

Determinants of Adverse Birth Outcomes in Ambon, Indonesia: A Case-Control Study

Magdalena Paunno^{1,*}, Ridwan Amiruddin², Masni³, Mardiana Ahmad⁴, Bertha Jean Que⁵, Ridwan Thaha⁶, Sudirman Nasir⁶, Anwar Mallongi⁷

Magdalena Paunno^{1,*}, Ridwan Amiruddin², Masni³, Mardiana Ahmad⁴, Bertha Jean Que⁵, Ridwan Thaha⁶, Sudirman Nasir⁶, Anwar Mallongi⁷

¹Department of Doctor of Public Health Sciences, Faculty of Public Health, Universitas Hasanuddin, INDONESIA.

²Department of Epidemiology, Faculty of Public Health, Universitas Hasanuddin, INDONESIA.

³Department Reproductive Health and Family, Faculty of Public Health, Universitas Hasanuddin, INDONESIA.

⁴Department of Midwifery, Faculty of Public Health, Universitas Hasanuddin, INDONESIA.

⁵Medical Faculty, Universitas Pattimura, INDONESIA.

⁶Faculty of Public Health, Universitas Hasanuddin, INDONESIA.

⁷Department of Environmental Health, Faculty of Public Health, Universitas Hasanuddin, INDONESIA.

Correspondence

Magdalena Paunno,

Department of Doctor of Public Health Sciences, Faculty of Public Health, Universitas Hasanuddin, 90245 makassar, INDONESIA.

E-mail: lenapaunno04@gmail.com

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ABSTRACT

Background: Globally, adverse birth outcomes were still high, especially in low and middle-income countries like Indonesia. Stillbirth, preterm birth (PTB), low birth weight (LBW), and first-minute birth asphyxia are some of the adverse birth outcomes. The incidence of adverse birth in Ambon is quite high but never been any research about determinants of adverse birth outcomes. **Objective:** This study aims to examine the determinants of adverse birth outcomes and identify the main modifiable risk factors in Ambon. **Method:** This retrospective case-control study included all birth outcomes in August and September 2023 in Ambon, Indonesia. A total of 165 birth outcomes (55 cases and 110 controls) with complete information in Puskesmas and Posyandu were included in the analysis. The Chi-square test and regression analyses were applied to evaluate the association between variables. **Result:** This study showed the impact of pregnant women's age, parity, passive smoking, ANC examination, and ANC counseling on birth outcomes. There are differences in maternal age ($p=0.006$; 95% CI: 1.22-6.11), parity ($p=0.001$; 95% CI: 1.52-8.51), passive smokers ($p=0.004$; 95% CI: 1.37-8.99, ANC examination ($p=0.02$; 95% CI: 1.08-5.01) and ANC counseling ($p=0.002$; 95% CI: 1.44-8.67) between case and control groups. **Conclusion:** Maternal age (≤ 20 and >35 years old), parity (one and ≥ 5), passive smokers, ANC examination not according to standard, and ANC counseling without a husband were associated with a high risk of all adverse birth outcomes.

INTRODUCTION

Birth outcomes are the results of the fertilization process, which are assessed from the age of viability (28 weeks) to the first week of the newborn. Birth outcomes include normal live birth, preterm birth (PTB), intrauterine fetal death (IUFD), stillbirth, low birth weight (LBW), and neonatal death. Adverse birth outcomes is a term used to describe health problems in mothers and newborns during pregnancy, childbirth, and postpartum. Stillbirth, premature delivery, low birth weight, and birth defects are some of the adverse birth outcomes.¹

Globally, an estimated 13.4 million babies were born preterm in 2020, and 1.9 million late-gestation stillbirths (at 28 or more weeks) in 2021. Meanwhile, preterm birth, childbirth-related complications (birth asphyxia or lack of breathing at birth), infections, and birth defects caused most neonatal deaths in 2019.²

Based on the 2021 Indonesian Health Profile data, it was found that infant deaths in 2021 were 27,566 and experienced a decrease compared to 2020, 28,158 in Indonesia. About 73.1% were stillbirths to deaths in the neonatal period, LBW 34.5%, 27.8% neonatal asphyxia, and 12.8% congenital abnormalities.³

Expected adverse pregnancy consequences comprise placental abnormalities, neonatal low birth weight, preterm birth, macrosomia, abortions, and stillbirths. These variation outcomes significantly impact pregnant women's and neonates' physiological and psychological well-being.^{4,5} Also, those adverse pregnancy effects can

cause long-term physical and neurological disorders in surviving babies, even death.⁶

Previous studies have demonstrated that maternal age, multiparity, passive smoke, length of gestation, and gestational diabetes mellitus, are all associated with adverse birth outcomes.⁷⁻¹⁴

Also, a history of antenatal care (ANC) is a risk factor for adverse pregnancy outcomes. Studies showed that women's inadequate antenatal care is associated with adverse birth outcomes.¹⁵⁻¹⁶ Routine antenatal care during pregnancy can detect adverse birth outcomes.¹⁴ In addition, a study in Indonesia presented that access to prenatal care can predictably reduce adverse outcomes both for the mother and the infant.¹⁷

Research on the determinants of adverse birth outcomes in Indonesia is limited. Likewise, in Ambon, research on adverse birth outcomes has never been conducted, even though the incidence of adverse birth is quite high. In 2021, there were 22 stillbirths, 29 neonatal deaths, and 215 LBW.

This article examines the determinants of adverse birth outcomes (PTB, LBW, first-minute birth asphyxia, and stillbirth) and identifies the main modifiable risk factors in Ambon.

METHOD

A retrospective unmatched case-control study was used. This study was conducted in four public health centers (Puskesmas) and Integrated Services Post (Posyandu) in Ambon, Indonesia, from August to September 2023.

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Data was collected from the birth outcomes based on the mother and child cohort at the Puskesmas dan Posyandu. All birth outcomes were considered the case and control groups. The inclusion criteria included pregnant women who lived at home with their husbands in Ambon City. On the other hand, unwillingness to participate in the study was considered an exclusion criterion.

The sample size was calculated by taking power at 80%, a confidence level at 95%, and the ratio of case to control was 1:2. The total sample size was 165, with 55 cases and 110 controls.

In this study, adverse birth outcomes were defined as the presence of either of parameters such as preterm birth, low birth weight, first-minute birth asphyxia, or stillbirth.

Data analysis was done using SPSS software version 21. Bivariate associations between independent variables and dependent variables were tested through the Chi-square test. The association was analyzed by calculating crude odds ratios (OR) at a 95% confidence interval through binary logistic regression. Multivariate logistic regression was examined for the relationship between independent and dependent variables to address the confounding effect. The Ethics Committee of the Hassanudin University of Health Faculty approved the study (Ethic code: 5038/UN4.14.1/TP.01.02/2023).

RESULTS

The most common adverse birth outcome was PTB (32.73%) (Table 1). Most of the respondents who participated in the study were aged 21-35 years in both the case and control groups (63.64% vs. 82.73%). There was a difference in maternal age between case and control groups

($p=0.006$; 95% CI: 1.22-6.11). The highest number of parities was one and ≥ 5 in the case and control groups (81.82% vs. 56.36%). This study showed a difference in parity between case and control groups ($p=0.001$; 95% CI: 1.52-8.51). Respondent characteristics were more dominant as passive smokers in the case and control groups (85.45% vs. 63.64%). The study showed the difference between mother passive smokers in case and control groups ($p=0.004$; 95% CI: 1.37-8.99). (Table 2).

This study showed that most ANC examinations were carried out not according to standards in both groups (72.73% vs. 53.64%). Cases group has more risk of adverse birth outcomes than the control group ($p=0.02$; 95% CI: 1.08-5.01). Meanwhile, the case and control groups were dominated by ANC counseling without their husband (83.64% vs. 60%). There was a difference in the case and control groups ($p=0.002$; 95% CI: 1.44-8.67) (Table 3).

Multivariable analysis was carried out to determine the effect of the independent variable on the dependent variable. Simultaneously controlled for variables that had a p -value <0.25 in the bivariable test analysis, namely age, parity, and passive smoking. The results of the analysis showed the influence of the variables ANC counseling, maternal age, parity, and passive smokers on birth outcomes was 15% (Table 4). Meanwhile, the influence of the variables ANC examination, maternal age, parity, and passive smokers on birth outcomes was 14% (Table 5).

DISCUSSION

This study aims to analyze the determinants of adverse birth outcomes in Ambon. The results of the study show the impact of maternal age, parity, passive smokers, ANC examination and ANC counseling on

Table 1: Birth outcomes of women in the two case and control groups (n=165).

Birth Outcomes	Cases (n=55)		Control (n=110)	
	n	%	n	%
PTB	18	32,73	0	0
LBW	16	29,09	0	0
First-minute birth asphyxia	13	23,64	0	0
Stillbirth	8	14,55	0	0
Normal	0	0	110	100,0

Table 2: The demographic characteristics of women in the two case and control groups (n=165).

Variables	Cases (n=55)	Controls (n=110)	OR	P value	CI 95%
Age					
≤ 20 & >35 y.o	20 (36,36)	19 (17,27)	2,74	0,006	1,22-6,11
21-35 y.o	35 (63,64)	91 (82,73)			
Parity					
1 & ≥ 5	45 (81,82)	62 (56,36)	3,48	0,001	1,52-8,51
2-4	10 (18,18)	48 (43,64)			
Passive smoker					
Yes	47 (85,45)	70 (63,64)	3,36	0,004	1,37-8,99
No	8 (14,55)	40 (36,36)			

Table 3: Antenatal care of women in the two case and control groups (n=165).

Variables	Cases (n=55)	Controls (n=110)	OR	P value	CI 95%
ANC examination					
Not according to standard	40 (72,73)	59 (53,64)	2,30	0,020	1,08-5,01
According to standard	15 (27,27)	51 (46,36)			
ANC Counselling					
Without husband	46 (83,64)	66 (60,0)	3,41	0,002	1,44-8,67
With husband	9 (16,36)	44 (40,0)			

Table 4: The relationship between ANC counseling and birth outcomes involves the characteristic pregnant women: logistic regression analysis.

Variabel	Model 1 OR (CI 95%)	Model 2 OR (CI 95%)	Model 3 OR (CI 95%)	Model 4 OR (CI 95%)	Model 5 OR (CI 95%)
ANC Counselling					
Without husband	3,407** [1,52, 7,66]	3,423** [1,49, 7,82]	3,89** [1,48, 7,77]	3,440** [1,46-7,31]	3,396** [1,44, 7,98]
With husband	1 [1, 1]	1 [1, 1]	1 [1, 1]	1 [1, 1]	1 [1, 1]
Age					
≤ 20 & >35 y.o		2,752** [1,28, 5,92]			1,956 [0,87, 4,41]
21-35 y.o		1 [1, 1]			1 [1, 1]
Parity					
1 & ≥ 5			3,466** [1,56, 7,71]		3,230** [1,41, 7,37]
2-4			1 [1, 1]		1 [1, 1]
Passive smoker					
Yes				3,392** [1,43, 8,04]	2,898* [1,17, 7,16]
No				1 [1, 1]	1 [1, 1]
Pseudo R²	0,048	0,080	0,098	0,09	0,15
AIC	204,0	199,2	195,5	197,1	188,7
n	165	165	165	165	165

Exponentiated coefficients; 95% confidence intervals in brackets

* p<0.05, ** p<0.01, *** p<0.001

Table 5: The relationship between ANC examination and birth outcomes involves the characteristic pregnant women: logistic regression analysis.

Variabel	Model 1 OR (CI 95%)	Model 2 OR (CI 95%)	Model 3 OR (CI 95%)	Model 4 OR (CI 95%)	Model 5 OR (CI 95%)
ANC examination					
Not according to standard	2,305* [1,14, 4,65]	2,287* [1,12, 4,68]	2,934* [1,39, 6,16]	2,110* [1,03, 4,33]	2,709* [1,26, 5,83]
According to standard	1 [1, 1]	1 [1, 1]	1 [1, 1]	1 [1, 1]	1 [1, 1]
Age					
≤ 20 & >35 y.o		2,716* [1,28, 5,77]			1,905 [0,85, 4,29]
21-35 y.o		1 [1, 1]			1 [1, 1]
Parity					
1 & ≥ 5			4,257*** [1,88, 9,60]		3,992** [1,72, 9,25]
2-4			1 [1, 1]		1 [1, 1]
Passive smoker					
Yes				3,119** [1,33, 7,33]	2,712* [1,09, 6,69]
No				1 [1, 1]	1 [1, 1]
Pseudo R²	0,027	0,059	0,094	0,064	0,140
AIC	208,3	203,6	196,3	202,6	190,7
n	165	165	165	165	165

Exponentiated coefficients; 95% confidence intervals in brackets

* p<0.05, ** p<0.01, *** p<0.001

birth outcomes. Statistical test results showed significant differences between the case and control groups.

The maternal age at risk has a 2.74 times chance of an adverse birth outcome. A meta-analysis study showed that maternal age >35 years was associated with a 65% increased risk of stillbirth, with a higher relative risk at age 40 years.¹⁸ Similar research has also shown a relationship between older pregnant women and increased rates of low birth weight (LBW) and preterm births.¹⁹

In addition, pregnancy at a young age is also associated with negative impacts on the child's health such as preterm birth, low birth weight, malnutrition, and poor development.²⁰ Thus, pregnancy at a young or late age is associated with an increased risk of adverse birth outcomes.¹²

Parity is also a factor that impacts birth outcomes, with a 3.48 times chance of adverse birth outcomes compared to women without risk. A meta-analysis study showed that women with parity ≥3 and aged over 35 years had an increased risk of prematurity and neonatal death compared with women with parity 1-2 and aged between 18 and 35 years old.²¹ Multiparity causes changes in the elasticity of the uterine wall and the emergence of uterine scar tissue so mothers tend to experience complications during pregnancy and childbirth.²²

Women passive smokers are 3.36 times more likely to experience adverse birth outcomes than women who do not smoke passively. These results were in line with previous studies which have explained that pregnant women who are exposed to cigarette smoke have an increased risk of

adverse birth outcomes including placental malperfusion, fetal growth restriction, premature events, asphyxia, and LBW (Ballbè *et al.*, 2023; Levy *et al.*, 2021; Liu *et al.*, 2023). Substances contained in cigarette smoke can disrupt placental development by altering the balance between the proliferation and differentiation of cytotrophoblasts by reducing blood flow, thereby creating a pathological hypoxic environment (Levy *et al.*, 2021). A study in Ambon also showed that passive smoking in pregnant women was a risk of stillbirth.²⁵

This study found that pregnant women who have an ANC examination not according to standards have a 2.3 times chance of adverse birth outcomes compared to pregnant women who have an ANC according to the standards. Standardization of ANC examinations is assessed by the number of ANC visits at least 6 times and receiving 10T ANC services. Previous research shows that ANC frequency ≤ 1 time has a 2.4 times higher chance of increasing PTB compared to ANC ≥ 3 times.²⁶

Screening during ANC includes 10T service standards, namely 1) Weigh BB and measure TB; 2) Blood Pressure; 3) Nutritional Status Value (LILA); TFU examination; 5) Determine fetal presentation and FHR; 6) Screening for TT immunization status; 7) Giving Fe Tablets; 8) Test Laboratory; 9) Case management; and 10) Interview/Counseling.²⁷ ANC early in pregnancy can improve screening and treatment of pregnancy-related complications, facilitate health education, and increase birth rates in health facilities (Greenfield *et al.*, 2022).

According to our study, ANC counselling without being accompanied husband is 3.41 times more likely to adverse birth outcomes compared to ANC counselling accompanied by a husband. Previous research has established that male partner involvement in ANC is positively associated with improving maternal and child health outcomes.²⁸⁻³¹ Unfortunately, male partner involvement in antenatal care is low globally and more so in low and middle-income countries.^{32,33} There are many barriers to men involved in the ANC including economic, cultural, and health facilities.³² On the other hand, previous ANC experience also impacts men's involvement in ANC.³⁴

Based on our research, the prevalence of PTB is higher than other adverse birth outcomes. This was possibly due to inaccuracy in reporting the LMP.³⁵ It commonly occurs in women who have received limited antenatal care services.³⁶⁻⁴²

A limitation of this study is that more determinants associated with adverse birth outcomes were not included. However, this research has the advantage of analyzing ANC counseling factors accompanied by husbands that are not explored by other studies. In addition, our research was the first to be conducted in Ambon to examine adverse birth outcomes.

Additionally, the association of other risk factors like socio-economic status, culture, history of previous ANC as well as modifiable risk factors should be accounted for in future research.

CONCLUSION

The adverse birth outcomes were quite high in Ambon and the most common was PTB. Maternal characteristics that impact adverse birth outcomes are mothers, parity, and mothers who are passive smokers. In addition, ANC examinations are not according to standard, and ANC counseling without being accompanied by the husband contributes to adverse birth outcomes.

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