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Analisis spasial dengan exploratory spatial data analysis (ESDA) perkawinan anak pada perempuan 15-24 tahun di Indonesia

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ABSTRACT

Introduction: Child marriage, which has existed for centuries, is a complex issue, deeply rooted in gender inequality, tradition, and poverty. Child marriage is increasingly recognized as a violation of girls' rights because it effectively ends education, deprives any opportunity to acquire vocational and life skills, exposes children to the risk of early pregnancy, bearing children, and motherhood before being physically and psychologically ready, increasing the risk of sexual violence and HIV infection

Objective: This study aims to conduct spatial analysis to determine the spatial autocorrelation between provinces in Indonesia based on the number of child marriages influenced by reproductive system knowledge in women aged 15-24 years who marry children (<=18 years) in Indonesia.

Method: This study used a cross-sectional approach covering all provinces of Indonesia using raw data from the 2017 Indonesian Demographic and Health Survey organized by BPS in collaboration with BKKBN and the Ministry of Health. Data on the distribution of child marriage events will be analyzed using Exploratory Spatial Data Analysis (ESDA) with GeoDa application version 16.

Result: Indonesia with 34 provinces has a minimum value of zero (0) child marriage maximum of 9, a median of 1, an average of 1.67, and a standard deviation of 2.11374. In addition, there is a positive autocorrelation between the number of child marriages and knowledge of the reproductive system. For bivariate spatial analysis that associates the number of child marriages in Indonesia with knowledge of the reproductive system, a coefficient correlation of 0.679 is known so that it can be interpreted that the number of child marriages has a moderate positive correlation.

Conclusion: It was concluded that the results of global autocorrelation for child marriage cases using Moran's I with a queen contiguity weighting matrix are known to have positive spatial autocorrelation or form a grouping pattern so that it can be interpreted spatially the number of child marriages in one province with other provinces is interconnected, especially neighboring ones.

Keywords: Child Marriage; Reproductive Health Knowledge; Spatial Analysis

INTRODUCTION

Child marriage refers to a formal marriage or informal union between a child under the age of 18 and another adult or child. Globally, the practice of child marriage continues to decline. Today, one in 5 young women aged 20-24 is child married compared to 10 years ago when one in 4 children had child marriage (1). Based on the Law of the Republic of Indonesia number 1 of 1974, marriage is an inner birth bond between a man and a woman as husband and wife to form a happy and eternal family (household) based on the One and Only Godhead. In addition, Law No. 1 of 1974 also regulates that marriage is permitted if the man has reached the age of 19 years and the woman has reached the age of 16 years (2). Changes from RI Law no. 1 of 1974 to RI Law no. 16 of 2019, especially Article 7 regulate not only the age of men but also women who are allowed to marry if they have reached the age of 19 years with one of the considerations that marriage at the age of children harms child growth and development and will lead to non-fulfillment of children's basic rights such as the right to protection from violence and discrimination, children's civil rights, health rights, education rights, and children's social rights Adolescence (3).

In Indonesia, in 2008, the prevalence of child marriage was 14.67 percent, but a decade later (in 2018) it only decreased by 3.5 points to 11.21 percent. Still, about 1 in 9 women aged 20 – 24 years have their first marriage before the age of 18 years or there are more than one million women aged 20 – 24 years whose first marriage occurred at the age of less than 18 years (1.2 million people) in Indonesia Women aged 20-24 years who had their first marriage before the age of 15 years were recorded as many as 61.3 thousand women. During the period 2015 - 2018, the increase and decrease in the prevalence of child marriage varied in different provinces. As many as 11 provinces have experienced increase in the prevalence of women 20-24 years old whose first marriage is less than 18 years (4). Based on SUSENAS data in 2018, the highest absolute number of child marriages occurred on the island of Java. The absolute figure is closely related to the population, so the 3 provinces with the highest child marriage rates are West Java, East Java, and Central Java. These three provinces account for 55% of child marriage in Indonesia. The prevalence and absolute number of child marriages by province suggest that geographical factors need to be considered in designing child marriage prevention efforts (5).

Many factors are associated with the incidence of child marriage. Based on research on adolescent girls in North Labuan Batu, it is known that factors related to child marriage are knowledge, education, employment, economic status, culture, promiscuity, and mass media (6). In addition, poverty, geography, lack of access to education, gender inequality, social conflicts, and disasters, lack of access to comprehensive reproductive health services and information, social norms that reinforce certain gender stereotypes (for example, women should marry young), and culture (religious interpretations and local traditions) are factors causing child marriage in Indonesia (4)(5). Another risk factor that is often found in various literature is the area of residence where the prevalence of child marriage is higher in rural areas than in urban areas (4).

Ending child marriage is currently the most prominent global development agenda contained in SDG (Sustainable Development Goal) 5.3 which aims to eliminate child marriage by 2030 (7). This is in line with the National Strategy for the Prevention of Child Marriage (STRANAS PPA) which aims to reduce the rate of child marriage with the first strategic objective being the realization of STRANAS PPA nationally which is aligned between stakeholders both at the central and regional levels to the village level and the second strategic objective is the establishment of coordination and synergy with various stakeholders in the implementation of accelerating the prevention of child marriage credibly and accountably where this National Strategy is targeted to be achieved in the next 5 years (5).

The success and implementation of STRANAS PPA depend on the active involvement of stakeholders at various levels. Hence, it is necessary to determine implementation based on each region's needs and current situation, the implementation process, and the choice of strategies that relevant stakeholders can adjust (5). It is therefore important to conduct a spatial analysis of child marriage in Indonesia. Spatial analysis is a collection of methods, statistics, and techniques that integrate concepts such as location, area, distance, and interaction to analyze, investigate, and explain patterns of geographic contexts, actions, or behaviors among spatially referenced observations that arise as a result of processes occurring somewhere (8) which can help stakeholders to make effective implementation decisions for the prevention of child marriage in each region.

METHOD

This study used a cross-sectional approach with the scope of research covering all provinces in Indonesia. The data used is in the form of area data (aggregate) of the 2017 Indonesian Demographic and Health Survey which is one of the population social surveys periodically held by the Central Statistics Agency (BPS), BKKBN, and the Ministry of Health specifically designed to collect various information on birth rates, deaths, family planning, and health, especially reproductive health. The variable outcome in this study is the number of child marriages in Indonesia in 2017. The population of this study was women aged 15-24 years amounting to 14,766 people, and the sample of this study was women aged 15-24 years. Data on the distribution of child marriage events will be analyzed

using Exploratory Spatial Data Analysis (ESDA). The spatial analysis begins with categorization by natural break map method and continues with simple analysis of univariate data using Choropleth maps, histograms, and Boxplots as well as bivariate spatial data analysis with scatter plots and scatter plot matrix. Spatial autocorrelation analysis for both univariate and bivariate data will also be carried out in this study and will use GeoDa application version 16.

Spatial analysis in this study only reaches the Explore stage which will be carried out using the Exploratory Spatial Data Analysis (ESDA) method which is a collection of visual and numerical methods used to analyze spatial data by applying classical nonspatial descriptive statistics that are dynamic-related to GIS maps and spatial objects and identifying spatial interactions, relationships, and patterns, through the use of spatial weight matrices (defined by appropriate conceptual methods), hypothesis testing and various metrics. ESDA methods and tools aim to explain and summarize spatial data distribution, visualize spatial distribution, test spatial autocorrelation (i.e. track spatial relationships and associations), detect spatial outliers, find clusters, and identify hot spots or cold spots according to Figure 1(8).

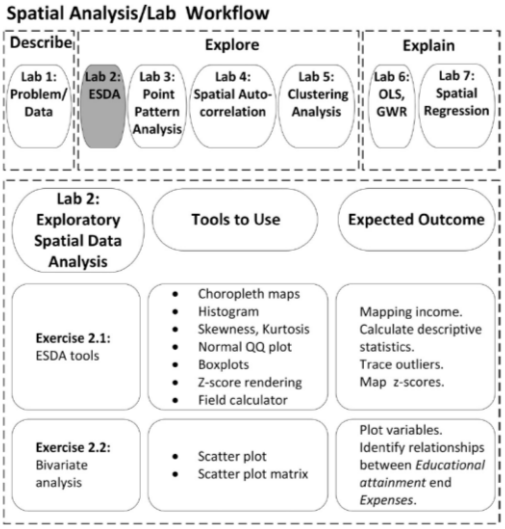

Figure 1. Spatial Analysis of Workflow and Overall Progress (8)

Spatial autocorrelation will analyze associations and dependencies in a two-dimensional sequence of values in a single variable that matches Tobler's first law of Geography that everything in geographic space is related; The closer the values, the stronger the association than the farthest (9). Global autocorrelation analysis in this study uses Moran's I method approach, while local autocorrelation uses the local Moran Index I method. The weighting matrix in this study used the queen contiguity method. The queen contiguity matrix is a weighting matrix that pays attention to the intersection of sides and angles in the map area (10). Moran's, I scatter plot is used to visualize statistical spatial autocorrelation. This provides a representation used to assess how similar attribute values in a location are to adjacent ones. The resulting scatter plot identifies the type of spatial autocorrelation that exists according to the place where the point is located (standing point for spatial entities, such as polygons).

In the case of polygon layers, the dot in the upper right corner (Q1) indicates a polygon that has a high X and a high Lag-X (also called "High-High"). In other words, this polygon has a high X value and is surrounded by other polygons that also have a high X value. In this case, there is a positive spatial autocorrelation. If a point is located in the lower left corner (Q3), the polygon has a low X value and is surrounded by a polygon with a low X value (i.e., Low-Low). Thus, we again have a positive spatial autocorrelation. The point in the upper-left corner (Q4) indicates a polygon with a low X surrounded by a polygon with a high X (i.e., Low-High). This is a negative spatial autocorrelation and a strong indication of the presence of outliers. Finally, the point in the lower right corner (Q2) indicates a polygon with a high X surrounded by a polygon with a low X (i.e., High-Low). There is a negative spatial autocorrelation and indications of the presence of outliers (8).

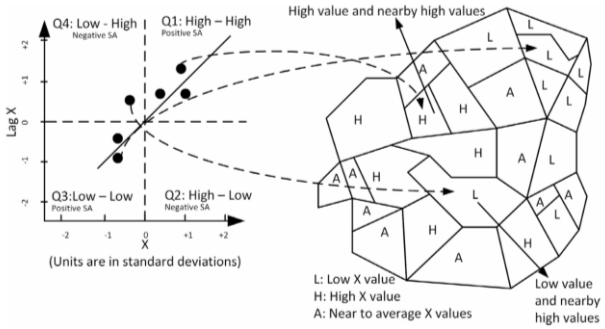

Figure 2. Moran's scatter plot (8)

Moran's I values range from -1 to 1. The higher Moran index value indicates the presence of positive spatial autocorrelation. The value of I needs to be compared with the expected value of E[I], if the value of I>E[I] indicates a positive autocorrelation and has a clustering pattern, the value of I=E[I] indicates the absence of spatial autocorrelation and the value of I < E[I] indicates a negative autocorrelation and has a diffuse data pattern (9). Local Moran is a local index used to determine the tendency of local grouping patterns (9). This local index can be used to identify hotspots and cold spots (11). Local Moran output generated from the GeoDa application is in the form of Moran's scatterplot, cluster map, and significance map (9). In addition, the global method of bivariate spatial autocorrelation will be used to generate the Bivariate Moran Scatter Plot to measure the extent to which the value for the variable child marriage in a location correlates with its neighbors for different variables Knowledge of the reproductive system consisting of Knowledge of the physical changes of puberty in girls, Knowledge of the fertile period of a woman, Knowledge of the risks of pregnancy, and Knowledge of HIV AIDS.

RESULTS

Based on the natural break map, it is known that the number of child marriages among women aged 15-49 years in Indonesia is 57 cases, of which most cases occur in West Java Province, 6 cases in East Java, and 5 cases in Central Java and Banten presented on the map figure 3.

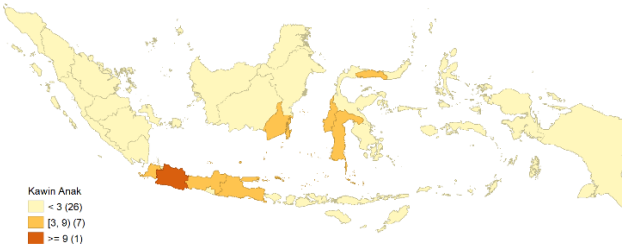

Figure 3. Map of the Distribution of the Number of Child Marriage in Indonesia

Univariate Analysis Results

In addition, the results of the histogram of the number of child marriages are known in 34 provinces to have a minimum value of zero (0) child marriage maximum of 9, median of 1, average of 1.67, and standard deviation of 2.11374 (figure 4).

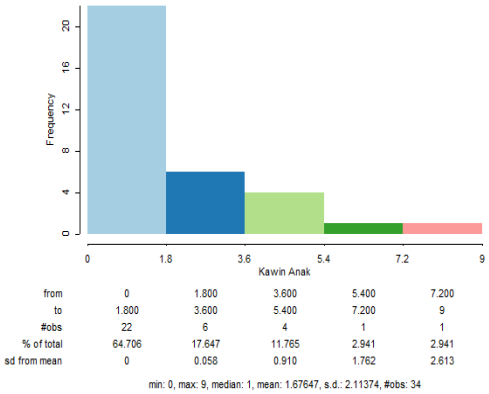

Figure 4. Histogram Graph of Number of Child Marriages in Indonesia

The results of the global autocorrelation test for child marriage cases using Moran's I with a queen contiguity weighting matrix are known Moran's I values of child marriage, Knowledge of the reproductive system, Knowledge of physical changes in puberty in women, Knowledge of a woman's fertile period, Knowledge of the risk of pregnancy, and Knowledge of HIV AIDS is greater than the expected value of E(I) and positive z-score results with the results of the significance test with randomization permutation 999 and obtained pseudo-p-value < α = 0.05, it can be concluded that there is a significant positive spatial autocorrelation or there are indications of clustering following table 1.

Table 1. Results of Global Moran's I Child Marriage and Knowledge of the Reproductive System

Variabel	N	Moran (I)	E (I)	Pseudo p-value	Result
Child Marriage	34	0.31	-0.04	0.037	I > E[I] (Positive autocorrelation)
Knowledge of the Reproductive System		0.51	-0.04	0.003	I > E[I] (Positive autocorrelation)
Knowledge of the physical changes of puberty in girls		0.55	-0.04	0.001	I > E[I] (Positive autocorrelation)
Knowledge of a woman's fertile period		0.63	-0.04	0.002	I > E[I] (Positive autocorrelation)
Knowledge of pregnancy risks		0.61	-0.04	0.001	I > E[I] (Positive autocorrelation)
Knowledge of HIV AIDS		0.55	-0.04	0.003	I > E[I] (Positive autocorrelation)

So, it can be interpreted that spatially the number of child marriages in one province with another adjacent province has a similar number of child marriages or has a clustered distribution compared to the number of child marriages in one province with provinces that are far apart or concluded to have a relationship.
Apart from that, if you look at the distribution pattern, all variables are grouped in quadrant I and quadrant III (High high and Low low, below average) which is interpreted to mean that provinces that have a high number of child marriages are surrounded by provinces that have a high number of child marriages and also Provinces that have a low number of child marriages are surrounded by provinces that have a low number of child marriages. Likewise, with the level of knowledge of the reproductive system, namely knowledge about the physical changes during puberty in women, knowledge about a woman's fertile period, knowledge about the risks of pregnancy, and knowledge about HIV AIDS. It is also the same as the level of knowledge of the reproductive system, namely Knowledge of the physical changes of puberty in girls, Knowledge of a woman's fertile period, Knowledge of the risk of pregnancy, and Knowledge of HIV AIDS.

To identify provinces that are hotspots for child marriage in Indonesia, Local Moran output in the form of a LISA Cluster Map is used. The output results of the Local Moran LISA Cluster Map were obtained by 2 provinces

with the High-High category, namely West Java and Central Java Provinces. The province with the Low-Low category, namely North Sumatra Province, is in Figure 5.

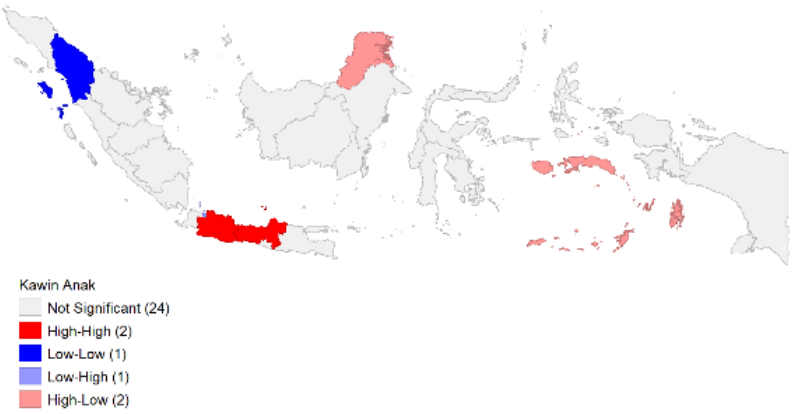

Figure 5. Map of Knowledge Distribution of Reproductive System in Indonesia

Results of Bivariate Analysis

For bivariate spatial analysis that associates the number of child marriages in Indonesia with knowledge of the reproductive system, a coefficient correlation of 0.68 is known so that it can be interpreted that the number of child marriages has a moderate positive correlation with reproductive system knowledge where the value of coefficient correlation values between 0.5 and 0.8 shows that there is an association of increased knowledge of the reproductive system with the number of child marriages but this relationship is not very strong according to figure 6.

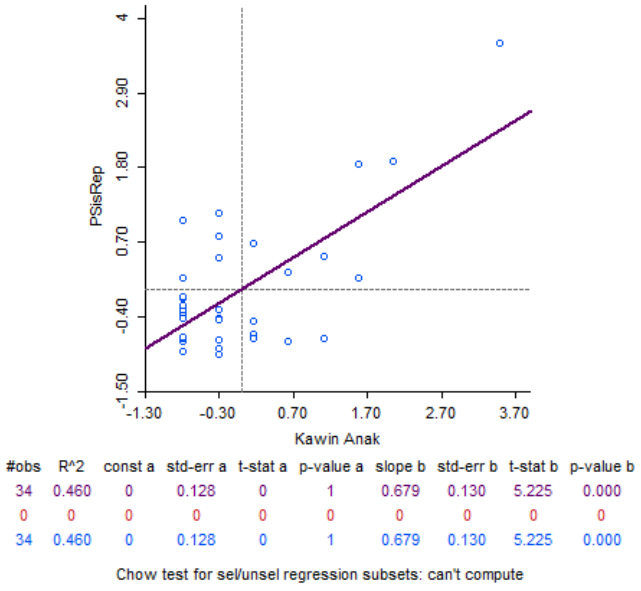

Figure 6. Scatter Plot for standardized values – correlation Number and Proportion of Child Marriages with Reproductive System Knowledge

Meanwhile, if you use a scatter plot matrix, to see the relationship between the number of child marriages with Knowledge of the reproductive system, Knowledge of physical changes in puberty in women, Knowledge of a woman's fertile period, Knowledge of the risk of pregnancy, and Knowledge of HIV AIDS it is known that all have a relationship where the relationship is linear positive moderate because it has a coefficient correlation between 0.5 to 0.8 (0.64; 0.59; 0.65; 0.69) as per figure 7. In addition, it is known that statistically between the number of child

marriages and Knowledge of the physical changes of puberty in girls, Knowledge of a woman's fertile period, Knowledge of the risk of pregnancy, and Knowledge of HIV AIDS have a significant relationship marked by one asterisk (*, $p < 0.05$) or two asterisks (**, $p < 0.01$).

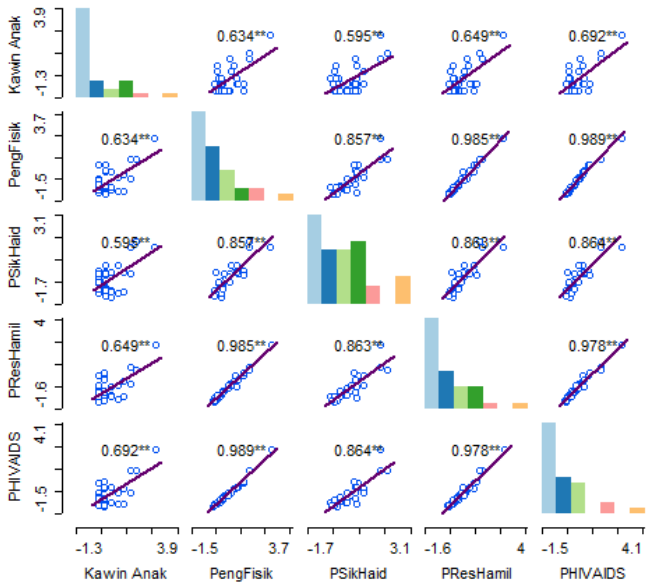

Figure 7. Scatter Plot between Number of Child Marriages with Knowledge of the physical changes of puberty in girls, Knowledge of a woman's fertile period, Knowledge of the risks of pregnancy, and Knowledge of HIV AIDS

The results of the Moran Global Bivariate LISA test to see the spatial autocorrelation between the number of child marriages with Knowledge of the physical changes of puberty in girls, Knowledge of a woman's fertile period, Knowledge of the risk of pregnancy, and Knowledge of HIV AIDS are known to match the value of Moran's I obtained from the output of the GeoDa application is greater than the expected value of E(I) with the results of the significance test with randomization of permutations 999 obtained p value $< \alpha = 0.05$ then this indicates the occurrence of spatial autocorrelation or forming a grouping pattern and has similar characteristics at adjacent locations. So it can be interpreted that spatially the number of child marriages is interconnected with knowledge of the reproductive system, knowledge of the physical changes of puberty in women, knowledge of a woman's fertile period, knowledge of the risk of pregnancy, and knowledge about HIV AIDS in one province with another, especially those whose provinces are neighboring according to the results in
table 2.

Table 2. Results of LISA Global Bivariate Moran's I Child Marriage and Knowledge of the Reproductive System

Variabel	N	Moran (I)	E (I)	Pseudo p-value	Result
Child Marriage - Reproductive System Knowledge	34	0.36	-0.035	0.014	I > E[I] (Positive autocorrelation)
Child Marriage - Knowledge of the Physical Changes of Puberty in Girls		0.33	-0.035	0.021	I > E[I] (Positive autocorrelation)
Child Marriage - Knowledge of a woman's fertile years		0.46	-0.035	0.007	I > E[I] (Positive autocorrelation)
Child Marriage - Knowledge of the risks of pregnancy	34	0.39	-0.035	0.012	I > E[I] (Positive autocorrelation)
Child Marriage - Knowledge of the risks of pregnancy		0.36	-0.035	0.016	I > E[I] (Positive autocorrelation)

DISCUSSION

The prevalence of child marriage in each province varies greatly each year. The period 2015-2018 shows a trend similar to the national figures, which experience increases and decreases showing variations in regional and

provincial contexts. If we review it based on absolute numbers, the highest number of child marriages is found in Java. The absolute number is closely related to the population, so the three provinces with the largest number are West Java, East Java, and Central Java (5).

Child marriage is a complex issue. Factors believed to contribute are poverty, geographical factors, lack of access to education, gender inequality, social conflicts, and disasters, lack of access to comprehensive reproductive health services and information, and social norms that reinforce certain gender stereotypes (e.g., women should marry young) and cultural (interpretations of religion and local traditions) (5). The prevalence and absolute number of child marriages by province suggest that geographical factors need to be considered in designing efforts to prevent child marriage. Recent studies in Indonesia have also shown that living in rural areas is a risk factor for child marriage. Other risk factors are media exposure via the Internet, the number of children in the family, parents' education, and socioeconomic status (5).

Under special conditions such as natural disasters and humanitarian crises, child marriage tripled. The reason, among other things, is that parents want to let go of the economic burden, safety factor, and fear of unwanted pregnancy. Natural conditions, disasters, and humanitarian crises often lead to insecurity in families. This condition is often a reason for families to marry off their daughters as a form of protection. The Association of Learning Circles for Women (LIBU Perempuan) in Central Sulawesi found 33 cases of child marriage in several disaster-affected refugee sites in Palu, Sigi, and Donggala, in Central Sulawesi. Causes of child marriage include unwanted pregnancies and post-disaster economic vulnerability, and due to parents, who died in natural disasters. Similar reasons also arise due to the eruption of Mount Sinabung, North Sumatra (5). From the explanation above, it can be concluded that in the development of child prevention strategies cannot be made in general for all regions, especially for all provinces. It is necessary to consider geographical factors including considering the vulnerability of the region due to natural disasters and humanitarian crises.

It is known that there is a positive spatial autocorrelation on the number of child marriages in provinces in Indonesia where cases of child marriage occur in groups or clustering, and the number of child marriages in a province has similarities or relationships with surrounding provinces. Therefore, it is necessary to map child marriage at the provincial level, especially in provinces that have significant positive autocorrelation, so that the determination of the implementation of child marriage prevention can coordinate with each other, especially in provinces with high child marriage rates surrounded by provinces that have a high number of child marriages as well. This mapping was carried out to identify trends in child marriage (prevalence and absolute numbers), identification of sociocultural aspects (education, norms, values, gender, community perspectives), and identification of related stakeholders, in line with the approach and stages of implementation of STRANAS PPA (5).

There is a significant relationship between the number of child marriages and reproductive system knowledge, so it is important to recommend increasing reproductive system knowledge to be one of the priority child marriage prevention interventions. A lack of information about sexual and reproductive health also makes adolescents more vulnerable. One study revealed that adolescents often don't know the consequences of sexual intercourse or the function of contraception (12). Ignorance of information related to sexual and reproductive health makes adolescents unable to protect themselves and encourages the practice of child marriage (5).

Salam et al also found Health Education, Counseling, and Debriefing contraception is an effective intervention in increasing sexual knowledge, contraceptive use, and reducing pregnancy rates among adolescents (13). It seems that comprehensive reproductive health education has the potential to strengthen adolescents' understanding of risk factors, which are believed to prevent child marriage. It seems that comprehensive reproductive health education has the potential to strengthen adolescents' understanding of risk factors, which are believed to prevent child marriage.

However, it should be noted that increasing knowledge related to the reproductive system is not the only effective intervention for the prevention of child marriage. According to Chae and Ngo (2017), the most successful intervention to prevent child marriage is to use reinforcement strategies for girls (57%). These strategies include providing information, capacity building, and support structures that enable girls to advocate for themselves and build their status and well-being (5).

CONCLUSION

Based on the results of spatial analysis of the number of child marriages in Indonesia using 2017 IDHS data, it was concluded that the results of global autocorrelation for child marriage cases using Moran's I with a queen contiguity weighting matrix are known to have positive spatial autocorrelation or form a grouping pattern so that it can be interpreted spatially the number of child marriages in one province with other provinces is interconnected, especially neighboring ones. Looking at the distribution pattern, group autocorrelation in quadrants I and III (High-High Low-low, below the average) is interpreted that provinces that have a high number of child marriages are surrounded by provinces that have a high number of child marriages as well and provinces that have a low number

of child marriages are surrounded by provinces that have a low number of child marriages. The results of the Local Moran LISA Cluster Map where 2 provinces with the High-High category were obtained, namely the number of high child marriages surrounded by provinces with a high number of child marriages, namely West Java Province and Central Java Province. While the province is Low-Low in North Sumatra Province.

The results of bivariate spatial analysis that links the number of child marriages in Indonesia with knowledge of the reproductive system are known to have a coefficient correlation of 0.68 so it can be interpreted that the number of child marriages has a moderate positive correlation indicating that there is a relationship with reproductive system knowledge. Moran's Bivariate Local results show the occurrence of positive spatial autocorrelation or forming clustering patterns. So, in adjacent provinces, the number of child marriages has a relationship with reproductive system knowledge.

SUGGESTION

Apart from conclusions, researchers also provide suggestions for further research related to this research. The suggestions given are as follows:

In further research, other independent variables can be added so that the analysis obtained is more in-depth because many other factors can influence child marriage besides knowledge of the reproductive system.

Under the direction of the national development policy for child protection, namely the realization of an Indonesia worthy of children through strengthening a child protection system that is responsive to diversity and characteristics of residence (5), taking into account the distribution of cases of child marriage which is clustered, it is necessary to focus more on the national prevention strategy child marriage, especially strategy 5, namely Strengthening Stakeholder Coordination, will be achieved through strategic focus: Increasing cooperation across sectors, fields and regions; Strengthening data and information systems; and Supervision, monitoring and evaluation (5). Especially for provinces that have a high number of child marriages with surrounding provinces, especially in the provinces of Gorontalo, South Sulawesi, Central Java, Banten, South Kalimantan, and West Sulawesi.

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