96
Post-term pregnancy	Experiencing a pregnancy beyond the month	2	2
	No	98	98
fetal abnormality	pregnant with breech/transverse position	5	5
	No	95	95
Polyhydramnios	pregnant with polyhydramnios	3	3
	No	97	97
Bleeding in Pregnancy	Experiencing Bleeding During Pregnancy	0	0
	No	100	100
Preeclampsia	Experiencing Preeclampsia	0	0
	No	100	100
Eclampsia	Experiencing Eclampsia	0	0
	No	100	100
Autoimmune Disease and under routine treatment	Yes	5	5
	No	95	95
Kidney disease	Suffering from kidney disease	0	0
	No	100	100
History of delivery: there was a IV degree perineal tear / IV degree hemorrhoids	Once	8	8
	Never	92	92

Table II shows the factors that influence the risk of pregnancy with a significance level of $p < 0.05$, namely parity, pregnancy spacing, maternal age, history of miscarriage, and history of delivery by CS, anemia and abnormal fetal position, where these factors can influence the occurrence of high-risk or very high-risk pregnancies.

Table II: Relationship of Maternal Risk Factors with Pregnancy Risk Categories (Low, High, Very High) in Pregnant Women (n=100)

Variables	High Risk/Low Risk Criteria	Pregnancy Risk Low		Pregnancy High Risk		Pregnancy Risk Very high		Total	%	P-Value
		Total	%	Total	%	Total	%			
Parity	2 - 3	23	26.7	43	50	20	23.3	86	100	0.001
	1& >3	0	0	4	28.6	10	71.4	14	100	
Tall Body	≥ 145 cm	20	23.3	43	50.	23	26.7	86	100	0.186
	Too short < 145 cm	3	21.4	4	28.6	7	50	14	100	
Pregnancy First	< 4 years	23	24.7	44	47.3	26	28	93	100	0.165
	Too late to get pregnant ≥ 4 years	0	0	3	42.9	4	57.1	7	100	
Distance pregnancy	2-5 years	22	36.1	33	54.1	6	9.8	61	100	0.000

	Getting pregnant too early <2 years and getting pregnant too late >5 years	1	2.6	14	35.9	24	61.5	39	100	
Age	20-35 years	22	27.5	41	51.3	17	21.3	80	100	0.000
	< 20 and >35 years	1	5	6	30	13	65	20	100	
History miscarriage	Never	23	27.7	41	49.4	19	22.9	83	100	0.001
	Had a miscarriage	0	0	6	35.3	11	64.7	17	100	
History give birth to with Action	Never	23	23.7	46	47.4	28	28.9	97	100	0.330
	Ever had a vacuum/urine dug/blood transfusion	0	0	1	33.3	2	66.7	3	100	
Birth history with SC	Never	23	25.6	44	48.9	23	25.6	90	100	0.010
	Ever been in SC	0	0	3	30	7	70	10	100	
Anemia	No	23	28	38	46.3	21	25.6	82	100	0.018
	Suffering from anemia	0	0	9	50	9	50	18	100	
Gemeli	No	23	23.2	46	46.5	30	30.3	99	100	0.566
	Twins/twin pregnancy	0	0	1	100	0	0	1	100	
IUFD History	Never	23	24	44	45.8	29	30.2	96	100	0.430
	Ever	0	0	3	75	1	25	4	100	
Post-term pregnancy	No	23	23.5	47	48	28	28.6	98	100	0.092
	Experiencing a post-term pregnancy	0	0	0	0	2	100	2	100	
fetal abnormality	No	23	24.2	47	49.5	25	26.3	95	100	0.002
	Pregnant with breech/transverse position	0	0	0	0	5	100	5	100	
Polyhydramnios	No	23	23.7	46	47.4	28	28.9	97	100	.330
	Pregnant with Polyhydramnios	0	0	1	33.3	2	66.7	3	100	
Autoimmune Diseases and in routine treatment	No	24	23.8	47	46.5	30	29.7	101	100	.241
	Yes	0	0	2	40	3	60	5	100	
History of labor with tearing perineum grade IV/hemorrhoids grade IV	Never	23		43		26		92	100	0.204
	Ever	0	0	4	50	4	50	8	100	

DISCUSSION

The findings show that the PRESMIL application detects that factors such as interpregnancy spacing, parity, history of miscarriage, maternal age, history of cesarean section, anemia, and fetal malposition statistically influence pregnancy complications. Parity is often associated with increasing maternal age, where age at pregnancy significantly influences complications such as gestational diabetes and preeclampsia. It is known that age above 40 years can increase the risk of high-risk pregnancies, which can be associated with the development of the fetus and mother[10].

Maternal anemia during pregnancy represents a significant public health concern that has been consistently linked to adverse perinatal outcomes. Research demonstrates that severe anemia in pregnancy is associated with multiple complications associated with both mother and fetus, with low birth weight (LBW) and prematurity being among the most prevalent adverse fetal outcomes. Specifically, studies have documented that LBW-intrauterine growth restriction (IUGR) constitutes the most common adverse fetal outcome at 45.0%, followed by LBW-prematurity at 28.8% among severely anemic pregnant women [11].

Interpregnancy spacing is another crucial factor. Too short a time between pregnancies increases the likelihood of a high-risk pregnancy. The main reason this can happen is that the mother has limited time and often does not have time to recover for the next pregnancy [12]. High pregnancy risk is often closely linked to the spacing between pregnancies [13]. In more frequent cases, anemia plays an important role in various complications that impact maternal health and mortality [14].

Physiological changes during pregnancy directly decrease maternal micronutrient reserves. Plasma concentrations of several vitamins (B6, B12, etc.) decline across pregnancy, falling to less than 1 standard deviation below baseline by 8 weeks of gestation [15]. Moreover, hormonal changes, increased blood hemodilution, transport of active vitamins to the fetus, decreased albumin, increased glomerular filtration, and changes in the capacity of vitamin B12-binding proteins may all contribute to decreased vitamin B12 levels. Without adequate recovery time between pregnancies, these depleted reserves cannot be replenished, leaving the mother vulnerable to deficiency-related complications, including anaemia, in subsequent pregnancies [16].

Other research suggests that recurrent hemorrhoids and a history of severe perineal tears in pregnant women can be significant factors in pregnancy complications. Therefore, it is important to minimize these factors of prevent pregnancy complications [17]. Premature birth and low birth weight are also significantly associated with heart failure in pregnant women. Therefore, risk assessment and management during pregnancy are crucial to reduce these risks [18].

Bleeding disorders during pregnancy, such as placenta previa and placental abruption, are significant causes of maternal and fetal morbidity, requiring close monitoring and tailored intervention plans during pregnancy to manage the risks.[19]Preeclampsia is a hypertensive condition that causes significant complications for both mother and fetus. Prediction is based on identifying risk factors such as family history, diabetes, and obesity. Preventive strategies may include monitoring[20].

The Angraini model developed by previous researchers is also reported to detect SEZ (Severe Energy Deficiency) early in pregnant women. It can assist health workers such as doctors, midwives, and nutritionists in primary health facilities. The Angraini Model is available online, openly, and can be accessed for free at modelangraini.com[21]. Previous research findings also show that predictive modeling and electronic health records using artificial intelligence are capable of monitoring fetuses and pregnant women with gestational diabetes in low-resource settings [22]. development of a web-based application for a high-risk maternal

referral system in the island region in South Bangka Regency in 2018. has higher benefits compared to manual data recording and detection [23]. One way to improve services for pregnant women is through web-based ANC examinations. Analyzing NIBP and BMI data sent and received via IoT is useful for diagnostic purposes. Using the MPX5050 sensor and load cell, the output will be processed and displayed on a web page. IoT-based NIBP and BMI data transmission can result in data loss or delays in receipt [24]. The application for pregnant women, namely E-Healthcare, can diagnose gestational diabetes in pregnant women using the Bayes Theorem method. A computer-based system that can help midwives, nurses, and patients diagnose gestational diabetes in pregnant women. The results of this problem are in the form of an application implementing an expert system using the Bayes Theorem method, which can later help midwives, nurses, and patients diagnose gestational diabetes in pregnant women and produce useful conclusions [25].

This study presents the first validation of PRESMIL (Pregnancy Risk Screening Mobile Application) as an integrated digital screening tool specifically designed for primary healthcare in Indonesia. Unlike previous applications that focused on single conditions such as gestational diabetes or malnutrition, PRESMIL provides comprehensive multifactorial risk stratification that encompasses demographic, obstetric, and medical variables in a single platform. The application's integration with existing maternal and child health documentation systems at community health centres (Puskesmas) represents a novel approach to bridging technological innovation with established healthcare infrastructure in resource-constrained settings.

This study was limited to six health centres in South Kalimantan, potentially limiting generalizability to other regions in Indonesia with different demographic characteristics.

This study demonstrated strong methodological rigor through validated instrumentation (S-CVI/Mean=0.94; Cronbach's alpha=0.75) and expert panel assessment. The multi-site design across twelve facilities increased sample diversity. Furthermore, the practical implementation of PRESMIL across digital platforms (laptop, Android, iPhone) increases accessibility for healthcare workers in diverse environments.

CONCLUSION

The variables parity, pregnancy spacing, maternal age, history of miscarriage, and history of cesarean delivery showed a significance value of $p < 0.05$, indicating that these factors contribute to increased pregnancy risks. For example, mothers with a parity of 1 or more than 3 years, a pregnancy spacing that is too short or too long, and maternal age under 20 or over 35 years showed an increased proportion of high- or very high-risk pregnancies. Furthermore, a history of miscarriage and cesarean delivery was also known to increase the potential risk.

Ethical Exemption: Banjarmasin Ministry of Health Polytechnic, Indonesia, ERC exemption letter No. 008/KEPK-BJM/02/2025.
Conflict of Interest: No conflicts of interest, as stated by the authors.
Financial Disclosure / Grant Approval: No funding agency was involved in this research.
Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Hipni R: Conceptualizing Research, Curating Data, Confirming Methodology, Writing Draft Manuscripts, Revisions
Zakiah Z: Curating Data, Confirming Methodology, Writing Draft Manuscripts, Revisions
Daiyah I: Conceptualizing Research, Curating Data, Revisions

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