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Original Article

Spatial Analysis of Antenatal Care and Low Birth Weight against Neonatal Mortality Rate in Aceh Province, Indonesia

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Abstract

Background: Similar to Indonesia, Aceh Province also showed a slight decline in neonatal mortality rate. However, the rate is still high compared to other provinces. Efforts to reduce neonatal mortality rate are essential because neonatal deaths contributed up to 71% of all under-five deaths in 2017 in Aceh. Antenatal care and low birth weight are known to be associated with neonatal mortality. The purpose of this study was to map district-level neonatal mortality rate and its determinants (antenatal care and low birth weight) in Aceh to inform policymakers in planning the interventions.

Methods: This was a cross-sectional study using publicly available secondary data obtained from Aceh Provincial Health Office. The study used the 2017 data of neonatal mortality rate, percent of 4th antenatal care visit and percent of low birth weight at district level. Thematic maps were produced using ArcMap (V.10.5). The correlation was analyzed using the Spearman rank test.

Results: The results indicated the regional variation of neonatal mortality rate across Aceh Province. Districts in the Southern region had lower neonatal mortality rates compared to others. Low birth weight was positively correlated with neonatal mortality rate at district level (Spearman's Rho=0.545, *P*=0.007). However, the percent of 4th antenatal care visit at district level was not correlated with neonatal mortality rate (Spearman's Rho= -0.35, *P*=0.097).

Conclusion: The study identified regional variations of neonatal mortality rate, low birth weight and ante natal care visit.

Keywords: Antenatal care; Low birth weight; Neonatal mortality rate; Spatial analysis

Introduction

Neonatal mortality rate in Aceh Province showed a slight decline from 10 per 1000 live births in 2013 to 7 per 1000 live births in 2019, which is similar to Indonesia (1,2). However, the rate is still considered high compared to other provinces (3). Neonatal mortality rate is related to several factors including community-level factors (such as mean number of antenatal care visits, percentage of newborns receiving postnatal care, percentage of deliveries assisted by trained birth attendants), socio-economic status, and proximate determinants (birth size, maternal age at childbirth, delivery factors, and post natal care) (4). In Indonesia, neonatal mortality is associated with low birth weight (5), and inadequate number of antenatal care (ANC) visits. (6). Efforts to reduce neonatal mortality rate require collaboration of various stakeholders, either government or community, that risk factors can be controlled. Prevention program priority should be made following the evidence-based policy. However, research data is difficult to display and understand by the wider community, as well as policymakers. Geographic Information Systems (GIS) has been used as a tool to bridge the gap by visually displaying data is for easier interpretation (7,8).

GIS is informatics tools that can stores and manage data identified based on their location. Medical GIS is used for identifying and mapping populations, health problems, risk factors, and their relationship (9). GIS is a useful tool for planning and implementing public health programs (10-12), including neonatal death (13,14). However, research that used spatial methods to identify and analyze neonatal mortality and its risk factors in Aceh Province is not widely studied yet.

We aimed to map district-level neonatal mortality rate and its determinants (antenatal care and low birth weight) in Aceh. This study will allow policymakers to prioritize the interventions according to their district conditions, to reduce neonatal mortality rate.

Methods

This was an observational study with cross-sectional design using publicly available secondary data from Aceh Health Profile 2017 accessed through Provincial Health Office website (1). We analyzed neonatal mortality rate, percent of four-time antenatal care (ANC), and percent of low birth weight at the district level. There are 23 districts/municipalities in Aceh included in the study. Neonatal mortality rate is defined as number of deaths during the first 28 completed days of life per 1,000 live births in Aceh by district. Percent of four times antenatal care (K-4) is defined as proportion of women who attended ANC at least four times during pregnancy in Aceh by district (%). Finally, percent of low birth weight is defined as a birth weight of less than 2500 grams in Aceh by district (%). Data in excel were joined to a shapefile for analysis using the GIS software. A shapefile for the Aceh province containing district boundaries was imported from info-geospatial website (15). The state map layer was then joined to the district attribute dataset using the district code.

The correlation between percent of four-times ANC and percent of low birth weight against neonatal mortality rate was analyzed using non-parametric statistics of Spearman's rank correlation as data were not normally distributed, with p-value set at <0.05. The analysis was conducted using SPSS (ver. 22.0, IBM Corp., Armonk, NY, USA).

Results

At the district level, neonatal mortality rate ranged from 3 deaths per 1,000 live births in Aceh Tenggara to 89 deaths per 1,000 live births in Pidie. Similarly, the four-time ANC was the lowest at 64% in Pidie, but the highest (96%) in Banda Aceh. When examining neonatal mortality rate against four-time ANC at the district level, it shows the negative correlation, indicating the higher percent of antenatal care, the lower neonatal mortality rate, but it was not statistically significant, rs (21) = - 0.35, P=0.09. Descriptive thematic map demonstrates variations in neonatal mortality rate and ANC across the districts in Aceh province. Neonatal mortality rate was high at the eastern region of Aceh, but the four-time ANC was not clustered (Fig. 1).

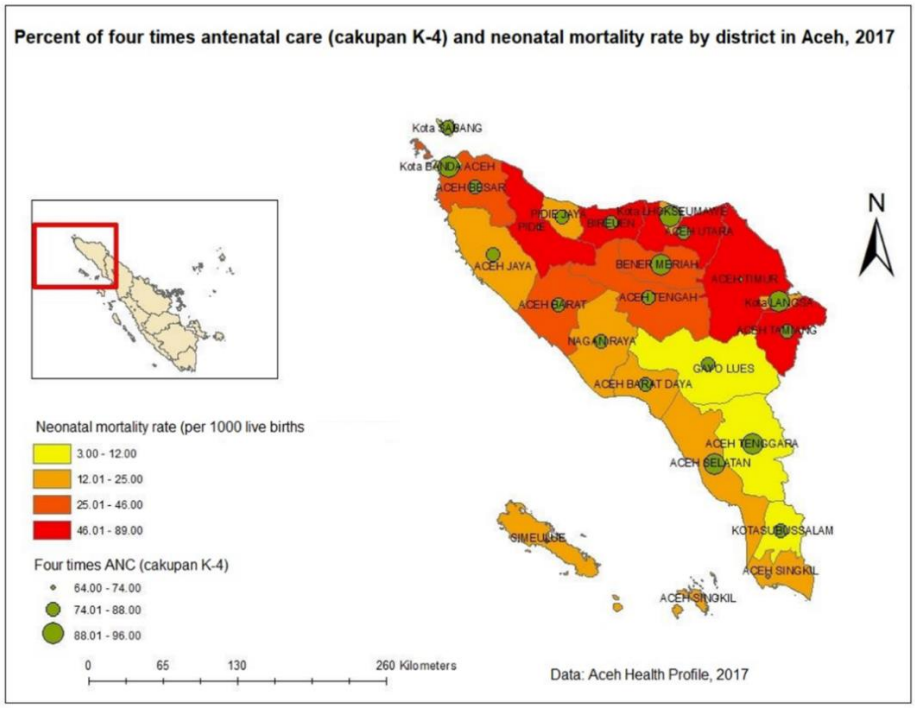

Fig. 1: Percent of four time's antenatal care and neonatal mortality rate by district in Aceh, 2017

For percent of low birth weight at the district level, Aceh Tenggara and Nagan Raya had the lowest percentage (0%), while Simelue had the highest (11%). When we examined the correlation between neonatal mortality rate and percent of low birth weight, it was a positive correlation, indicating the higher percentage of low birth weight, the higher neonatal mortality rate and it was statistically significant, rs (21) = 0.54, P=0.007. The thematic map suggests that districts at the eastern region of Aceh that had high neonatal mortality rate were also had a high percentage of low birth weight (Fig. 2).

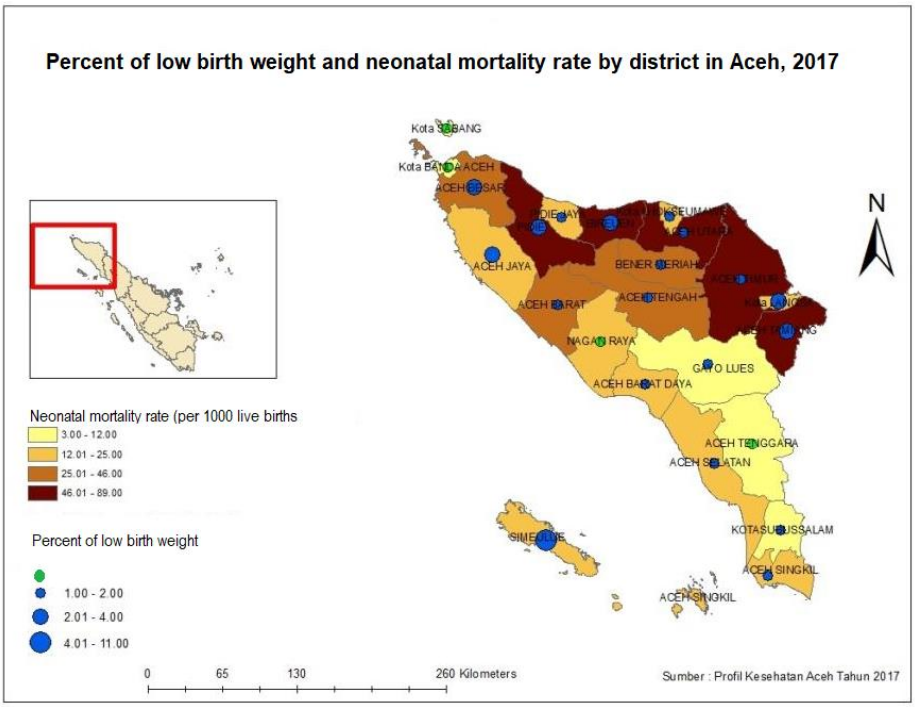

Fig. 2: Percent of low birth weight and neonatal mortality rate by district in Aceh, 2017

Discussion

The study focused on antenatal care and low birth weight against neonatal mortality rate at the district level in Aceh Province, Indonesia. The map (Fig. 1) shows there were clear regional trends in neonatal mortality rate across Aceh, the east coast region had higher neonatal mortality than the west coast region. However, there is no clear pattern of antenatal care visits. Not all districts with high neonatal death had low four-time visit ANC. This align with the statistical result that indicates no correlation between four-time antenatal care visit with neonatal mortality rate at the district level. The result is consistent with the findings from two systematic reviews conducted in both high- and low-income countries among socially disadvantaged and vulnerable pregnant women (16,17). These reviews compared women who had lower number of ANC and those who had standard number of ANC visits. However, other studies had the opposite results that show positive effects of antenatal care in preventing neonatal deaths (18-20). This conflicting result may be related to other determinants of neonatal mortality rate than antenatal care visits for example newborn characteristics such as fetal congenital, prematurity, APGAR score (21), maternal characteristics such mother's age, gestational age, parity, etc. (22).

The map (Fig. 2) highlights the pattern of neonatal mortality rate and low birth weight, showing the districts at the east coast region had higher low birth weight and neonatal deaths than those at the west coast. Low birth weight is one of the most important predictors for neonatal mortality (23) and is related to area-level social determinants of health (24). This spatial disparity may be explained by different health facilities and access to health care across the regions in Aceh Province. Villanova et al indicated that children with low birth weight are more likely to die before one year old, particularly children whose mothers at young age and born in public hospitals (25). Another factor that may contribute to this regional variety of low birth weight and neonatal death is socioeconomic inequalities also considered an important factor in low birth weight and infant mortality (26).

Conclusion

At the district level, the higher percentage of low birth weight, the higher rate of neonatal death. Conversely, the higher percentage of mothers having four-time antenatal care, the lower the neonatal mortality rate, but it is not statistically significant. Understanding the spatial patterns of low birth weight, antenatal care, and neonatal deaths in Aceh was an important step in conducting a geographic evaluation of the Provincial's reported infant mortality rates. Future research is needed to investigate determinants of neonatal deaths at the district level to reduce the geographical variation across Aceh.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Conflict of interest

The authors declare that they have no competing interest.

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