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Determinants of Neonatal Mortality: A Case Study in Sleman District Indonesia

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ABSTRAK

Latar Belakang: Kematian neonatus merupakan masalah kesehatan global. Sebagian besar kasus terjadi di negara berpenghasilan rendah dan menengah termasuk Indonesia. Di Kabupaten Sleman, Yogyakarta, selama lima tahun terakhir, angka kematian neonatal belum membaik dan tetap tinggi.

Tujuan: Penelitian ini bertujuan untuk mengidentifikasi masalah yang berkontribusi terhadap kematian bayi baru lahir di Kabupaten Sleman.

Metode: Pendekatan studi kasus digunakan dengan metode kualitatif untuk mendeskripsikan dan membahas lima kasus kematian bayi di Kabupaten Sleman. Penelitian ini melibatkan wawancara mendalam dengan tiga ibu yang mempunyai bayi/neonatus sebagai informan utama, 3 tokoh masyarakat sebagai perwakilan masyarakat, dan pemangku kepentingan kesehatan lainnya yang diwakili oleh bidan lokal di Kabupaten Sleman.

Hasil dan Pembahasan: Terdapat 12 subtema yang teridentifikasi dalam penelitian ini yang mencerminkan 3 tema utama yang berhubungan dengan kematian neonatus yaitu: 1) kondisi neonatus: kelahiran prematur, pneumonia, BBLR, dan imaturitas organ vital; 2) faktor ibu: stres psikologis, hipertensi, diabetes, dan obesitas; dan 3) sistem pelayanan kesehatan: peran bidan, peran kader desa, dan pendataan kesehatan ibu dan anak.

Kesimpulan: Umumnya penyebab kematian neonatus adalah karena prematuritas dan janin kembar; Oleh karena itu, diperlukan skrining yang mendalam untuk mencegah kematian neonatus.

Kata Kunci: Determinan; kematian bayi; sistem pelayan kesehatan; *case study*

ABSTRACT

Background: Neonatal mortality is a significant global health problem. Most of the cases occur in low and middle-income countries including Indonesia. In Sleman District, Yogyakarta for the last five years, the neonatal mortality rate has not improved and remains high. This research aimed to identify the root causes of newborn deaths in Sleman District.

Methods: A case study approach was used with qualitative methods to describe and discuss five infant mortality cases in Sleman District. This study involved in-depth interviews with 3 mothers of neonates as the main informants, three public figures as society representatives, and other health stakeholders represented by local midwives in Sleman District.

Results and Discussion: There were 12 sub-themes identified in this study that reflected 3 main themes associated with neonatal mortality which are: 1) the neonates' condition: premature birth, pneumonia, low birthweight, and immaturity of vital organs; 2) the maternal factors: psychological stress, hypertension, diabetes, and obesity; and 3) the healthcare system: midwives' roles, village cadre roles, and health data collection of mothers and children.

Conlusions: Generally, the causes of neonatal mortality were due to prematurity and multiple fetuses; therefore, in-depth screening is needed to prevent neonatal mortality.

Keywords: Determinant; Neonatal Mortality; Healthcare System; Case Study

INTRODUCTION

Neonatal mortality is a significant global health problem and contributes to more than 60% of newborn baby mortalities before their first birthday.[1] Worldwide, of 7.7 million under-five children's mortalities, 3.1 million cases were in the period after their birth to the first month of life.[2] Many neonatal mortality cases occur in low and middle-income countries, including Indonesia. Neonatal mortality mostly happens in babies with low birth weight (LBW).

In Indonesia, there are four priority areas in improving the quality of human life contained in the national nine-point development agenda known as *Nawacita*, number 5. One of these agenda goals is the reduction of maternal and child mortality rates. Addressing this problem is the shared responsibility among stakeholders. However, in the context of the nation and state, the government oversees enhancing society's quality of life. Specifically, the Regulation of the Ministry of Health of the Republic of Indonesia number 4 in 2019 stated that the Minimum Standard Service is the responsibility of the Regional Head.[3]

The mortality rate and babies with LBW are two of four vital indicators in public health measurements. To date, the infant mortality rate (IMR) in Indonesia is considerably high compared to other ASEAN countries. Based on the Nursing Diagnosis Standard in Indonesia in 2007, the IMR of Indonesia was as high as 34 per 1,000 live births, and the neonatal mortality rate was 19 per 1,000 live births. Meanwhile, in the Millennium Development Goals (MDGs), number 4 in 2015 was aimed to reduce the IMR to 23 per 1,000 live births. To achieve the target, the attempts of reducing the neonatal mortality rates should consider contributing around 66% toward the IMR. In the meantime, the neonatal mortality rate has only decreased 5% compared to 2002 and the neonatal mortality rate in Indonesia ranks 10th in the world.

Most neonatal mortalities in developing countries befell infants with LBW, which is not only a direct cause of the death, but also a main factor threatening the newborns' chances of survival. The prevalence of LBW which is estimated to be around 15% among live births globally constituted 6% from developed countries and 30% from developing countries. While only 14% of low-birthweight babies are born in developing countries, this number is accountable for 60% to 80% of neonatal mortality. The present number of LBW cases in Indonesia has not indicated a downward trend as can be seen in the reports of the Nursing Diagnosis Standard of Indonesia in the periods of 1991, 1994, 1997, 2002-2003, and 2007 with 7.3%, 7.1%, 7.7%, 7.2% and 6.7%, respectively. The Basic Health Research in 2010 reported that the national rate of LBW was around 11.1% with a range of 6%-19.2%. Meanwhile in Sleman District, the IMR in 2017 increased compared to 2016. Infant mortality cases in 2016 were 44 from 14,139 live births with IMR = 3.11 per 1,000 live births, while infant mortality cases in 2017 were 59 cases from 14,025 live births with IMR = 4.4 per 1,000 live births with LBW as the highest cause (17 cases). In Sleman District, according to the vice-regent of Sleman, the referral administration system has been a fluctuating factor contributing to maternal and children mortality since the first National Health Insurance Program known as *Jaminan Kesehatan Nasional* (JKN). The fluctuating trend indicates there are inappropriate steps in the existing referral system.

A Demographic and Health Survey (DHS) result in 40 countries stated that, between 1995-2003, lack of health service utilization including unassisted home births had caused more than 50% of neonatal deaths. This is in line with the result of research showing that the survival rate of LBW babies with mothers utilizing health services is lower than those who do not.

The fluctuating IMR in Sleman District dominated by neonatal mortality involving LBW is the basis of the study, to determine the relation of childbirth service aspects with LBW neonatal mortality in Sleman District. This research aimed to explore the root causes and detailed circumstances associated with neonatal mortality in Sleman District, Yogyakarta, Indonesia.

METHODS

This qualitative research was conducted with a case study design. Cases of new birth mortality were examined in-depth to identify the root problems along with the accompanying factors underlying the occurrence of neonatal deaths. This article used primary data from a study titled, "Determinants of Neonatal Mortality and Efforts to Reduce IMR; A Case Study in Sleman District", research nested in Health and Demographic Surveillance System (HDDS) in Sleman. The sample included in this research was based on the data of infant mortality in the last year in the Sleman District, Yogyakarta.

Sample selection of informants used the purposive sampling method. This research involved neonates' parents, public figures, health cadres and village midwives in Sleman District.

The data collection method was in-depth interviews. This technique was conducted with the neonates' mothers to reveal babies' condition before death, how the babies were treated, and the value system embedded in the baby's death. In-depth interviews with the local midwife were done to explore the healthcare system since antenatal care, childbirth assistance until postnatal care, programs that had been done, and obstacles in running the programs. Data collection involved transcripts from in-depth interviews which were first transcribed verbatim and then analyzed using a coding process, categorization and thematic analysis. The research variable was the researcher alone helped by the research assistant during the interview. To ensure the validity of the data, there was cross-checking or triangulation either from the informants or with the methods. Qualitative data analysis was aided by software, namely nVivo version 12 to organize and arrange the data to ease the coding process and determine the main categories based on the themes that emerged in the research

RESULTS AND DISCUSSION

1. Characteristics of Neonates

Babies in Sleman District who died in 2018 based on Verbal Autopsy of Health and Demographic Surveillance System (HDDS) were 5 neonates. All of them were male and born at gestational age of 27-29 weeks. The condition of neonates were twins, weighing less than 1,000 grams, and pneumonia was determined as the cause of their death.

Table 1. Characteristics of Newborn Deaths

Neonates 1. a	Male	27 Weeks	900 grams	Pneumonia	Obstetricians
Neonates 1. b	Male	27 Weeks	800 grams	Pneumonia	Obstetricians
Neonates 2. a	Male	29 Weeks	600 grams	Pneumonia	Obstetricians
Neonates 2. b	Male	29 Weeks	800 grams	Pneumonia	Obstetricians
Neonates 2. c	Male	29 Weeks	900 grams	Pneumonia	Obstetricians

*Based on Verbal Autopsy data and diagnosed using Inter-VA software program

2. Characteristics of Participants

Researchers conducted the in-depth interviews with the infant's parents, public figures, and local midwives to identify the root causes and detailed circumstances associated with the death of the neonates including the efforts made by the parents to sustain the life of their newborns. The parental participants were 3 mothers who are housewives, in a productive age, senior high school graduates, Javanese and Moslem.

Table 2. Characteristics of Informants

1.	Female	27	Senior High School	Housewife/ Entrepreneur	Neonate's mother
2.	Female	27	Senior High School	Housewife	Neonate's mother
3.	Female	35	Senior High School	Housewife	Neonate's mother
4.	Female	52	Senior High School	Entrepreneur	Dukuh Klaci 2
5.	Female	28	Senior High School	Housewife	Health Cadre
6	Female	45	Senior High School	Housewife	Health Cadre

3. Determinants of Neonatal Mortality

Based on the qualitative data analysis, there were three main themes identified in this research, which are neonatal complications, maternal complications, and the healthcare utilization.

Theme 1. Neonatal Complications

Health condition of the fetus was the main cause of deaths in the neonates. The condition of premature fetus resulted in pneumonia, LBW, lung and heart immaturity. All neonates who died in this research were neonates from twin fetuses with male sex and born prematurely, so that their heart and lung had not fully formed yet. Newborns weighed around 600 grams to 900 grams. All neonates were hospitalized in the Neonatal Intensive Care Unit room (NICU) with incubators and depended on the medical devices. While being treated, the newborns continued to drink breast milk through Orofaring Nasogastric Tube (OGT). The newborns survived until the seventh to fifteenth day after the birth.

"The baby who came out first weighed only 6 ounces. 6 ounces was the smallest, that was the one with a weak heart and lungs and if I'm not mistaken the heart was leaking so it needed an injection." (P3, Mother of Neonates).

Theme 2. Maternal Complications

Pregnancy condition was accountable for factors of newborns mortality including the history of abortion in the previous pregnancy. All the neonates had a history of twin fetuses. Participants admitted that there was a history of particular diseases such as diabetes, asthma, and hypertension during pregnancy. This worsened the pregnancy condition of the mothers because of the difficulty to move and getting tired easily.

"In my four months, I have encountered difficulties, even doing things feels exhausting, like it is already 9 months. In the five months, I feel my stomach cannot fit the baby anymore, my stomach skin is relatively thin, and at that time it seems extremely thin, going anywhere is tiresome." (P3, Mother of Neonates)

All mothers of the neonates stated that they experienced psychological stress and anxiety concerning the pregnancy, due to their unpreparedness to have twins or personal problems. One participant described the stress as follows:

"When in stress, I usually just stay in the bedroom, never tell my father nor mother but my husband on different days sometimes, or I tell him nothing but maybe they already understand… hehehe." (P1, Mother of Neonates)

During the pregnancy, the mothers said they did not really understand indications and risks of childbirth and were not able to decide on what to do when there were indications of early delivery at 24 weeks gestation.

"It was when I felt the pain, but I did not immediately go to the hospital. So what I regretted the most is why I didn't go straight away (to the hospital), I was confused .. like being darkened (the thoughts), how come I didn't immediately check it out." (P1, Mother of Neonates)

Theme 3. Healthcare Utilization

All the neonates received the rescue efforts performed by health workers both from the public health centers (*Puskesmas*) and referral hospitals. Supplementing these efforts to save the baby, the role of village midwife and health cadres was described as centrally essential. Efforts of saving the baby included performing surfactant injections by the gynecologist both in the womb and after the fetus was born.

"The lungs were extremely weak, and the heart was leaking if .. must be injected, then inject it and move all immediately to the NICU." (P1, Mother of Neonates)

There were several attempts from *Puskesmas* in reducing the IMR through various programs implemented by the village midwives. Those programs take the form of preventive measures such as the giving tetanus vaccine to the prospective bride, education associated with reproductive health to the teenagers, and education about the indications of a high-risk pregnancy in addition to holding the antenatal care checks both in the *Puskesmas* and integrated healthcare centers (*Posyandu*) in a village. Outreach efforts from the *Puskesmas* through the village midwives also included home visits to the mothers with high-risk pregnancy or childbirth with complications for whom the health of both mother and the baby should be monitored.

"For a program, the (IMR prevention) has actually run well, we also do home visits to mothers with high-risk pregnancy and if there is a delivery that needs monitoring, later we will cooperate with village cadres." (P7, Village Midwife)

Puskesmas also empowers health cadres who are considered as the person-in-charge as the assessor of the pregnant mother and the birth of the baby, and facilitators for *Posyandu* programs, who monitor the health of mother and baby in that area. Cadres are accountable for intermediation of health consultations between pregnant mothers and health workers at Puskesmas.

"Every month Posyandu is specifically for the toddlers, then for the pregnant women, we will gather the data for body weight, and arm circumference only if being asked by the Puskesmas." (P4, Health Cadre)

DISCUSSION

Key Finding of risk factors

This study found 3 main risk factors associated with neonatal death. The risk factors were as follows: 1) Neonatal complication, 2) maternal complications and 3) health utilization.

Neonatal Complications

In this study, the neonatal complications are premature birth causing pneumonia, low-birth weight baby, and heart and lung immaturity. Almost all babies born prematurely experienced respiratory disorders identified as pneumonia. Lung infections are common in preterm newborns and sick newborns. Pediatricians will suspect pneumonia if the baby has difficulties in breathing, changes in respiratory rates or an increase in the number of apneic episodes.[4,5,6] Premature babies with pneumonia have an increased chance of dying since they are less likely to respond to antibiotics.[7]

Premature birth also affects the baby's weight, which is caused by low fetal age and decreases their chance of survival. This finding is in line with the results of Suraya (2017) and Simbolon (2015). Neonatal mortality is more common in the group of infants with low birth weight.[8] Babies born prematurely with LBW are at 2.9 to 3.9 times higher risk of dying until the neonatal period compared to those born with normal weight.[9]

Based on the gender, all neonates who died were male. This demonstrated that male babies had more possibilities to experience LBW at birth than female babies. Cases in Sleman District showed that male babies had lower weight than female babies.[10] Other study in Indonesia have identified the following risk factors as being associated with a high risk of neonatal death: low birthweight, neonatal complication at delivery, and low Apgar score.[1]

Maternal complications

In this study, the mothers of the neonates had a history of illness including hypertension, diabetes, and obesity. The study showed that pregnant mothers with obesity, hypertension, and diabetes were considered a significant risk factor in association with the LBW and premature birth of a baby that contributed to the cause of death.[11] Comorbidities during pregnancy such as hypertension causes excessive unnatural proteinuria edema which contributes to the hypertensive condition and preeclampsia. Other illnesses such as diabetes could be burdensome to the mother and the fetus because of the disruption on the pancreas to produce

sufficient insulin in the formation and maintenance of fetal metabolism.[12] Complications caused by the increase of blood sugar levels could increase the risk of premature birth. Research showed that the risk of premature birth because of gestational diabetes was higher if the mother suffered from diabetes before the 24th week of pregnancy.[7,8]

Participants said there was a feeling of being depressed during pregnancy, either due to personal problems or anxiety of being unable to care for and support their children in the future. Psychological conditions of mothers such as stress during pregnancy could influence fetal health, causing a restriction of fetal growth including mortality due to slow development of the cardiovascular, respiratory, and cerebrovascular systems. The mother's stress increases the cortisol level and causes inflammation, which directly affects the placenta activities.[15] Another research showed that the mother's stress during pregnancy was predicted to increase the risk of both infectious illness and non-infectious illness in infants (16) and contribute to LBW.[15]

Healthcare Utilizations

Healthcare services have been demonstrated to be a vital aspect in the efforts to save the baby both in the form of promotional and preventive programs, as well as rehabilitative actions either in *Puskesmas* or the referral hospitals. In this study there were efforts to save the baby performed by the doctor by surfactant injection in the lungs and cardiac organs for maturation. Surfactant injection is considered able to prevent the death of the infant which was caused by very immature respiratory failure.[5] Another study indicated that surfactant decreased newborn's death with weight $\geqslant$ 1.500 grams and hypoxemic respiratory failure.[17] In this research, the newborns eventually died even though they had received the surfactant injection. Their death could be due to other factors including the LBW baby's weight was < 1,000 grams.

Another effort to prevent the baby's death was the central role of the midwives in promotional and preventive actions by providing counselling related with the dangerous indications of an at risk pregnancy, utilizing the mother and children health book (KIA) and performing antenatal care. Counselling was considered effective in increasing the efficacy of pregnant women to utilize the services of *Puskesmas* such as consultation and pregnancy tests.[14,15] However, in the actual implementation, pregnant women were more reluctant to check the progress of their pregnancy at the *Puskesmas* and chose a maternity clinic or hospital, so that the pregnancy was unrecorded in the *Puskesmas*. This condition was caused by economic factors. Society members with middle to high income levels tend to prefer private clinics.[20]

The findings showed that health cadres were actively involved in the public health efforts in reducing the number of infant mortalities in Sleman District. They performed an essential role as facilitators in providing health classes and pregnancy programs and maintaining health records for the pregnant women and toddlers to be reported on *Puskesmas*.[21]

One of the obstacles encountered by *Puskesmas* was related to data collection of infants, and suboptimal mortality and natality reports from the hospitals. Even though there are recording and reporting systems available electronically through the Maternal and Child Health Management Information System (SIM KIA), not all hospitals input the data associated with the baby's death and birth of the LBW neonates into this system.

Weaknesses and Strengths of the Research

Newborns who died were patients from three years ago so that it is possible that the informants forgot some of the detailed events related to the death of these newborns. The researchers did triangulation with the family members, neighbors, health cadres, and public figures who knew about the neonate's death in this research to achieve data validity.

CONCLUSIONS

1. The main determinants of neonatal mortality, in this case series, are premature birth causing pneumonia, low-birth weight baby, and heart and lung immaturity. Besides, the psychological condition of the pregnant mother and mother health condition are contributing determinants of neonatal mortality.

2. Efforts to reduce the infant mortality rate in Sleman District are conducted through programs performed by the village midwives or health cadres and were running well. However, during the program, there were many obstacles such as pregnant women with middle-to-high income who were reluctant to get checked at the *Puskesmas* so that the screening of the at risk pregnancy was not optimal.

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