BASIC IMMUNIZATION COVERAGE MAPPING IN INDONESIA

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ABSTRACT

Background: National vaccination program as an integral part of infectious disease control is one effort to reduce the incidence and burden of vaccine-preventable diseases. Vaccination coverage among children is one of the five priority health programs in Indonesia. Full immunization coverage among children under 2 years of age decreased in 2018 at 57.9% from 59.2% in 2013, which became a public health concern. This study aimed to map childhood vaccination coverage by the province in Indonesia to examine the disparity and identify its determinants related to vaccination coverage.
Subjects and Method: This was a cross-sectional study using secondary data from the 2018 National Basic Health Research conducted in 34 provinces in Indonesia. A total of 16,494 children ages 12-23 month was selected for this study by total sampling. The dependent variables were maternal age when pregnant with the child analyzed, antenatal care visits during pregnancy, place of delivery, and parental residency. The independent variable was children who had completed all five basic immunizations before 23 months of age. Thematic maps were created using ArcGIS, and data were analyzed using SPSS.
Results: The study found a disparity of full immunization coverage across the provinces in Indonesia, with the highest full coverage in Bali, while the lowest was found in Aceh. The disparity was also found in all determinants across the nation, which may be related to the variety of vaccination coverage in different provinces.
Conclusion: Findings suggest that increased access to immunization is required, particularly in provinces with low immunization coverage

Keywords: GIS, vaccination, mapping, Indonesia, children.

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BACKGROUND

Childhood vaccination coverage is an important indicator of the performance of national maternal and child health. Low full vaccination coverage is a public health problem that requires special attention because of the impact on the increasing incidence of communicable diseases or the re-emerging of certain communicable diseases that have been eradicated (Peck et al., 2019). The Indonesian government is currently working to increase the childhood vaccination coverage in an Expanded Program on Immunization (EPI) to reduce the geographical inequities across provinces in Indonesia (WHO, 2017). Due to limited resources, it is important to accurately target the intervention program. Public health data is crucial in prioritizing health programs. Instead of collecting primary data that may require expenses, it is better to use electronically publicly accessible health-related data that allows national and provincial systems

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to become more efficient in targeting the interventions Shapiro et al., 2011).

Geographic Information Systems (GIS) have been widely used for public health problems (Caley, 2004; Rushton, 2003). GIS can describe the conditions of health problems, such as evaluating patterns of health inequity and mapping for health intervention plans (Foley et al., 2007; Nurjannah et al., 2020; Nurjannah et al., 2021). The use of GIS in epidemiological studies can provide information for policymakers to understand the relationship between the environment, disease, and health (Cutchin, 2007). Epidemiological research integrated with GIS will produce maps that present interpretations of information that are relatively easy to understand and interpret from the complex relationships of various variables (Maantay, 2002). These maps can be used to inform the development of prevention policies and increase understanding of the translation of health problems in the community (Miranda and Dolinoy, 2005). Indonesia's vast territory and archipelago along with social and cultural diversity, contribute to the differences in vaccination coverage determinants in each region. The GIS approach can be used to inform policymakers in setting program priorities in each province. This study aimed to map childhood vaccination coverage by the province in Indonesia to examine the disparity and identify its determinants related to vaccination coverage.

SUBJECTS AND METHOD

1. Study Design

This was a retrospective observational cross-sectional study using secondary data from the 2018 National Basic Health Research (Riset Kesehatan Dasar) which was conducted every five years by the Ministry of Health. The research covered 34 provinces in Indonesia.

2. Study informants

The population was all children ages 12 – 23 months who had immunization data, totaling 16,494 children. As the study also examined other variables other than immunization data, such as mother's age, antenatal care visits during pregnancy, place of birth, and parental residency, the study was only able to retrieve 6,894 samples for final analysis, which was 41.5% of total childhood immunization data from the 2018 National Basic Health Research.

3. Study Variables

The dependent variables included maternal age when pregnant with the child analysed, antenatal care visits during pregnancy, place of delivery, and parental residency. The independent variable was whether a child had completed all five-basic immunization before the age of 23 months or not. The vaccine included the Hepatitis B vaccine, the Bacille Calmette-Guérin (BCG) vaccine, Polio 1–4, diphtheria, pertussis, tetanus, Haemophilus influenzae type B (DPT-HB) vaccine 1–3, and measles (WHO, 2019). Full coverage vaccination for each child is defined when a child has received all of the vaccines aforementioned during the duration specified in the immunization program. When a child misses one of the vaccines, then will be categorized as incomplete vaccination coverage. All samples were categorized as having complete or incomplete vaccination.

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4. Operational Definition of Variables

Vaccination among children age 12–23 months is then for each province, percentage of children having completed or non-completed childhood vaccination was calculated. Dependent variables were place of delivery, antenatal care and parental residency. Place of delivery was defined as place where mothers had their babies delivered, and classified into health and non-health facilities. Again, for provincial data, percentage of mothers deliver their babies in health or non-health facilities was retrieved.

Antenatal care is defined as how many times a mother having antenatal care services, and categorized into never had antenatal care, 1 – 3 times visit of antenatal and more than 4 times visit during pregnancy. A percentage of mothers having antenatal care were calculated by province. Finally, the variable parental residency was defined as place where parents domicile which can be categorized as rural or urban areas. Percentage of parents living in either urban or rural areas was calculated by province.

5. Instruments

The data were obtained secondary data related to variables examined in the study.

6. Data Analysis

Data were aggregated at the provincial level as a percentage of categories of each variable. The percent of full vaccination coverage for each province was calculated by dividing the number of children who had full vaccination coverage by the number of total children the same age for the same province (in%). Thematic maps were generated from ArcGIS 10.7 software by making overlays of dependent and independent variables. The layer of the dependent variable was processed into a graduated color map, as a base map classified into three classes using the manual method by adopting the classification of percentage completed vaccination coverage by province, as follows: low coverage of completed vaccination (3.8–13.3%), medium coverage of completed vaccination (13.31 – 23%), and high coverage of completed vaccination (23.1–33.2%). On the other hand, the independent variable layer was processed into a graduated symbol map using the manual method. We classified each variable as followed:

a) The percentage of mothers, age was divided into three classes: age ≥ 40 years, 30–39 years, and ≤29 years old
b) Percentage of mothers having delivery in health facilities or non-health facilities
c) Percentage of mothers having antenatal care visits during pregnancy, divided into three classes: no antenatal care visits, 1–3 visits, and ≥4 visits during pregnancy divided into three classes: no antenatal care visits, 1–3 visits, and ≥4 visits during pregnancy
d) Percentage of parents residency, divided into two classes: urban and rural areas

This class division can facilitate the reading of maps and can be used to assess program achievements. Statistical analysis used Pearson correlation performed using SPSS v.25.

7. Research Ethics

This study was approved by the National Health Research and Development

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Ethics Commission with registration number KEPPKN based on decree number 089/EA/FK-RSUDZA/2021 from Syiah Kuala University.

RESULTS

The low vaccination coverage was found in the 11 provinces, including Aceh, Papua, and North Sumatra, while high vaccination coverage was found in 10 provinces, including Bali, West Java, and DKI Jakarta (Figure 1). The map shows the geographical disparity of childhood vaccination coverage by province in Indonesia.

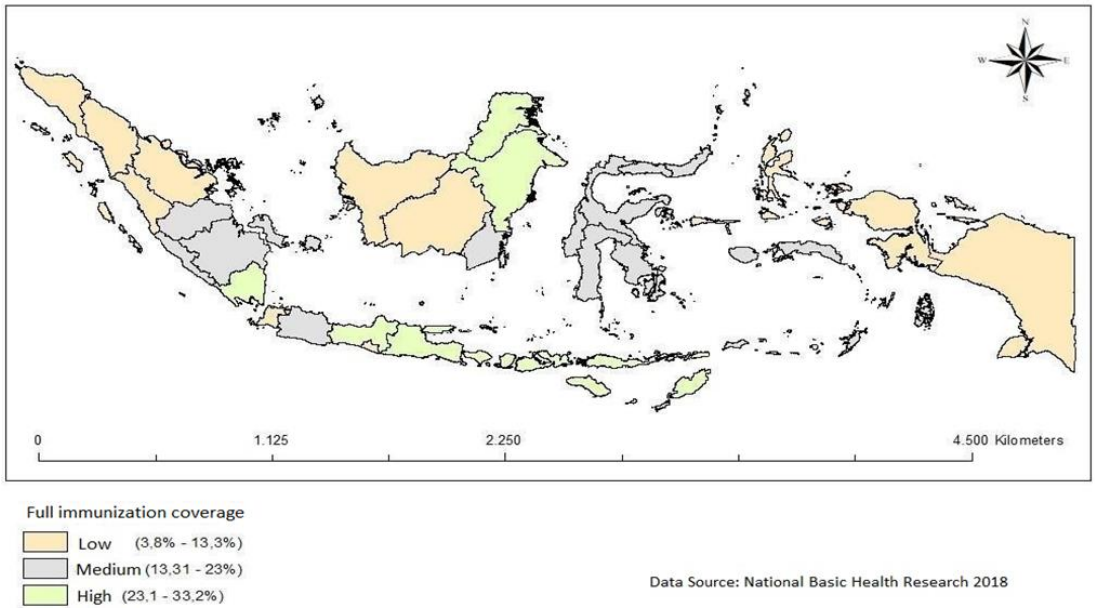

Figure 1. The percentage of childhood vaccination coverage by province in Indonesia

Figure 2 showed examining the percentage of full vaccination coverage against the maternal age, the study indicated that North Kalimantan had a high percentage of mothers ages ≤ 29 years old, nonetheless, the percentage of vaccination coverage was high. On the other hand, North Maluku had the highest percentage of mothers aged above 40 years old but also had low vaccination coverage.

Figure 3 shows the childhood vaccination coverage and place of delivery, indicating that babies who were delivered in non-health facility was found highest in the province of Maluku, and it also had low childhood vaccination coverage. On the contrary, the province with the highest percentage of mothers who delivered their babies in health facilities was Bali, and it had high vaccination coverage. It seems that babies who were delivered at home are more likely not to have full vaccination coverage.

Figure 4 indicated that Papua has the highest percentage of mothers not having antenatal care visits during their pregnancy and also had low childhood vaccination coverage. Conversely, the province of Bali has a high percentage of mothers having antenatal care visits, with it being more than 4 times, and also had high vaccination coverage among children ages 12 – 23 months.

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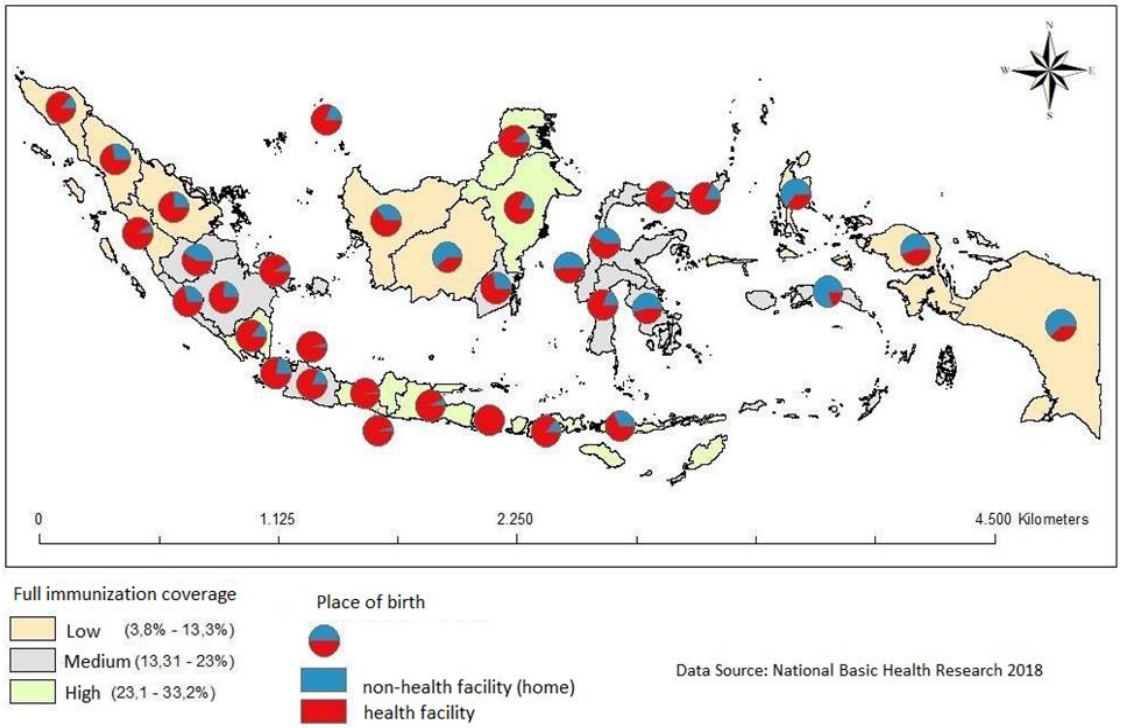

Figure 2. The percentage of childhood vaccination coverage and maternal age by the province in Indonesia

Figure 5 shows that provinces with a high percentage of children living in urban areas had high vaccination coverage, while provinces with a high percentage of children living in rural areas had low vaccination coverage.

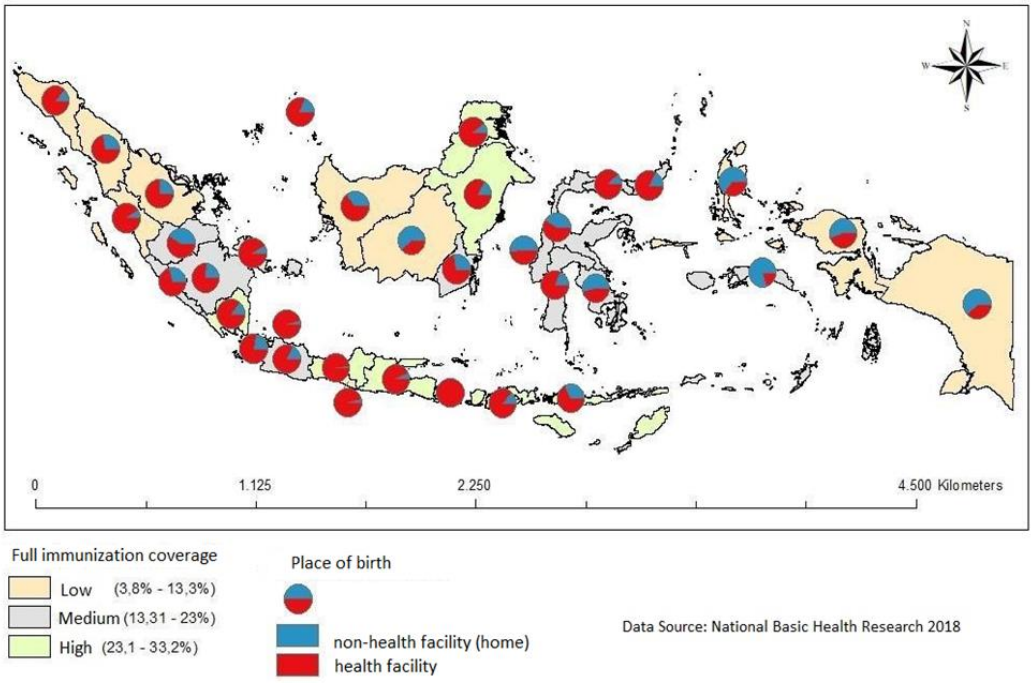

Figure 3. The percentage of childhood vaccination coverage and place of delivery by the province in Indonesia

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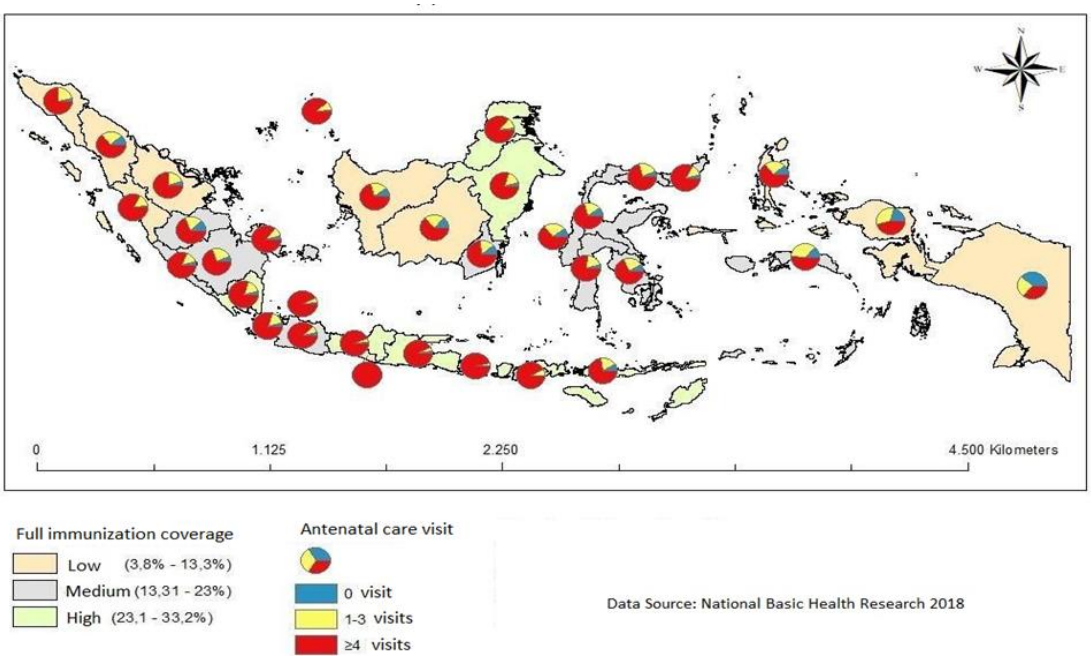

Figure 4. The percentage of childhood vaccination coverage and antenatal care visit by the province in Indonesia

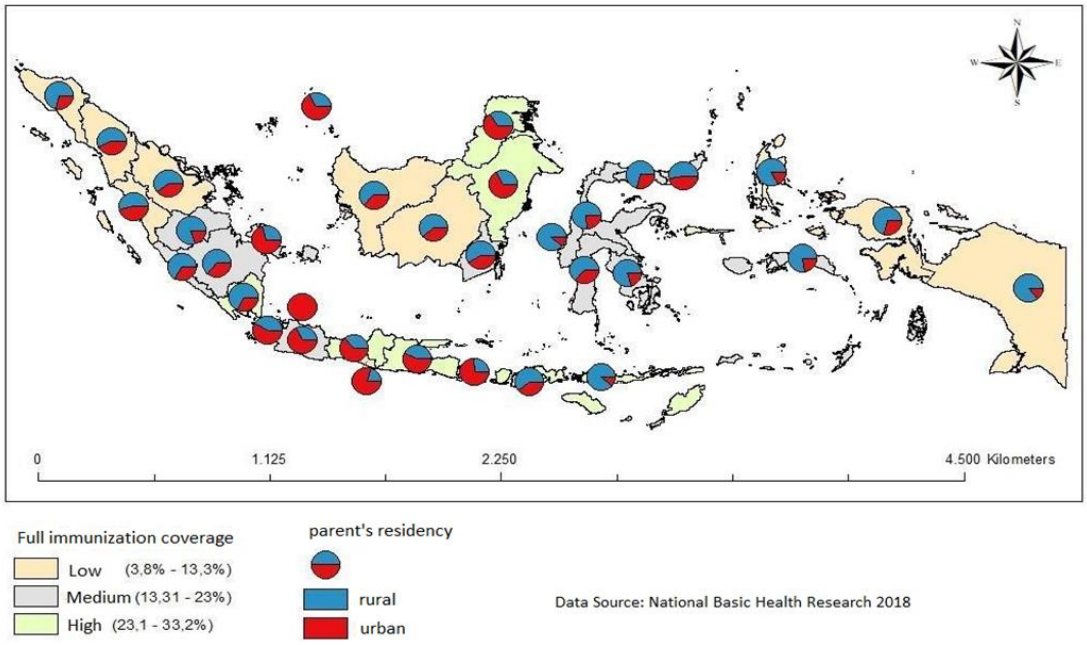

Figure 5. The percentage of childhood vaccination coverage and residency by the province in Indonesia

To examine the correlation between all determinants with vaccination coverage among children ages 12 – 23 months, we used Pearson correlation as all data were normally distributed with $p>0.05$. The Pearson correlation test (Table 1) showed a significant relationship between place of delivery with child-

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hood vaccination coverage (p= 0.004). The province with a high percentage of babies delivered in health facilities also had a high percentage of vaccination coverage among children ages 12 –23 months, indicating a positive correlation (r= 0.48).

Similarly, the province with a high proportion of mothers having antenatal care visits more than four times during pregnancy also had high vaccination coverage (r= 0.49; p= 0.003). However, the study found a negative correlation between mothers who had no antenatal care and vaccination coverage (r = -0.45; p= 0.007). The higher percentage of mothers not having antenatal care visits, the lower childhood vaccination coverage.

Table 1. Correlation is all determinant with childhood vaccination coverage

Correlation is all determinant with vaccination coverage	n	r	p
Maternal age			
≥ 40 years	34	-0.26	0.13
30 – 39 years	34	-0.05	0.77
≤ 29 years	34	0.15	0.38
Place of delivery			
Non-health facility	34	-0.48	0.004
Health facility	34	0.48	0.004
Antenatal care visit			
No antenatal care visit	34	-0.45	0.007
1 – 3 visits during pregnancy	34	-0.46	0.006
≥ 4 visits during pregnancy	34	0.49	0.003
Residency			
Urban residency	34	-0.30	0.08
Rural residency	34	0.30	0.08

DISCUSSION

Childhood vaccination coverage found in this study was lower (33.2%) than the national data using all population (57.9%) (Kemenkes, 2018), which may be related to only 41.5% of total immunization data analysed in this study. All of the provinces have not met the target of full vaccination coverage of 93% set by the Indonesian government (Kemenkes, 2018). When evaluating the relationship between maternal age and vaccination coverage, the study found that provinces with high number of younger mothers also had high childhood vaccination coverage. This is inconsistent previous studies that indicated older mothers are likely to have their children fully immunized. Older mothers are more likely to have more experience and knowledge regarding raising children than younger mothers (Maharani & Kuroda, 2018). However, the increasing information in the mass media may help mothers in obtaining information about vaccination for their children (Jung et al., 2015).

The province with a high percentage of babies delivered in health facilities also had a high percentage of vaccination coverage among children ages 12

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–23 months, indicating a positive correlation. The result from this study consistent with another finding conducted by Aalemi and colleagues (2020), who suggested that child born in a health facility were 2.1 times more likely to be fully immunized than children born at home or at a non-health facility, who are more likely to be non-vaccinated.

Similarly, the province with a high proportion of mothers having antenatal care visits more than four times during pregnancy also had high vaccination coverage. The higher percentage of mothers having antenatal care visits, the higher childhood vaccination coverage. There is a positive correlation between antenatal visit and childhood vaccination coverage. Other studies confirmed that making more antenatal care visits positively affected the coverage of vaccination. When having antenatal care visits at a healthcare facility, mothers may be exposed and be familiar with healthcare services such as vaccination programs (Aelami et al., 2020; Dixit et al., 2013). Mothers who made antenatal care visits 1 – 3 times had a 70% higher relative risk of having a child with full immunization compared to mothers who have never had antenatal care visits (Aelami et al., 2020).

For children living in urban or rural areas, the finding indicated that children in rural areas had no significantly differrent possibility of having full vaccination than children living in urban areas. This may have been a result of the developments that have been made to health facilities in rural areas of Indonesia. The Indonesian government has contributed a strategy for distributing healthcare workers to rural areas that may have improved access to health care services in rural areas (Maharani & Kuroda, 2018).

The study has several limitations, including having only 41.5% of total immunization data from the Basic National Health Research that may affect the lower proportion than the entire data. Additionally, the result of this study may be inconsistent with the previous studies using individual level data due to modifiable areal unit problem (MAUP), indicating different findings are resulted from analysis of the similar data that are aggregated into different geographic levels.

It can be concluded that this study found that the overall coverage of full vaccination by province in Indonesia was low among children ages 12–23 months the highest in the island of Java, indicating a disparity of vaccination coverage by province. Furthermore, this study identified that antenatal care visits and place of delivery are associated with children being fully vaccinated. This study suggests that expanding access for delivery in health facilities and antenatal care services may increase childhood vaccination.

AUTHOR CONTRIBUTION

Nur Najikhah conception of idea, retrieving the data, creating maps, writing manuscript. Nurjannah conception of idea, data analysis, and writing the manuscript.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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REFERENCES

Aalemi AK, Shahpar K, Mubarak MY (2020). Factors influencing vaccination coverage among children age 12-23 months in Afghanistan: Analysis of the 2015 Demographic and Health Survey. PloS one, 15(8), e0236955. https://doi.org-/10.1371/journal.pone.0236955.

Caley LM (2004). Using geographic information systems to design population-based interventions. Public health nursing, 21(6), 547-554. https://doi.org/10.1111/j.-07371209.2004.21607.

Cutchin MP (2007). The need for the "new health geography in epidemiologic studies of environment and health. Health & place, 13(3): 725-742. https://doi.org/-10.1016/j.healthplace.2006.11.003,

Dixit P, Dwivedi LK, Ram F (2013). Strategies to improve child immunization via antenatal care visits in India: a propensity score matching analysis. PloS one, 8(6), e66175. https://doi.org/10.1371-/journal.pone.0066175.

Foley R, Platzer H (2007). Place and provision: Mapping mental health advocacy services in London. Social science & medicine, 64(3): 617-632. https://doi.-org/10.1016/j.neuro.2004.10.003

Jung M, Lin L, Viswanath K (2015). Effect of media use on mothers' vaccination of their children in sub-Saharan Africa. Vaccine. 33 (22): 2551-2557. https://doi.org/-10.1016/j.vaccine.2015.04.021.

KEMENKES RI (2018). Hasil Utama Riset Kesehatan Dasar 2018. Jakarta: Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan Republik Indonesia. Accessed from: https:-//www.litbang.kemkes.go.id/hasil-utama-riskesdas-2018/.

Maantay J (2002). Mapping environmental injustices: pitfalls and potential of geographic information systems in assessing environmental health and equity. Environmental health perspectives, 110(2): 161-171. https://doi.org/-10.1289/ehp.02110s2161.

Maharani A, Kuroda Y (2018). Determinants of immunization status among 12-to 23-month-old children in Indonesia (2008–2013): a multilevel analysis. BMC Public Health, 18(1): 1-11. https://doi.-org/10.1186/s12889-018-5193-3.

Miranda ML, Dolinoy DC (2005). Using GIS-based approaches to support research on neurotoxicants and other childrens environmental health threats. Neurotoxicology, 26(2): 223-228. https://doi.org/10.1016/j.neuro.-2004.10.003.

Nurjannah N, Baker KM (2020). Using GIS and death records to inform statewide school-based diabetes prevention interventions in

Michigan. Journal of Public Health Research, 9(4). https://-jphres.org/index.php/jphres/article/view/1887.

Nurjannah N, Curtis AB, Baker KM, Paul R (2021). Mapping diabetes burden by school-district for school-based diabetes prevention interventions in selected cities in Michigan, USA. Geospatial Health, 16(1). https://doi.org/10-.4081/gh.2021.941.

Peck M, Gacic DM, Diallo MS, Nedelec Y, Sodha SS, Wallace AS (2019). Global routine vaccination coverage, 2018. Morbidity and mortality weekly report, 68(42), 937. https://dx.doi.org/10.15585%2-Fmmwr.mm6842a1.

Rushton G (2003). Public health, GIS, and spatial analytic tools. Annual review of public health, 24(1), 43-56. https://doi.org/10.1146/annurev.publhealth.24.012902.140843.

Shapiro JS, Mostashari F, Hripcsak G, Soulaki N, Kuperman G (2011). Using health information exchange to improve public health. American journal of public health, 101(4), 616-623. https://-doi.org/10.2105/AJPH.2008.15890.

World Health Organization (2009). Recommended routine immunizations for children–Summary of WHO position papers. Accessed from: https://www.who.int/immunization/policy/Immunization_routine_table2.pdf.

World Health Organization (2017). State of health inequality: Indonesia. World Health Organization. Accessed from: https://-apps.who.int/iris/bitstream/handle/10665/259685/9789241513340-eng.pdf.