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## PUBLIC HEALTH RESEARCH

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# The Impact of Maternal Factors on Neonatal Mortality among Low Birth Weight in Aceh Province, Indonesia

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### ABSTRACT

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**Introduction** The health of newborns is inextricably linked to that of their mothers. Some maternal factors can influence neonatal survival, particularly for low birth weight babies who are more vulnerable to diseases than normal weight babies. The aim of this study is to assess the impact of maternal factors on neonatal mortality among low birth weight babies in Aceh Province, Indonesia.

**Methods** Study design was unmatched case control. Data collected from 2010 to 2012 in 8 districts in Aceh province, Indonesia. Total sample was 500, divided into 250 LBW who died in neonatal period (case group) and 250 who did not die in neonatal period (control group). There were 6 maternal variables analysed.

**Results** Three of six variables analysed were not associated with neonatal mortality among LBW ( $P > 0.05$ ); these were: maternal death, parity and education level. The age of the mother had a significant association with neonatal mortality among LBW ( $P < 0.05$ ), but was not a determinant factor. The maternal illness and birth interval were determinant factors of neonatal mortality among LBW ( $P < 0.05$ ); maternal illness (Adj OR= 2.6; 95 % CI: 1.68 - 4.0) and birth interval (Adj OR= 1.8; 95 % CI: 1.20 - 2.91).

**Conclusions** Maternal illness and birth interval were determinant factors of neonatal mortality among LBW. Appropriate care throughout stages of pregnancy and increasing women's knowledge on high risk pregnancy are the key factors to the decrease of the neonatal mortality related to the maternal factors.

**Keywords** Maternal factors - neonatal mortality - low birth weight.

## INTRODUCTION

Maternal mortality statistics is indicative of the overall state of maternal health for a particular population, but it is only the tip of the iceberg. For every woman who dies, some twenty others face serious or long-lasting consequences. Women who survive severe, life-threatening complications often require lengthy recovery times and may face long-term physical, psychological, social and economic consequences. The chronic ill-health of mothers put surviving children who depend on their mothers for food, care and emotional support, at greatest risk<sup>1,2</sup>.

Maternal health factors have direct impaction infant health. Maternal health refers to the health of women during pregnancy, childbirth and the postpartum period. While motherhood is often a positive and fulfilling experience, for many women it is associated with suffering, ill-health and even death. The primary direct causes of maternal morbidity and mortality include hemorrhage, infection, high blood pressure, unsafe abortion, and obstructed labor<sup>3</sup>.

In developing countries, a mother's death in childbirth means almost certain death for her newly born child. When mothers are malnourished, sickly, or receive inadequate prenatal and delivery care, their babies face a higher risk of disease and premature death. The rate of neonatal death is thus higher in regions where the risk of maternal death is high<sup>4</sup>. The survival of neonates is inextricably linked to that of their mothers particularly the LBW who are vulnerable to diseases and environmental<sup>5</sup>.

LBW is defined as babies born with a birth weight less than 2500 grams<sup>5</sup>. The LBW are categorized into three groups: preterm birth, intrauterine growth restriction (IUGR) and newborn who are preterm and growth restricted<sup>6</sup>. LBW suffer from extremely high rates of morbidity and mortality from infectious disease, and are underweight, stunted or wasted beginning in the neonatal period through childhood<sup>7</sup>. The high number of LBW contributes to the higher neonatal mortality rate in the world. About 40% of all under-five deaths are neonatal, occurring during the first 28 days of life. The main cause of neonatal mortality in the world in 2011 was preterm birth complications (35% of all neonatal mortality)<sup>8</sup>.

In Indonesia the percentage of LBW in 2011 was 9% of all live births and the LBW was the second highest cause of neonatal mortality<sup>9</sup>. Meanwhile, the estimate percentage of LBW in Aceh province in 2010 was 11% of live births and the number of neonatal death due to LBW rose from 178 cases (2008) to 217 cases in 2010<sup>10</sup>. Many factors influence the neonatal mortality of LBW, one of them is maternal factor. This study was conducted to assess the impact of the maternal factors on neonatal mortality among low birth weight babies in Aceh Province, Indonesia.

## METHODS

### *Study design*

An unmatched retrospective case control study was used.

### *Population*

Neonates who were delivered in year 2010 till 2012 in the Aceh Province, Indonesia were targeted.

### *Sampling*

Purposive sampling techniques were used to select the districts for study sites. The study conducted in 8 of 23 districts in Aceh Province Indonesia. The total sample size required for this study was 510 (255 cases and 255 controls). The period for data collection was a year. Considering the limitation of the study (geographical, budget, time, number of neonatal death in the district of study site, etc), researcher used consecutive sampling as the techniques sampling to select cases and controls in the district and sub-district. Total sample of this study was 500 and were divided into: 250 LBW babies who died in the neonatal period (case group) and LBW babies who survived the neonatal period (control group).

### *Data Collection*

The data collection was conducted between January to December 2012 using questionnaire and medical record as the study instruments. The purpose of the questionnaire was for collecting information about mother and neonate, related to risk factors for neonatal mortality. The questionnaire was administered to mother or family who care for the baby in neonatal period, and was guided by enumerator to fill up any the unclear part. The medical record was obtained from health facility.

### *Operational definition of variable*

There were 7 variables analyzed. Dependent variable was neonatal mortality (A live birth baby with birth weight < 2500 grams and died during the first 28 days of life<sup>5</sup>). Independent variables were: maternal death (the mothers who died during delivery process or within 28 days after the babies were born, by any cause), maternal illness (mothers who were ill or bedridden during the neonatal period by any cause such: PPH, malaria, anemia, eclampsia, hepatitis, tuberculosis, accident, etc. and could not care for the neonate or mother died during neonatal period), maternal age (age of a mother when delivering the LBW), birth interval (the interval between present delivery and previous delivery; in years), parity (the number of deliveries by the mother) and education level (education level that the mother had completed before she delivered the neonate).

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### Data analysis

The data was analyzed through three steps using Statistical Package for Social Sciences (SPSS) version 20.0. Those steps were: descriptive analysis, simple logistic regression and multiple logistic regression analysis.

## RESULTS

### Characteristic of the neonates

Table 4.1 below describes the characteristics of the neonates in Aceh Province. There were 101 (40.4%) girls and 149 (59.6%) boys in the case group. In the control group, 140 neonates (56.0%) were girl and 100 neonates were boy (44.0%). The birth weight showed that 171 (68.4%) neonates in the case group were born with weight  $\geq 1500$  grams (MLBW/ moderate low birth weight) and 79

(31.6%) neonates were born with weight  $< 1500$  grams (VLBW/very low birth weight). In control group, 243 neonates (97.2%) were born with weight between 1500- 2499 grams and 7 (2.8%) for weight  $< 1500$ g. The mean birth weight in the case group was 1728 grams with a standard deviation (SD) of  $\pm 416.8$ . The mean birth weight in control group was 2063 grams with SD of  $\pm 283.5$ .

The gestational age indicated that 44 neonates (17.6%) in case group were born full term ( $\geq 37$  weeks) and 206 neonates (82.4%) were born preterm ( $< 37$  weeks). However, there were 103 (41.2%) neonates in the control group were born full term and 147 neonates (58.8%) were born preterm. The mean gestational age in the case group was 32 weeks with SD of  $\pm 4$ , and mean in control group was 35.1 weeks with SD of  $\pm 3.3$ .

**Table 1** Characteristic of Neonates in Aceh Province

Characteristics	Case (250)		Control (250)	
	n	%	n	%
Gender				
- girl	101	40.4	140	56.0
- boy	149	59.6	110	44.0
Birth weight				
- MLBW	171	68.4	243	97.2
- VLBW	79	31.6	7	2.8
Mean $\pm$ SD	1728 $\pm$ 416.8		2.063 $\pm$ 283.5	
Gestational Age				
- Full term	44	17.6	103	41.2
- Pre term	206	82.4	147	58.8
Mean $\pm$ SD	32 $\pm$ 4.0		35.1 $\pm$ 3.3	

### Characteristic of the mothers

Table 2 shows that 2 mothers (0.8%) died during the neonatal period, and none in the control group. There were 168 (67.2%) neonates had low risk maternal illness (the mother was healthy and could care for the neonate) and 82 (32.8%) neonates had high risk maternal illness (the mother who was ill and could not care for the baby/mother died during neonatal period). In the control group, 221 (89.1%) neonates were of low risk maternal illness and 27 (10.9%) neonates were of high risk maternal illness.

The age of mothers showed that 182 (72.8%) mothers in the case group were of low risk (20- 35 years old) and 68 (27.7%) were of high risk ( $< 20$  or  $> 35$  years old). In the control group, 211 (84.4%) were of low risk and 39 (15.6%) were of high risk. The mean age of mothers in the case group was 28.7 years with SD of 6.6. Meanwhile, the age of mothers in the control group was 27.6 years with SD of 5.7 years.

Birth interval factor showed that 165 (66.0%) mothers in the case group were of the low risk category (2-5 years from previous pregnancy) and 85 (34.0%) were of high risk ( $< 2$  or  $> 5$  years). In the control group, 201 (80.4%) were of low risk and 49 (19.6%) were of high risk. The mean birth interval in the case group was 2.1 (SD  $\pm 2.3$ ), and in the control group 2.3 (SD  $\pm 2.3$ ). The parity showed that 134 (53.6%) mothers in the case group were of low risk (the 2nd to 4th pregnancy) and 116 (46.4%) were of high risk (1st or  $\geq 5$ th pregnancy). In the control group, 147 (58.8%) were of low risk and 103 (41.2%) were of high risk. The mean value of parity in case group was 2.9 times with SD of 1.7, while in the control group was 2.4  $\pm$  SD 1.4.

The maternal education level showed that 86 (34.0%) mothers in case group graduated from senior high school, 80 (32.0%) mothers graduated from junior high school, 55 (22.0%) mothers graduated from elementary school, and 7 (2.8%) mothers graduated with a degree. In the control group, 99 (39.6%) mothers graduated from senior

high school, 68 (27.2%) mothers graduated from junior high school, 47 (18.8%) mothers graduated from elementary school, 26 (10.4%) mothers obtained diploma and 10 (4.0%) mothers have bachelor degree. There were 29 (11.6%) mothers in

the case group were of high education level ( $\geq$  Diploma) and 221 (88.4%) mothers were of lower education level. In the control group, 36(14.4%) were of high education level and 214 (85.6%) were of lower education level.

**Table 2** Description on mother characteristics

Characteristics	Case (250)		Control (250)	
	n	%	n	%
Maternal Death				
- Mother died	0	0.0	2	0.8
- Mother alive	250	100.0	248	99.2
Maternal illness				
- Low risk	168	67.2	221	89.1
- High risk	82	32.8	27	10.9
Age				
- Low risk	182	72.8	211	84.4
- High risk	68	27.2	39	15.6
Mean $\pm$ SD	28.7 $\pm$ 6.6		27.6 $\pm$ 5.7	
Birth Interval				
- Low risk	165	66.0	201	80.4
- High risk	85	34.0	49	19.6
Mean $\pm$ SD	2.1 $\pm$ 2.3		2.3 $\pm$ 2.3	
Parity				
- Low Risk	134	53.6	147	
- High Risk	116	46.4	103	58.8
Mean $\pm$ SD	2.9 $\pm$ 1.7		2.4 $\pm$ 1.4	41.2
Maternal Education level				
- Elementary school	55	22.0	47	18.8
- Junior high school	80	32.0	68	27.2
- Senior high school	86	34.0	99	39.6
- Diploma	22	8.8	26	10.4
- $\geq$ Degree	7	2.8	10	4.0

#### Statistical analysis

There was no association between mother died in the neonatal period and neonatal mortality among LBW ( $P > 0.05$ ). Simple logistic regression analysis found there was a significant association between mothers being ill and neonatal mortality among LBW ( $p < 0.01$ ) and OR 2.88 (95% CI: 1.87- 4.43). Neonates who had an ill mother who could not care for it had a risk of neonatal death 2.9 times greater than neonate who had healthy mother who cared for her baby.

There was a significant association between the age of the mother and neonatal mortality ( $P < 0.05$ ) and OR was 2.00 (95% CI:

1.30- 3.14). Neonates born from mothers aged  $<20$  or  $> 35$  years, had a 2 times greater risk of death than neonates born to mothers aged between 20 and 35 years old. There was a significant association between birth interval and neonatal mortality. Neonates born  $< 2$  years or  $> 5$  years from their siblings had more than 2 times greater risk of death than neonates born with birth intervals between 2-5 years from their siblings ( $P < 0.01$ ) and OR was 2.11 (95% CI : 1.40- 3.17). There was no association between parity and maternal education level with neonatal mortality among LBW ( $P > 0.05$ ).

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**Table 3** Association between Maternal Factors and Neonatal Mortality among LBW

Variables	Group		OR 95 % CI	P Value
	Case 250(%)	Control 250(%)		
Maternal Death				
Mother died	0 (0.0)	2 (0.8)	0.000	0.999
Mother alive	250 (100.0)	248 (99.2)	0.000	
Maternal illness				
present	82(32.8)	27 (10.9)	2.88	0.000*
absent	168 (67.2)	221(89.1)	(1.87- 4.43)	
Age				
<20 or >35 years old	68 (27.2)	39 (15.6)	2.0	0.002*
20-35 years old	182 (72.8)	211 (84.4)	(1.30- 3.14)	
Birth Interval				
>2 or >5	85 (34.0)	49 (19.6)	2.11	0.000*
2-5	165 (66.0)	201 (80.4)	(1.40- 3.17)	
Parity				
1 or >5	116 (46.4)	103 (41.2)	1.23	0.242
2-5	134 (53.6)	147 (58.8)	(0.86- 1.76)	
Maternal Education level				
Low level				0.353
High level	221(88.4)	214(85.6)	1.28	
	29 (13.6)	36 (14.4)	(0.75- 2.16)	

In multivariate logistic regressions, four variables that had P value < 0.25<sup>11</sup> were analysed. They were maternal illness, age, birth interval and parity. The result of multivariate logistic regressions showed that maternal illness and birth interval as the determinant factors of neonatal mortality among LBW (P < 0.05). Neonates born to mothers who were ill and could not take care of them had a 2.6 greater risk of death than neonates

who had healthy or unwell mothers who can take care of their neonates (OR 2.60; CI 95 % : 1.68-4.00). Meanwhile, neonate born < 2 years or > 5 years interval from their sibling had a 1.8 greater risk of death than neonates born with birth intervals between 2-5 years from their sibling or as the first child (OR 1.80; CI 95 % : 1.20- 2.91).

**Table 4** Multivariate logistic regression for determinant of neonatal mortality among LBW in Aceh Province

Variables	Adjusted OR 95 % CI	P Value
Maternal illness		
present	2.6 (1.68- 4.0)	<0.001
absent	1.00	
Maternal age		
<20 or >35 years old	1.5 (0.92- 2.45)	0.102
20-35 years old	1.00	
Birth Interval		
<2 years or >5 years	1.8 (1.20- 2.91)	0.005
2-5 years	1.00	
Parity		
1 or >5	1.1 (0.75- 1.67)	0.558
2-4	1.00	

*Significant variable: p < 0.05*

## DISCUSSION

The present study found that maternal illness and birth interval were determinant factors of neonatal mortality among LBW in Aceh province Indonesia. The LBW neonates who had mother who was ill and could not care for the baby, had a risk of death 1.8 times greater, than neonates who had a healthy mother or un well mother but could still care for her baby. A previous study showed an association between present of maternal hypertensive disorders with neonatal mortality among LBW<sup>12</sup>. Other study conducted in Thailand found that malaria was associated with LBW and neonatal mortality<sup>13</sup>. The differences between previous study and present study were operational definition of maternal illness. This study did not focus on a specific illness.

The newborn's health is tied closely to maternal health, because they are highly dependent on their mothers for their lives<sup>14</sup>. The social culture practices of Aceh province put the mother as the primary caregiver at home, especially during 40 days after birth. The father or family members are only a replacement caregiver if the mother is tired or unwell. All the baby's needs are provided by the mother 24 hours a day, including feeding, bathing, etc. If the mother is unwell or cannot care for the baby, this could affect the baby's health or even lead to death.

Birth interval was another determinant factor of neonatal mortality among LBW. The LBW who were born < 2 years or > 5 years interval from their sibling had a risk for death 2.1 times greater risk of death than the LBW has birth interval of 2- 5 years. The result of this study was similar to another study conducted earlier in Indonesia. The study concluded that there was a strong association between short birth intervals and neonatal death<sup>15</sup>. However, even though the result was the same, the study method was different because the samples of previous study were LBW and normal birth weight.

There was no definite theory relating the relationship between birth interval and neonatal mortality until now, but some theories suggest the possibility of a relationship. One study suggests that short birth interval may result in inadequate replenishment of maternal nutrient stores and reduce foetal growth. The short birth interval can lead to increased stress and preterm/LBW. Unidentified metabolic and anatomic factors may play a role in the interval period of infertility in women with long birth intervals. These factors can possibly influence the risk for preterm/LBW births and death<sup>16</sup>. Another study found that the shorter birth interval increases the chances of chronic and general under-nutrition<sup>17</sup>.

This study shows that maternal death, parity and education level were not associated with neonatal mortality. Conversely some previous

studies found maternal death, parity and education level were significantly associated with neonatal mortality<sup>18, 19, 20, 21,22,23,24</sup>. Small number of maternal death compared with surviving mothers; differences of operational definition concerning parity; educational level; and the study site were key factors distinguishing this study from previous studies. This study found that there was a significant association between maternal age and neonatal mortality among LBW babies ( $P < 0.05$ ), but this factor was not a determinant factor. A similar result was found by previous studies, but these studies addressed all live births and focussed on LBW babies<sup>12, 25</sup>. A study that conducted in Iran found the same result with our study, but that study was focused on LBW babies who were delivered at hospitals<sup>23</sup> and not a population based study.

## CONCLUSIONS

This study found that maternal illness and birth interval were determinant factors of neonatal mortality among LBW babies in Aceh Province, Indonesia. Increasing quality of health services is needed to decrease the impact of maternal factor on neonatal mortality. Mother should receive appropriate care during pregnancy, delivery and post natal. Furthermore, increasing women's knowledge concerning reproductive health since teenager, particularly about the high risk age for pregnant is important to avoid early age pregnancy or too late to be pregnant.

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