The effect of accessibility and availability of health infrastructure on maternal healthcare utilization in Indonesia to achieve Sustainable Development Goals

Dian Ayu Puspitasari* and Omas Bulan Samosir

1 Faculty of Economics and Business, Universitas Indonesia, Depok, 16424, Indonesia

*diayupuspitasari2004@gmail.com

Abstract. The first goal in Sustainable Development Goals (SDGs) 3 aims to reduce maternal mortality and provide equitable access to maternal health care. High maternal mortality rates are often associated with inadequate maternal healthcare service utilization. The utilization of maternal healthcare services in Indonesia shows variations between provinces, allegedly influenced by each province's contextual factors. This study investigates the association between accessibility and availability of health infrastructure with maternal healthcare service utilization. The multilevel logistic regression method was used to test the hypothesis that the accessibility and availability of health infrastructure were associated with maternal healthcare service utilization. This study indicates that the characteristics of the region where women live have a significant effect on maternal healthcare service utilization. The average distance to the nearest hospital is significantly associated with the three dimensions of maternal healthcare services. The farther the distance to reach the nearest hospital, the propensity for women to utilize maternal healthcare services will decrease. Therefore, to reduce disparities between regions in maternal healthcare service utilization, one of the interventions that can be carried out is shortening the distance to health facilities so that access to health facilities becomes more accessible than before.

1. Introduction

Ensuring healthy lives and promoting well-being at all ages is crucial to sustainable development. The Sustainable Development Goals (SDGs) in the third goal emphasizes good health and well-being for all, including maternal health. Maternal health is a keystone for healthy and productive societies [1].

The first goal in SDGs 3 aims to reduce maternal mortality and provide equitable access to maternal health care [1]. In 2017, approximately 810 women died each day due to complications during and following pregnancy and childbirth [2]. Maternal healthcare service utilization has known and widely accepted could reduce morbidity and maternal mortality rate [3]. Antenatal care aims to provide comprehensive and quality health examinations that enable health workers to detect diseases or complications early during pregnancy [3]. Institutional delivery is essential to ensure that the mother gives birth in a place with hygienic conditions and equipped with adequate life-saving equipment to help the mother and her baby avoid the risk of complications that can lead to maternal morbidity and mortality [4]. Postnatal care is necessary to identify various life-threatening conditions for the mother and require immediate medical attention because most maternal deaths occurred during this period [5].
According to United Nations inter-agency estimates, the global Maternal Mortality Ratio (MMR) decreased by 38%, from 342 to 211 deaths per 100,000 live births between 2000-2017. Meanwhile, in Indonesia, MMR only declined by 22% from 1990 to 2015 - from 390 to 305 deaths per 100,000 live births [6]. Compared to other countries in Southeast Asia, Indonesia's MMR in 2015 was ranked the second-highest after Laos [6]. The achievement of reducing the MMR is also still far from the target in the SDGs 3, which is 70 deaths per 100,000 live births by 2030. These high maternal mortality rates are often related with inadequate maternal healthcare service utilization [7,8].

The coverage of maternal healthcare service utilization in Indonesia has increased; however, there are still disparities between provinces with quite significant variations [3]. The results of the 2017 Indonesia Demographic and Health Survey (IDHS) show that Yogyakarta has the highest coverage for pregnant women who receive antenatal care from professional health worker at least four times during pregnancy (K4), which is 90.2%, while in Papua, the coverage is only half (42.9%) of the coverage in Yogyakarta. The 2017 IDHS also shows that all pregnant women in Yogyakarta gave birth in health care facilities, while in Maluku, only about 28.7% of them gave birth in health care facilities. In Bali, almost all women (98.7%) received postnatal care from professional health workers within the first two days after delivery. Meanwhile, in Maluku, only about one in two women receive their postnatal care within the first two days after delivery.

The difference in the coverage of maternal healthcare service utilization inter-provinces needs to be linked to each province's contextual factors because each region has a variety of characteristics that can affect maternal healthcare service utilization by women [9]. Individual factors influence low maternal healthcare service utilization in some regions. However, there are factors in the broader scope of individuals that affect women in utilizing maternal healthcare services. Contextual factors are important to study because, in addition to individual factors, women's maternal healthcare service utilization can also be influenced by the environmental context in which these women live [10].

Studies on the determinants of the utilization of maternal healthcare services in Indonesia pay little attention to the accessibility and availability of health infrastructure. Distance is an essential factor in influencing maternal healthcare services [8,11–17]. However, the association between distance from health infrastructure and women's decisions to utilize antenatal, delivery, and postnatal care services has not been widely explored. Thaddeus and Maine (1994) emphasize how regional differences in availability and access to health infrastructure may influence timely care-seeking, reaching the health care facility, and receiving appropriate treatment for obstetric complications [18]. Several previous researches have shown that women living in a poor community are least likely to utilize adequate maternal healthcare services [10,15,19–21]. The number of doctors in the community significantly promotes maternal healthcare service utilization [22–24], while the number of a health facility enhances maternal healthcare utilization for pregnancy, childbirth, and postnatal [11,20]. Based on these issues, this study investigates the association between accessibility and availability of health infrastructure in provinces where women live with maternal health service utilization by women in Indonesia.

2. Method

The analysis in this study used the multilevel binary logistic regression method. This study uses two levels of data, the individual and the contextual level. At the individual level, this study uses data from the 2017 IDHS [25] with a sample of women aged 15-49 years who gave birth their last child between 2012-2017 as many as 15,357 women. The permission to download the IDHS datasets is submitted through the MEASURE Demographic and Health Surveys (DHS) program website by first registering as a DHS data user. After registered as a user, the researcher will be given the authority to download the datasets according to the research project proposed by the researcher. In this case, we applied for permission to use the data on women of childbearing age in the 2017 IDHS. After the cleaning process for missing data, the number of observations for antenatal care utilization was 15,317 women, 15,321 women for delivery care utilization, and 15,219 women for postnatal care utilization.
At the contextual level, the data used are secondary data from the 2017 Republic of Indonesia Health Profile [26] and the 2018 Survei Potensi Desa [27]. The unit of analysis at the contextual level in this study was 34 provinces in Indonesia. Ratio of doctors per population, ratio of Primary Health Center (PHC) per sub-district, and poverty rates variables at the provincial level were obtained from the 2017 Republic of Indonesia Health Profile publication. Meanwhile, the average distance to the nearest hospital variable was obtained from data processing results from the 2018 Survei Potensi Desa.

This study's dependent variable consisted of three variables: the utilization of antenatal care, delivery care, and postnatal care. The antenatal care utilization is measured through prenatal care conducted by doctors, midwives, or nurses at least four times or more according to standards that are at least one time in the first trimester, at least one time in the second trimester, and at least two times in the third trimester. The delivery care utilization is measured through institutional (hospitals, PHC, clinics, and village midwives) delivery. Postnatal care utilization is measured through the first postnatal examination conducted by professional health workers (doctor, midwife, or nurse) in less than three days after delivery. This study's outcomes were categorized into two, 0 for those who did not fit the standard and 1 for those who comply with the standard.

The independent variable is also divided into two levels, the contextual and the individual level. At the contextual level, the variable studied is the average distance to the nearest hospital, poverty rate, the ratio of PHC per sub-district, and doctors' ratio per 100,000 population. The measurement results of these four contextual variables are numerical data. Meanwhile, the independent variables at the individual level used as a control in this study include mother's age at childbirth, mother's education level, birth order, health insurance ownership, women's autonomy, the experience of complications during pregnancy, and type of residence.

3. Results and discussion

3.1. Descriptive analysis
Descriptive statistics of several contextual variables used in this study are presented in Table 1. The wide range of minimum and maximum values indicates that provinces have adequate health infrastructure and easy access to health facilities. On the other hand, other provinces still have limitations in terms of access and the number of health infrastructure.

| Contextual Variables                  | Average (Std.Dev) | Min-Max    |
|--------------------------------------|-------------------|------------|
| 1. The ratio of PHC per sub-district | 1.63 (1.21)       | 0.71-7.73  |
| 2. Average distance to the nearest hospital (km) | 29.08 (16.12) | 3.76-68.75 |
| 3. The ratio of doctors per 100,000 population | 44.70 (20.82) | 24.49-124.25 |
| 4. Poverty Rate (%)                  | 10.96 (4.97)      | 3.78-27.76 |

Table 2 presents the distribution of individual samples according to some of the women's characteristics. This study shows that there are 72.87% of women who take antenatal care according to standards. The percentage of women who gave birth in health facilities or institutional delivery was 75.14%. Meanwhile, the percentage of women who underwent postnatal care within three days after delivery was 84.26%.

Table 2 also shows that nearly two-thirds of women's total sample were between the ages of 20-34. About half of the sample's total women have secondary education, that is, graduates from Junior High School or Senior High School. Of the total sample, 61.96% have health insurance, such as JAMKESDA, JKN/BPJS, private health insurance, or other types. Only one in ten women who did not have autonomy in making decisions about health care to do. Only about two out of ten women
experience complications during pregnancy. Furthermore, more women live in rural areas than in urban areas.

Table 2. Percentage distribution of women by background characteristics, 2017 IDHS [25].

| Variable                                      | Number of Women | %  |
|------------------------------------------------|-----------------|----|
| **Dependent Variables**                       |                 |    |
| 1. Utilization of antenatal care according to standards | 11,162          | 72.87 |
| 2. Utilization of institutional delivery       | 11,512          | 75.14 |
| 3. Utilization of postnatal care according to standards | 12,824          | 84.26 |
| **Individual Independent Variables**          |                 |    |
| 1. Mother's Age at Childbirth                 |                 |    |
| <20 years                                     | 1,187           | 7.73 |
| 20-34 years                                   | 11,193          | 72.89 |
| ≥35 years                                     | 2,977           | 19.39 |
| 2. Birth Order                                |                 |    |
| 1                                            | 4,756           | 30.97 |
| 2-4                                          | 9,412           | 61.29 |
| 5+                                           | 1,189           | 7.74 |
| 3. Mother's Education Level                   |                 |    |
| ≤ Primary                                     | 4,064           | 26.46 |
| Secondary                                     | 8,633           | 56.22 |
| High                                         | 2,660           | 17.32 |
| 4. Health Insurance Ownership                 |                 |    |
| No                                           | 5,842           | 38.04 |
| Yes                                          | 9,515           | 61.96 |
| 5. Mother's Autonomy                          |                 |    |
| No                                           | 1,586           | 10.69 |
| Yes                                          | 13,252          | 89.31 |
| 6. Complications During Pregnancy             |                 |    |
| No                                           | 12,342          | 82.62 |
| Yes                                          | 2,596           | 17.38 |
| 7. Type of Residence                          |                 |    |
| Rural                                        | 7,786           | 50.70 |
| Urban                                        | 7,571           | 49.30 |

3.2. Multilevel analysis
To detect possible contextual factors that might influence maternal healthcare services by women, the first step to do in multilevel analysis is to estimate the null model. The null model is used as the basis for calculating the Intraclass Correlation (ICC). The ICC value for the utilization of antenatal, delivery, and postnatal care services was 9.80%, 31.52%, and 12.90%, respectively. It means that 9.80% of the total variation in the utilization of antenatal care; 31.52% of the total variation in the utilization of delivery care, and 12.90% of the total variation in the utilization of postnatal care by women in Indonesia was caused by differences in characteristics between provinces, while the rest was due to differences in individual traits within provinces.

3.2.1. Utilization of antenatal care. Contextual factors effects. Table 3. presents the result of the multilevel regression of the individual and contextual variables related to the use of maternal healthcare services by women in Indonesia. The average distance to the nearest hospital and the poverty rate negatively associated with the propensity of women having adequate antenatal care visits.
It means that the increasing distance to the nearest hospital and a higher percentage of poor people in a province is related to a decrease in women's propensity to use antenatal care services. The ratio of PHC per sub-district has a positive and significant relationship with women's number of antenatal visits. When the ratio of PHC per sub-district increases by one, women's probability of having adequate antenatal visits will increase by 1.154 times. The ratio of doctors per population significantly affects the utilization of women's antenatal care services only at the 10% significance level. However, a negative association was shown between doctors' ratio per 100,000 population and the use of antenatal care services by women.

| Variable                                      | Antenatal Care | Delivery Care | Postnatal Care |
|----------------------------------------------|----------------|---------------|----------------|
| Contextual Variables                         |                |               |                |
| 1. Distance to the nearest hospital (km)      | 0.984<sup>c</sup> | 0.959<sup>c</sup> | 0.981<sup>c</sup> |
| 2. Poverty rate (%)                          | 0.973<sup>b</sup> | 1.025         | 0.974<sup>a</sup> |
| 3. Ratio of PHC per sub-district             | 1.154<sup>a</sup> | 0.876         | 0.925          |
| 4. Ratio of doctors per 100,000 population   | 0.992<sup>a</sup> | 1.021<sup>b</sup> | 1.005          |

| Individual Variables                         |                |               |                |
| 1. Mother's Age at Childbirth                |                |               |                |
| <20 years (ref)                              |                |               |                |
| 20-34 years                                  | 2.279<sup>c</sup> | 1.685<sup>c</sup> | 1.949<sup>c</sup> |
| ≥35 years                                    | 2.218<sup>c</sup> | 2.611<sup>c</sup> | 2.734<sup>c</sup> |
| 2. Birth Order                               |                |               |                |
| 2-4 (ref)                                    | 0.818<sup>c</sup> | 0.690<sup>c</sup> | 0.846<sup>b</sup> |
| 4+                                           | 0.450<sup>c</sup> | 0.368<sup>c</sup> | 0.533<sup>c</sup> |
| 3. Mother's Education Level                  |                |               |                |
| ≤ Primary (ref)                              |                |               |                |
| Secondary                                    | 1.528<sup>c</sup> | 2.083<sup>c</sup> | 2.085<sup>c</sup> |
| High                                         | 2.235<sup>c</sup> | 3.690<sup>c</sup> | 3.373<sup>c</sup> |
| 4. Health Insurance Ownership                |                |               |                |
| No                                           |                |               |                |
| Yes                                          | 1.326<sup>c</sup> | 1.365<sup>c</sup> | 1.263<sup>c</sup> |
| 5. Women's Autonomy                          |                |               |                |
| No                                           |                |               |                |
| Yes                                          | 1.163<sup>b</sup> | 1.121         | 1.012          |
| 6. Complications During Pregnancy            |                |               |                |
| No                                           |                |               |                |
| Yes                                          | 1.093           | 1.669<sup>c</sup> | 1.312<sup>c</sup> |
| 7. Type of Residence                         |                |               |                |
| Rural (ref)                                  |                |               |                |
| Urban                                        | 1.250<sup>c</sup> | 3.326<sup>c</sup> | 1.390<sup>c</sup> |

<sup>a</sup> Significant at p < 0.10 ; <sup>b</sup> Significant at p < 0.05 ; <sup>c</sup> Significant at p < 0.01

Individual factors effects. This study indicates that women who are more than 20 years old have a 2.3 greater possibility of having adequate and continuous antenatal care visits compared to women who are less than 20 years old. The negative association between birth order and the use of antenatal care services indicates that the higher the birth order, the lower the possibility of women having good antenatal care visits. Highly educated women have a 2.2 greater likelihood of having good antenatal
care visits during pregnancy than women with low education. Women who have health insurance and autonomy, respectively, are 1.3 and 1.2 times more likely to have standard antenatal care than women without health insurance and autonomy in deciding what health care to do. Women living in urban areas were 1.25 times more likely to utilize antenatal care services adequately during pregnancy than women living in rural areas.

3.2.2. Utilization of delivery care. Contextual factors effects. The possibility for women to give birth in a health care facility will decline as the distance to the nearest hospital increases. The OR of the ratio of doctors per 100,000 population is 1.021, which means that when the ratio of doctors per 100,000 population increases by one, the likelihood for women to give birth in health care facilities will increase by 1.021 times, assuming all other variables are constant. However, this study indicates that the percentage of poor people in a province and the average ratio of PHC per sub-district are not significant predictors in influencing women's utilization of institutional delivery.

Individual factors effects. This study indicates that women aged 20-34 years have 1.7 times greater possibility and increase to 2.6 times when women are over 35 years old to give birth in a health care facilities compared to adolescent women. Highly educated women are 3.7 times more likely to deliver in health care facilities than women with low education. Having health insurance increases the likelihood of giving birth in health care facilities. Women who had experienced complication during pregnancy were 1.7 times more likely to give birth at a health care facilities than women who had never experienced complications during pregnancy. Women who live in urban areas are 3.3 times more likely to give birth in health care facilities than women who live in rural areas.

3.2.3. Utilization of postnatal care. Contextual factors effects. The distance to the nearest hospital and the poverty rate is a strong predictor that influences postnatal care services utilization. The possibility of women utilizing postnatal care services in less than three days after delivery will decline as the nearest hospital's distance and the percentage of poor people in a province increases. However, this study shows that the average ratio of PHC per sub-district and the ratio of doctors per 100,000 population are not significant predictors of influencing the utilization of postnatal care services by women.

Individual factors effects. This study indicates that women aged 20-34 years are 1.9 times more likely to undertake postnatal care in less than three days after the delivery when compared to adolescent women. This study confirms that the higher the level of education attained by women, the greater the likelihood of having postnatal care according to standards. Women who have health insurance are 1.3 times more likely to utilizing postnatal care in less than three days after delivery than women who do not have health insurance. Women who have had complications during pregnancy have a 32% greater possibility of utilizing postnatal care services according to standards than women who have never experienced difficulties during pregnancy. Women who live in urban areas are 1.4 times more likely to utilize postnatal care less than three days after delivery than women who live in rural areas.

3.3. Discussion
Unlike previous studies conducted in Indonesia, this study includes utilizing three dimensions of maternal healthcare services (antenatal care, delivery care, and postnatal care) at once. This study also discusses the association between the characteristics of the region where women live (contextual factors) with the utilization of maternal healthcare services by women in Indonesia, which have not been widely discussed in previous studies. The contextual factor that was significantly associated with utilizing the three dimensions of maternal healthcare services by women was only the distance to the nearest hospital. This study confirms several previous studies that the possibility of women utilizing maternal healthcare services will decrease with increasing distance to the nearest hospital [8,11–17]. This study also shows that the nearest hospital's average distance has the most significant effect on the utilization of institutional delivery. The accessibility factor, one of which is measured by the distance
to health facilities, is one of the deliberations for women to choose a place of delivery [28]. The results of the 2018 Riset Kesehatan Dasar (Riskesdas) show that 62.9% of households in Indonesia still find it difficult to access hospitals. Due to the difficulty of access to these health facilities, several women give birth, not in health facilities [29].

This study shows that the poverty rate, which represents social disadvantage, is only related to the utilization of antenatal care and postnatal care. This study's findings are in line with several previous studies, which stated that living in an area with a high poverty rate will reduce the possibility of women utilizing maternal healthcare services [10,15,19–21]. Social disadvantage is positively associated with poor access to health care services [30]. Health care providers may be less interested in providing health care facilities in neighborhoods with socioeconomic disadvantage, making health care services more difficult to find and afford [31].

The availability of health facilities, represented by the ratio of PHC per sub-district, is only positively and significantly associated with the number of antenatal care visits. The results of this study and several previous studies provide clear evidence of the benefits of developing health infrastructure in increasing women's propensity to utilize health care services during pregnancy [11,20]. Increasing the number of PHC in an area will reduce the burden on existing PHC so that the services provided can be of higher quality [20]. The availability of quality maternal healthcare services can motivate women to utilize maternal healthcare services [32].

The availability of health workers, represented by doctors' ratio per 100,000 population, is associated with the number of antenatal care visits and institutional deliveries. The results of this study support several previous studies and concluded that the probability of women giving birth in health facilities would increase with the increase in the ratio of doctors in the area where they live [22–24]. The increase in the number of health workers in an area will impact reducing patient waiting time because, with the increasing number of health workers, the number of patients who can be served at the same time will increase. The growing number of health workers will also trigger higher competition so that the price that must be incurred by patients to utilize health care services can become lower. Finally, an increase in the ratio of health workers to the total population in an area may be correlated with an increase in the number of health care facilities so that the distance to health care facilities can be closer [33].

Besides identifying contextual factors, this study also identifies several characteristics of women associated with the use of maternal healthcare services. This study indicates that the socioeconomic and demographic factors of women are related to the utilization of maternal healthcare services. Individual characteristic variables related to the three dimensions of maternal healthcare services in Indonesia are mother’s age at childbirth, mother's education level, birth order, health insurance ownership, and type of residence.

Age is an approach to the need factor because age is related to a person's morbidity [34]. Therefore, it is very reasonable that if women get older, they will be more careful and have a positive attitude towards their health to have a greater propensity to utilize maternal healthcare services. A strong association between the mother's age at childbirth and the utilization of maternal healthcare services shown in this study is in line with the findings of several other previous researches [12,14,35–37].

Birth order is a proxy to capture women's experiences with previous pregnancies and births. Women with their first pregnancy have a greater probability of utilizing maternal healthcare services because pregnant women or have given birth for the first time tend to have less experience [38]. On the other hand, previous childbirth experience may make women feel that they do not need to utilize maternal healthcare services, especially if they have not experienced difficulties in prior pregnancies [39,40].

Women's education reflects women's social identity and exposure to formal education, which is expected to encourage women to utilize maternal healthcare services [41]. This study's result is in line with many other earlier studies, which show that women's education is a significant factor and positively affects the utilization of maternal healthcare services by women [13,17,42–44]. Education can increase women's likelihood to have a better acceptance of information related to modern medical
practices and have better communication with healthcare service providers so that they can demand adequate health services [44].

Health insurance ownership is related to a person's ability to get the health care they need [31]. The positive and significant association between health insurance ownership and the use of maternal healthcare services by women, as shown in this study, is consistent with the results of several other previous studies [45–48]. Financial problems often become an obstacle for women to access maternal healthcare services. According to Comfort et al. (2013), the effect of insurance ownership in increasing the use of maternal healthcare services by women is through reducing the costs incurred in seeking and utilizing health care services. In Indonesia, BPJS Kesehatan, as the administrator of the health insurance program for all Indonesians, will cover delivery, pregnancy, and postpartum examination costs.

Women's autonomy in deciding which health care to do is only significantly associated with antenatal care utilization, not with delivery or postnatal care. That may be because both women who have and do not have autonomy consider that postnatal care is not important and needs to be done, especially if they do not experience complications during pregnancy or childbirth [16].

The experience of complications during pregnancy is only related to institutional delivery and postnatal care. The absence of an association between women's difficulties and the use of antenatal care services can occur because fear and concern for their health precisely make women avoid thinking about their health rather than dealing with it [49]. According to Alanazy & Brown (2020), fear does not always lead to positive health behaviors. Some worried that their health might utilize antenatal care services more adequately and continuously, but some will avoid it.

The residence area is used as an indicator of geographic proximity to health services [41]. This study shows that living in urban areas will increase the probability of women utilizing maternal healthcare services rather than living in rural areas that are consistent with the results of several earlier studies [36,44,50]. That is due to better infrastructure and transportation in urban areas than in rural areas [50].

4. Conclusion
This study illustrates that various factors influence the utilization of maternal healthcare services by women in Indonesia. Apart from the socioeconomic and demographic factors, women's utilization of maternal healthcare services is also influenced by contextual factors that have a broader scope than the individual women factors. Policymakers have to grasp that both contextual and individual women factors influence different dimensions of maternal healthcare services differently. Therefore, policymakers' policies to increase the utilization of maternal healthcare services should be focused at specific components rather than planning umbrella strategies. These policies would help to decrease maternal mortality and achieve the third goal of the Sustainable Development Goals.

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