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Spatial analysis of under five years pneumonia incidence in DIY Province 2020

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Abstract

Purpose: Globally, pneumonia is a major cause of morbidity and mortality, as the largest burden of disease and death in developing countries. In 2018, more than 19,000 children under five died from pneumonia. The Under-five Mortality Rate (AKBa) reflects the social, economic, and environmental conditions in which children live and maintain their health. WHO issued an integrated global action to prevent and control the incidence of pneumonia and diarrhea (GAPPD). Yogyakarta is in the second position with the highest prevalence of pneumonia under five (3.7%). To carry out a more focused pneumonia prevention program, spatial pattern analysis is needed both globally and locally, this study examines whether there is a global and local spatial correlation in the number of pneumonia cases under five years in *Daerah Istimewa Yogyakarta* (DIY) in 2020. **Methods:** This ecological study uses aggregated data at the sub-district level. DIY Province has 78 sub-districts that serve as the unit of analysis. **Results:** The global spatial autocorrelation test on the number of cases of toddler pneumonia in DIY is significantly positive. High-high areas include the sub-districts of Semin, Ponjong, Rongkop, Semanu, Karangmojo, Wonosari, Playen, Paliyan, Saptosari and Panggang. Hot spots were found in the southeastern region. A closer look at the sub-districts in the hotspot area, all from Gunung Kidul Regency, shows that specific interventions targeting these areas must be strengthened, regional health planning and resource allocation. **Conclusion:** A cluster correlation (clustering) exists spatially with the number of toddler pneumonia in the DIY. Locally, it can be seen that the hot spots (high-high) and low-high districts are found in one district. So it is a priority area that needs comprehensive handling but with a different emphasis according to the characteristics of each sub-district in one district.

Keywords: toddler pneumonia; spatial analysis; Moran's index; hot spots

INTRODUCTION

The biggest cause of child death in the world is caused by pneumonia compared to other infectious diseases. 800000 children under five die each year because of this disease [1]. Globally, pneumonia is a major cause of morbidity and mortality, making it the largest burden of disease and death in developing countries [2,3].

In 2018, more than 19000 children under five died from pneumonia [1]. The Under-five Mortality Rate (AKBa) is an indicator of the Sustainable Development Goals (SDGs). AKBA reflects the social, economic, and environmental conditions in which children live and care for their health. This indicator also identifies the economic difficulties of the population [4].

This morbidity and mortality rate in children under five has prompted WHO to issue an integrated global action to prevent and control the incidence of pneumonia and diarrhea, known as the Global Action Plan for Prevention and Control of Pneumonia and Diarrhea (GAPPD) [5]. The GAPPD proposes a cohesive approach in order to prevent pneumonia and diarrheal deaths. Research shows that these measures are successful in reducing the incidence of pneumonia, including exclusive breastfeeding and proper complementary feeding, use of *Streptococcus pneumoniae* and *Haemophilus influenzae type b* vaccines, use of measles and pertussis vaccines, use of standard pneumonia treatment guidelines such as MTBS, administration of Zinc , sanitation and hygiene interventions including access to drinking water, reduction of household air pollution with better stoves [1,5].

Yogyakarta occupies the second position with the highest prevalence of pneumonia under five (3.7%) [7]. It is well known that pneumonia is an infectious disease caused by several infectious agents, including viruses, bacteria and fungi. The most common causes are *Streptococcus pneumoniae*, *Haemophilus influenzae type b* (*Hib*), respiratory syncytial virus, and *Pneumocystis jiroveci* in HIV-infected children [8]. Indonesia is a tuberculosis endemic area [9]. *Mycobacterium tuberculosis* infection can occur in endemic areas and among children with immunodeficiencies, therefore authorities must consider local and regional epidemiology, individual immunization status, and underlying health issues that may affect the likelihood of which pathogen is the cause [2]. In order to carry out a more focused pneumonia prevention program, spatial pattern analysis is needed both globally and locally.

At the end of this study, it is hoped that we can find out the relationship between the number of pneumonia cases regionally, both globally and locally. Researchers hope that this research can become a basis for local governments, as well as related agencies regarding the management of toddler pneumonia in Yogyakarta. As well as inspiring other researchers to do further research on toddler pneumonia regionally.

METHODS

This ecological research uses aggregated data at the sub-district level in the Province of the Special Region of Yogyakarta (DIY). Secondary data was obtained from the DIY Province Health Profile 2021, the Central Statistics Agency for the DIY Province 2021 and the 2018 Riskesdas results report from the Ministry of Health of the Republic of Indonesia. DIY Province has 78 sub-districts that serve as the unit of analysis.

The first step in spatial analysis is to determine neighbors, this study uses queen contiguity, where areas are said to be neighbors if they share borders or corners [10]. Spatial autocorrelation is the level of spatial dependence, association or correlation between the observed values of spatial entities and neighboring observation values of the same variable [10]. Moran's autocorrelation index is used to calculate the similarity of the outcome variables between regions which are defined as spatially related, with the null hypothesis (H_0) that there is no spatial autocorrelation (I=0) with an alpha of 0.05. Moran's index is between +1 and -1. A zero value on the Moran's index indicates no grouping. A positive Moran's index (positive autocorrelation) is obtained if the Moran's index value obtained is greater than the expected value E (I) ; this is interpreted as a grouping of areas with similar attribute values. On the other hand, for the negative index Moran's (negative autocorrelation) is obtained if the value of the Moran's index obtained is smaller than the expected value E (I) means that neighboring areas tend to have different attribute values. Visually, the global Moran index is in the form of a Moran's I scatter plot [10,11]. Meanwhile, the local Moran's index is used to focus on each spatial object separately in a predetermined environment. So, we can map local Moran's indexes, because each spatial object has its own Moran's index value.

Maps are created using the QGIS application. The data were explored and analyzed using the R application. The classification of the number of toddler pneumonia used the quartile method where the data was divided into four categories.

RESULTS

A map of the distribution of the number of cases of pneumonia under five in the DIY in 2020, grouped by sub-district and classified by quartile is shown in Figure 1. Patuk, Piyungan, Gedangsari, Mergangsan, Semin, Ponjong, Rongkop, Semanu, Karangmojo Districts Wonosari, Playen, Paliyan, Saptosari and Panggang have the highest number of cases, while the 20 sub-districts that have the lowest number of cases

include Temon, Wates, Padandatan, Galur, Srandakan, Bambangparlipuro, Dlingo, Berbah, Samigaluh, Nanggulan, Minggir, Wirobrajan, Mantrijeron, Kraton, Gondomanan, Pakualam, Gondokusuman, Turi, Pakem and Cangkringan. In general, areas with the highest number of toddler pneumonia are concentrated in the southeast of Yogyakarta, while areas with the lowest number of toddler pneumonia are in the north and southwest of Yogyakarta.

The global spatial autocorrelation test on the number of cases of pneumonia under five in DIY can be seen in Table 1. There is a statistically significant positive spatial autocorrelation in the number of toddler pneumonia. It can also be seen in the Moran's scatter plot (Figure 2) which areas have the greatest influence, including Wonosari, Karangmojo, Paliyan, Panggang, Semanu and Saptosari.

The results of an autocorrelation test show the degree of spatial significant correlation in the number cases of pneumonia toddlers. The number of pneumonia cases has an autocorrelation value of 0.5210 and an expected value of -0.0129. The test produced a very low p-value of 2.649e-15, indicating a high autocorrelation in the data.

Based on the toddler pneumonia rate, high-high areas include the sub-districts of Semin, Ponjong, Rongkop, Semanu, Karangmojo, Wonosari, Playen, Paliyan, Saptosari and Panggang which not only show high rates of toddler pneumonia but are also surrounded by sub-districts with high toddler pneumonia rates. The sub-districts of Ngawer, Nglipar and Tanjungsari are in the low-high area, which means that in these three sub-districts the number of toddler pneumonia is low but these areas are surrounded by sub-districts that have a high number of toddler pneumonia. Meanwhile, in the high-low areas, there are two sub-districts, namely Pandak and Merangsan sub-districts. In general, high-high areas are located in the West of DIY (Figure 3).

DISCUSSIONS

In this study, we utilized GIS to explore the geographic distribution patterns and hotspots of the number of toddler pneumonia in the DIY. The main results show that there is a pattern of spatial cluster distribution of the number of toddler pneumonia in the DIY, which means that the incidence of toddler pneumonia in one area is related to other areas that are nearby. This is in accordance with spatial modeling research on cases of toddler boys with pneumonia in the city of Bandung where there is a significant spatial autocorrelation [12].

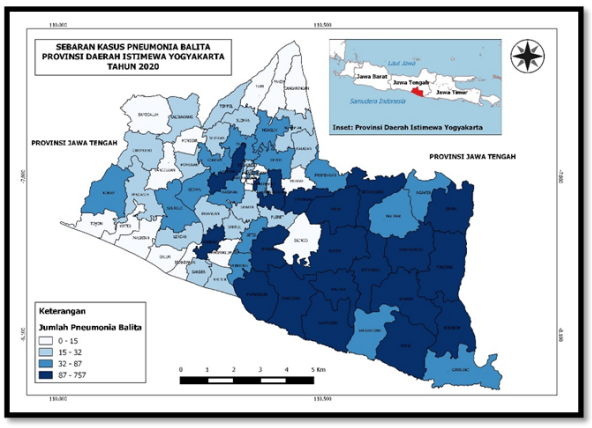

Figure 1. Map of the distribution of the number of cases of pneumonia under five in the DIY Province for 2020

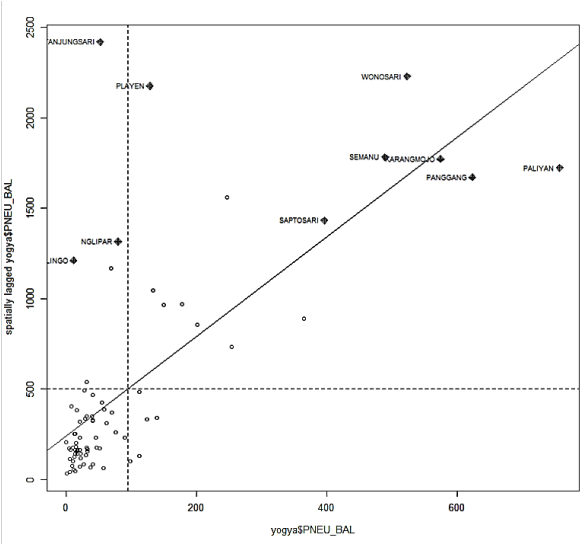

Figure 2. Moran's Scatter plot

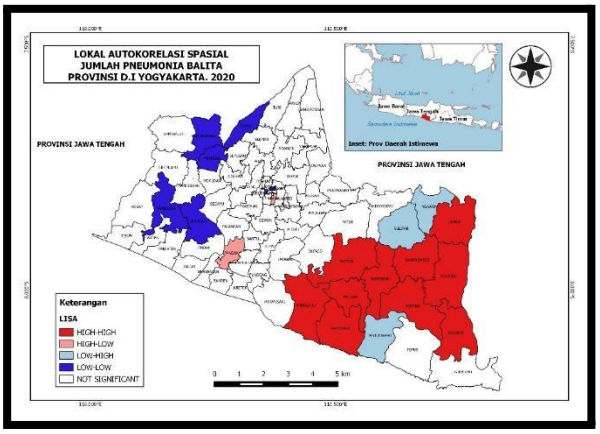

Figure 3. Local spatial autocorrelation of number of toddlers pneumonia in DIY, 2020

The pneumonia prevention program, namely GAPPD (Global Action Plan for Pneumonia and

Diarrhea) from WHO and UNICEF in 2013. GAPPD has the goal of ending preventable child deaths due to pneumonia and diarrhea by 2025 stating that there are thirteen points which are divided into three main factors in prevention of pneumonia cases in toddlers, namely: Protection includes exclusive breastfeeding, provision of adequate MPASI, administration of vitamin A; the second is prevention including vaccines (pertussis, measles, Hib, PCV and rotavirus), washing hands with soap, drinking water and proper sanitation, reducing household air pollution, HIV prevention, prophylaxis for children infected and exposed to HIV; as well as the third factor, namely treating [6].

In this study, hot spots were found in the southeastern region. A closer look at the sub-districts that are in the hotspot area are all from Gunung Kidul Regency, which shows that specific interventions targeting these areas must be strengthened, regional health planning and resource allocation. When viewed from the protective factor of exclusive breastfeeding according to the research of Anjaswanti et al, 2022 based on a meta-analysis by not getting exclusive breastfeeding increases the risk of pneumonia in toddlers 1,934 times compared to those who get exclusive breastfeeding [13]. In Gunung Kidul district, which is a hotspot area, the exclusive breastfeeding rate in 2018 (Riskesdas) ranked last (14.35%) in the DIY [7]. Maybe this affects the number of toddler pneumonia in the hot spot area, namely Gunung Kidul Regency.

Adequate complementary foods are also one of the ways to deal with GAPPD pneumonia. In the hot spot areas, the highest supplementary feeding was in the DIY (83.06%) where the reasons for obtaining additional food at the age of 6-59 months were: malnutrition (0%), malnutrition (2.83% of 1.81% province), wasting (family poor (0% of 0.73% province) and others (0%) [14]. The results from Riskesdas related to undernutrition, thinness, and illness which are still quite high in this district need to be considered because these things should be detected earlier which is in line with the lack of integrated healthcare center (posyandu) weighing coverage which is still far below the provincial average.

Coverage of vitamin A administration in hot spot areas (Gunung Kidul Regency) in children aged 6-59 years occupies the last position (54.23%) in the DIY [14]. This may be a contributing factor to another reason why many areas of Gunung Kidul Regency are hot spot areas.

In addition to the hot spot area on the local moran's analysis, there are high-low and low-high areas. The high-low area includes Pandak and Mergangsan Districts. It can be interpreted that these two sub-districts have a high number of under-five pneumonia but are surrounded by areas with a low number of under-five pneumonia. So, it needs to be a concern so that this high number of cases does not spread to areas where the number of pneumonia is low. The government's mandatory immunization program included the Pentavalent vaccines, namely (DPT, HB and Hib) and follow-up immunization for toddlers starting around mid-2013. This program started in four provinces including DIY [15]. In Mergangsan District (Yogyakarta City) in 2019 it had complete basic immunization coverage of 99.2%, but under two years immunization with Hib4 only reached 83.9% of the average 84.4% in Yogyakarta City [16]. This may be one of the factors that make Mergangsan District a high-low area.

Meanwhile, the Districts of Ngawen, Nglipar and Tanjungsari are low-high areas. From these results it can be said that these three sub-districts have a low number of toddler pneumonia but are surrounded by areas that have a high number of cases. These three areas need to be protected so that the number of toddler pneumonia does not increase.

CONCLUSION

This study illustrates that there is a cluster correlation (clustering) spatially with the number of pneumonia under five in the DIY. Locally, it can be seen that the districts that are hot spots (high-high) and low-high are found in one district. So that it is a priority area that needs comprehensive handling but with a different emphasis according to the characteristics of each sub-district in one district. It would be very helpful for monitoring, observation, evaluation and further analysis of cases of pneumonia under five if health reports or other public publications at the sub-district or public health center (puskesmas) level could be made uniform and made available every year. Research on pneumonia under five with spatial analysis still needs to be continued to see the correlation with various factors that might influence the number of cases of pneumonia under five and it is hoped that this will reduce the mortality rate among under five due to preventable infectious diseases.

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