Blood Lead Levels of Pregnant Women in Agricultural and Coastal Area: A SDG’s Indicator for Health and Pollution in Brebes District

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Abstract. Maternal mortality is still a severe problem in Indonesia. One of the causes is the blood lead levels. Blood lead levels in pregnant women can increase the risk of preeclampsia which is the cause of high maternal mortality in Indonesia. One of the factors for high blood lead levels is living close to the source of lead pollution. This study determines the differences in blood lead levels in pregnant women in agricultural and coastal areas in Brebes District. The t-test independent is used to analyze the mean differences with SPSS v 21 software with 84 samples. The results show a significant difference in the average blood lead levels in pregnant women in agricultural and coastal areas in Brebes Regency (p-value=0.047). The average blood lead levels are higher in agricultural areas (46.243 µg/dL) than in coastal areas (37.731 µg/dL). It can be implied that the risk of maternal mortality in an agricultural area is higher than in a coastal area.

1 Introduction

Maternal mortality reduction is a priority under goal three in Sustainable Development Goals (SDGs) agenda through 2030. The target is reducing the global maternal mortality ratio (MMR) to lower than 70 maternal deaths per 100,000 live births. In Indonesia, nationally, The MMR in 2015 of 305 maternal deaths per 100,000 live births has not succeeded in reaching the SDGs target [1]. However, in 2015, Brebes Regency was the region with the highest maternal mortality rate in Indonesia, with 37 maternal deaths per 100,000 live births [2].

Several factors cause maternal mortality in pregnant women, such as preeclampsia. One of the causes of preeclampsia is that the Blood Lead Levels (BLLs) in pregnant women exceed the standards set by the Central for Disease Control (CDC) [3]. In pregnant women, BLLs affect hypertension then causes eclampsia and preeclampsia. BLLs below 10 µg/dL can cause hypertension. Bayat 2016 [4] stated that there is a correlation between BLLs with preeclampsia (p=0.028) where the mean of BLL is 6.24±1.74 µg/dL (control) and 8.0±3.1 µg/dL (case). This statement is supported by Disha et al. (2019) [5], which mentions a strong correlation of BLLs in pre-eclamptic women. Every 1 µg/dL BLL is followed by the raise of systolic blood pressure (0.014 mmHg) and diastolic (0.013 mmHg) with p-value of 0.04. The danger is not only faced by the mother but also the infant. BLLs in pregnant women transfuse through the placenta and blood-brain barrier. It can cause miscarriage and slow development of the infant. An infant that was born from a mother with high BLLs has a risk of congenital health disease.

The point of source of BLLs in pregnant women can come from everywhere. Environmental conditions can affect the BLLs in pregnant women to increase. A study by Sakina et al. (2018) [6] has
determined that the BLLs of pregnant women in coastal areas are at $42.437 + 19.758 \mu g/dL$, which exceed the CDC threshold. Another study mentions that women living near highways have BLLs higher than those far away from the highway [7]. A study by Suhartono et al. (2021) [8] reveals that it exceeds the CDC’s threshold.

Lead usually enters the blood through breathing, digestion, and direct touch. Sources of exposure includes pesticides, the habit of using newspaper as a food wrapper, inhalation from the air near roads with dense vehicles, et cetera [6]. A person’s place of residence also determines whether or not humans are close to a source of lead exposure. For example, the pattern of eating seafood in coastal areas will be higher than in agricultural areas. The majority of the community in Brebes Regency lives in agricultural and coastal areas which have a high potential of lead exposure. Therefore, this study aims to determine the difference in BLLs of pregnant women in the agricultural and coastal areas.

2 Methods
The cross-sectional design is used during January-June 2018. The study location was done in four districts in Brebes Regency, namely Wanasari, Tanjung, Bulakamba, and Losari. The Pantura Highway separates the agricultural area and coastal area. The coastal area is in the northern part and the agricultural area in the southern. The population is selected with the inclusion criteria of: pregnant women in the second and third semester, not in severe health condition, do not have any history of severe illness, especially bone cancer, and live in the study area within two years or more. The minimum sample is calculated with a sample formula for a hypothesis test for independent population means. From the calculation, 38 samples were used in this research. However, to avoid the error of sample, so that, the samples were increased to 42 samples. There are two groups (agricultural and coastal area) thus, the sample is multiplied by 2. Thus, there are 84 samples.

2.1 BLLs Analysis
The blood was analyzed by Atomic Absorption Spectrometer (ASS) with a 17.0 nm wavelength. Laboratory health analysts took blood samples. Before taking the blood sample, the researcher gave informed consent to pregnant women. Five ccs of venous blood are taken into a tube. Without additives, the blood will be frozen in this tube, and the serum is separated with spinning. The blood that has been taken is then taken to CITO Tegal Regency for examination of BLL. The maximum concentration standard of BLL is 5 µg/dL in the human body [3].

2.2 Data Analysis
This research used univariate and bivariate analysis. The univariate describes the minimum, maximum, standard deviation, median, and mean of BLLs. At the same time, bivariate analysis is used to analyze the mean differences. Before testing the mean difference, the normality test with Kolmogorov Smirnov is used. The result is p-value>0.05. Thus, t-test independent was preferable to be used.

3 Results and Discussion
3.1 Background Study
The Brebes regency is one of the autonomous regions in the Province of Central Java, with an area of 1,662.96 km². From the location of the study, Bulakamba district has the vastest area (102.93km²), and the smallest is Tanjung District (67.74 km²). Brebes is one of the regencies passed by the Pantura Route, a national road length of $\pm 32.8$ km in the Brebes Regency. In figure 1, the red line shows the Pantura Roadway, which separates the coastal and the agricultural area. The blue dots are the respondents who live in the coastal area while the black dots show the respondents who live in the agricultural area.

Table 1 shows the univariate analysis of the variable. Most of the respondents, whether in the agricultural and coastal area are not classified as pregnant women with high risk by age (<20, 20-24 and >35 years old) [9]. The last education of pregnant women in both the agricultural and coastal area were only at primary school. M.Restrepo-Mendez et. al. [9] argue that mothers who are less educated will tend to bear increased risks. It is shown by the proportion of the last education in primary school in an agricultural area (64.28%) is higher than in coastal area (50%).
Figure 1. Distribution of Respondents in Coastal Areas and Agricultural Areas
(Source: Personal data)

Table 1. Univariate Analysis of the Variables.

| Characteristics | Agricultural Area | Coastal Area |
|-----------------|-------------------|--------------|
|                 | f | Mean | Median | Min | Max | SD | f | Mean | Median | Min | Max | SD |
| Age (year)      | 42 | 31.21 | 32.00 | 20.00 | 38.00 | 4.81 | 42 | 29.22 | 29.50 | 19.00 | 41.00 | 5.48 |
| BBLs (µg/dL)    | 42 | 46.24 | 43.25 | 5.60 | 114.80 | 22.33 | 42 | 37.73 | 34.80 | 3.60 | 79.60 | 15.75 |
| Education       |  | - | - | - | - | - | 42 | - | - | - | - |
| No school       | 1 | 3 | - | - | - | - | 3 | 3 | - | - | - |
| Primary School  | 27 | 21 | 7 | 4 | 13 | 1 | 7 | 4 | - | - | - |
| Junior HS       | 7 | 13 | 6 | 4 | - | - | 4 | 4 | - | - | - |
| High S          | 6 | 4 | 1 | 1 | - | - | 1 | 1 | - | - | - |
| College         | 1 | - | - | - | - | - | 1 | - | - | - | - |

3.2 The Difference BBLs in Agricultural and Coastal Areas
The normality test result shows that the p-value is 0.054, which means the data is appropriate for t-test independent use. In Table 2, the t-test independent of BBLs in Pregnant Women shows a mean difference of pregnant women in coastal and agricultural areas. The mean of BBLs of pregnant women in an agricultural area is higher than in a coastal area. This result is equal to a study by Carpenter et al. [10], which evaluates BLL in infants in different areas (mountain and coastal).

Table 2. T-test Independent of BBLs in Pregnant Women

| Variable        | Area   | n | T-test Independent |
|-----------------|--------|---|-------------------|
| Blood Lead Levels (µg/dL) | Agricultural | 42 | 37.731 | 0.047 |
|                 | Coastal | 42 | 46.243 |   |

It might be because of pesticides in Brebes Regency because Brebes regency is one of Indonesia’s most prominent shallots producers. They mix 2-3 pesticides that contained heavy metals such as Plumbum (Pb) [11]. It correlates with Forsyth et al. (2018) [12], which found that high BLLs in pregnant women was caused by exposure to pesticides and herbicides. The distribution of the respondents who live near the highway can cause high BLLs in pregnant women. Daniel et al. (2016) [7] reveals that BLLs of women living near a highway in Ethiopia were significantly higher than those far from the highway.

The BLLs in pregnant women associated with exposure to lead during pregnancy are a significant health concern. BLLs can disrupt the cardiovascular system [13], the nervous system [14], the urinary
system [15], and the reproduction system [16]. Pregnant women are vulnerable to lead exposure [3]. A previous study mentioned a relationship between BLLs and preeclampsia (p=0.028) [4]. There is a potential increase in blood pressure, an increase in diastolic (0.013 mmHg) and systolic blood pressure (0.014 mmHg), with 1 µg/dL increase of BLLs [4]. The high level of BLLs can endanger motherhood healthiness. It can contribute to the increase of MMR, which is an unwanted effect. An intervention is needed to reach the SDGs goal three in 2030. Calcium supplements can help reduce BLLs in pregnant women. A study conducted by Suhartono et al. (2021) [8] shows a significant difference in the reduction of BLLs between the control and intervention groups. It is also necessary to consider monitoring pregnant women with high BLLs in areas that potentially have high lead exposure.

4 Conclusion
The results imply that BLLs in pregnant women, both in agricultural and coastal areas of Brebes Regency, exceed the standards. However, the highest BLLs are found in the agricultural area. It may be caused by the pesticide where so many shallot farmers are still using pesticides that contain lead. It triggers the high risk of MMR in Brebes Regency.

The limitations of this study are that this study did not examine the point source of lead exposure. However, further research must find out what variables precisely cause the high BLLs in pregnant women. This study also did not make use of any intervention with calcium supplements towards respondents in both areas. For further research, an intervention is needed to reduce the BLLs of pregnant women in Brebes Regency. This study needs improvement, and it is necessary to reach the SDGs goal three.

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