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Spatial model of susceptible district of dengue fever in Ngemplak Subdistrict, Boyolali

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Received 25 September 2019; accepted 11 November 2019

KEYWORDS

Geographical
information system;
Susceptible district;
Dengue fever illness

Abstract

Background of study: As an effort of prevention of Dengue Fever Occurrence, it must be applied an information system which is able to give fast, exact, complete, and easy understood information. Because of that, it needs to be developed a Geographical Information System {Sistem Informasi Geografis (SIG)} in society health service, that is related to the distribution and risking factors of Dengue Fever Occurrence. The Geographical Information System model can show the description of spatial distribution of Dengue Fever cases in a district, the tendency of illness spreading, and whether there is clustering of the illness or not, so it can identify unsafe / susceptible level in a district to Dengue Fever Occurrence.

Method: The design of this research is observational analytic with *Cross Sectional* approach, using Geographical Information System in *spatial analysis*. The samples of the research are all dengue fever victims recorded at public health centre in Ngemplak Subdistrict, Boyolali Regency from 2016 to 2017, which are 93 respondents. The data analysis is done by univariate, bivariate with *Contingency Coefficient* test and spacial analysis in Geographical Information System approach.

The result of the study: The result of the research shows risking factors that is proved significantly related to dengue fever occurrence. Those are population density percentage ($p=0.003$) and the number of free mosquito larva percentage ($p=0.001$). Spacially, districts in Ngemplak Subdistrict, Boyolali, that have highest susceptible level to dengue fever are Sindon and Gagak S village.

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Peer-review under responsibility of the scientific committee of the 3rd International Conference on Healthcare and Allied Sciences (2019). Full-text and the content of it is under responsibility of authors of the article.

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<https://doi.org/10.1016/j.enfcli.2020.01.008>

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Please cite this article in press as: Setyaningsih W et al. Spatial model of susceptible district of dengue fever in Ngemplak Subdistrict, Boyolali. Enferm Clin. 2020. <https://doi.org/10.1016/j.enfcli.2020.01.008>

1 Introduction

The numeral case of dengue fever occurrence in Indonesia from 2008 to 2010 is still high. In 2008, it is recorded that the morbidity number (IR) is 59.02 per 100.000 population, in 2009 the morbidity number (IR) is 68.22 per 100.000 population, and in 2010 the morbidity number (IR) is 65.70 per 100.000 population. The number stated before is still above the national target that is the morbidity number (IR) < 53 cases per 100.000 population.¹

Geographical Information System Model can show the description of spatial distribution of dengue fever case in a district, tendency of illness spreading / dissemination, and whether there is clustering of the illness or not, so that it can identify susceptible level of a district to dengue fever occurrence.²⁻⁶

1 Method

The design of this research is Analytic Observational with Cross Sectional Approach, using Geographical Information system in Spatial Analysis to get description about the spatial distribution of dengue fever case and spatial connection to factors which are related to dengue fever occurrence in Ngemplak Subdistrict Boyolali Regency. The sample of this research are all dengue fever victims recorded at Public Health Centre in Ngemplak Subdistrict Boyolali Regency from 2016 to 2017, which are 93 respondents.⁷⁻¹⁰

The data analyzed by bivariate with Contingency Coefficient test,¹¹⁻¹³ While spacial analysis uses overlay function in Geographical Information System Model, using ArcGIS Software.¹⁴⁻¹⁶

Result

Univariate analysis

1. The Description of Dengue Fever Case Distribution.

Spatial description of dengue fever case distribution in Ngemplak Subdistrict Boyolali Regency can be seen in Fig. 1.

Based on spatial description above, dengue fever cases happen most in 4 villages continuously. Those are 25 cases or 27 % in Ngesrep village, 16 cases or 17% in Manggung village, 13 cases or 14% in Gagaksipat and Sindon village, and 12 cases or 13 % in Sobokerto village.

2. The Description of Population Density.

See Table 1.

3. The Description of Free Mosquito Larva Number

The dengue fever illness is an illness which can spread easily and the quantity tends to always increase. Because of that, the prevention action is a very suggested thing by controlling development factors that can spread the illness, that is by controlling the development of Aedes Aegypti mosquito. From the result of the research using secondary data of free mosquito larva at Public Health Centre in Ngemplak Subdistrict Boyolali Regency in 2017, it is gotten data as the following (Table 2).

4. The Description of The Width of Settlement Percentage

See Table 3.

Discussion

Spatial analysis with overlay function in this research is done to see and predict some districts which are susceptible or have high risks to dengue fever occurrence in Ngemplak Sub-district. Overlay is done to the description of dengue fever case map in Ngemplak Subdistrict and the map of population density, free mosquito larva, and the width of settlement percentage.

a. Overlay of Population Density and the Distribution of Dengue Fever Case

From the result of spatial analysis done by overlay function to the map of dengue fever case distribution, it is gotten a description that Sawahan, Pandeyan, Donohudan,

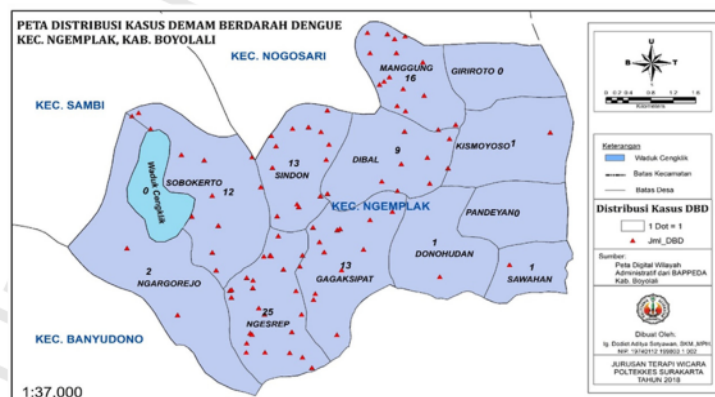


Figure 1

Q1 Spatial model of susceptible district of dengue fever in Ngemplak Subdistrict

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Table 1 The average of population and population density based on villages in Ngemplak subdistrict.

Village	Number of population	Width of region (km ²)	Population density (person/km ²)
Ngargorejo	3.650	3.066	1.19
Sobokerto	6.159	4.974	1.24
Ngesrep	6.072	4.022	1.51
Gagaksipat	6.864	2.556	2.69
Donohudan	6.689	2.445	2.74
Sawahan	8.817	2.658	3.32
Pandeyan	7.112	2.564	2.77
Kismoyoso	6.506	3.779	1.72
Dibal	6.036	2.799	2.16
Sindon	5.075	2.571	1.97
Manggung	6.337	4.223	1.50
Girioto	5.888	2.865	2.06

Table 2 Free mosquito larva number and the number of dengue fever case based on villages in Ngemplak subdistrict in 2017.

Village	Free mosquito larva number (ABJ)	DBD cases	
		Number of case	%
Ngargorejo	98	2	2
Sobokerto	85	12	13
Ngesrep	80	25	27
Gagaksipat	85	13	14
Donohudan	98	1	1
Sawahan	98	1	1
Pandeyan	96	0	0
Kismoyoso	96	1	1
Dibal	96	9	10
Sindon	90	13	14
Manggung	86	16	17
Girioto	98	0	0

Table 3 The width of settlement percentage based on villages in Ngemplak subdistrict in 2017.

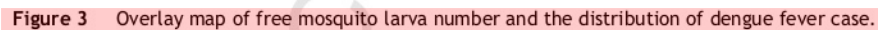
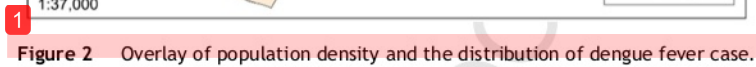
Village	The number of population	The width of region (km ²)	Percentage of the width of settlement (%)
Ngargorejo	3.650	3.066	1.19
Sobokerto	6.159	4.974	1.24
Ngesrep	6.072	4.022	1.51
Gagaksipat	6.864	2.556	2.69
Donohudan	6.689	2.445	2.74
Sawahan	8.817	2.658	3.32
Pandeyan	7.112	2.564	2.77
Kismoyoso	6.506	3.779	1.72
Dibal	6.036	2.799	2.16
Sindon	5.075	2.571	1.97
Manggung	6.337	4.223	1.50
Girioto	5.888	2.865	2.06

and Gagaksipat village are districts with the most population density among 12 villages in Ngemplak Subdistrict Boyolali Regency.

The description of overlay between the map of dengue fever case distribution in Ngemplak Subdistrict and the map of population density can be seen in Fig. 2.

b. Overlay of Free Mosquito Larva Number and the Distribution of Dengue Fever Case

From the result of spatial analysis done by overlay function to the map of dengue fever case distribution in Ngemplak Subdistrict and the map of free mosquito larva,



Based on the result of bivariate analysis bivariate above, the connection among the variables can be explained as the following:

1 a. The Connection between Population density and The Number of Dengue Fever Occurrence

Spacially, the result of connection analysis between population density and dengue fever case in Ngemplak Subdistrict shows the same description result done by statistic test using *Contingency Coefficient*, that there is no connection between population density and dengue fever case in Ngemplak Subdistrict, which is shown by minimum case in a village with high population density compared to other districts.

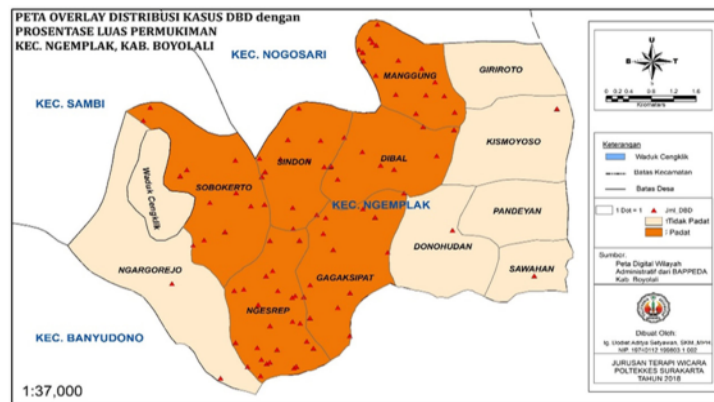


Figure 4 Overlay map of the width of settlement percentage and the distribution of dengue fever case.

Table 4

Variabel	P
Population density	
Overcrowded	0.276
Less crowded	
Percentage of density settlement	
Overcrowded	0.003
Less crowded	
Percentage of free mosquito larva	
Height	0.001
Low	

b. The Connection between Free Mosquito Larva and The Number of Dengue Fever Occurrence

From the result of bivariate analysis in Table 4, it is gotten $p=0.001$. It means that statistically there is a meaningful connection between free mosquito larva number and the number of dengue fever occurrence in Ngemplak Subdistrict.

Spacially, the result of connection analysis between free mosquito larva number and dengue fever case in Ngemplak Subdistrict shows the same description result done by statistic test using *Contingency Coefficient*, that there is a connection between free mosquito larva number and dengue fever case in Ngemplak Subdistrict, which is shown by the height of the case in a village with low free mosquito larva number compared to other districts.

c. The Connection between The Width of settlement Percentage and The number of Dengue Fever Occurrence

From the result of bivariate analysis in Table 4, it is gotten $p=0.003$. It means that statistically there is a meaningful connection between the width of settlement percentage and the number of dengue fever occurrence.

Spacially, the result of connection analysis between the width of settlement percentage and the number of dengue fever case in Ngemplak Subdistrict shows the same description result done by statistic test using *Contingency*

Coefficient, that there is a connection between the width of settlement percentage and dengue fever case in Ngemplak Subdistrict, which is shown by the height of the case in a village with high percentage of the width settlement percentage.

The connection between free mosquito larva and the number of dengue fever occurrence

From the result of bivariate analysis in Table 5, it is gotten $p=0.001$. It means that statistically there is a meaningful connection between free mosquito larva number and the number of dengue fever occurrence in Ngemplak Subdistrict.

Spacially, the result of connection analysis between free mosquito larva number and dengue fever case in Ngemplak Subdistrict shows the same description result done by statistic test using *Contingency Coefficient*, that there is a meaningful connection between free mosquito larva number and dengue fever case in Ngemplak Subdistrict, which is shown by the height of the case in a village with low free mosquito larva number compared to other districts.

This matter has the same result with a research conducted by¹⁷ in Magetan Regency, that there is a significant connection between the existence of mosquito larva and dengue fever occurrence.

Free mosquito larva number is one of measurement tools which is used to see the density of dengue fever factors, based on House Index (HI) which can give a description about how big the development of illness factors in a district. Higher the possibility of breeding factor, higher the risk of being infected dengue fever illness.¹⁸⁻²⁰

The connection between population density and the number of dengue fever occurrence

From the result of bivariate analysis in Table 5, it is gotten $p=0.276$. It means that statistically there is no meaningful connection between population density and dengue fever occurrence in Ngemplak Subdistrict.

Spacially, the result of connection analysis between population density and dengue fever case in Ngemplak

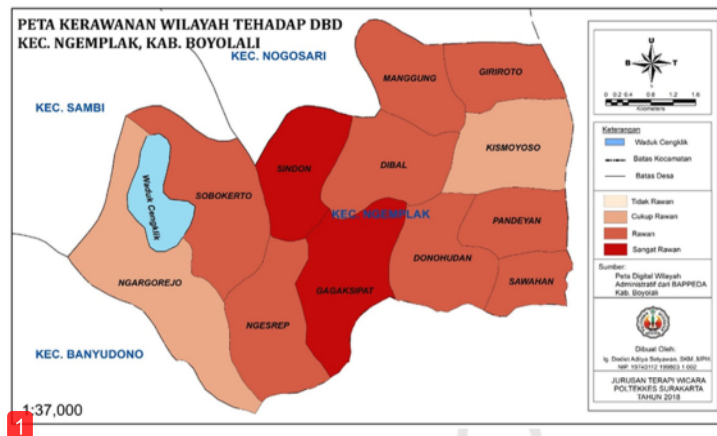


Figure 5 Description map of susceptible level district to dengue fever illness.

Subdistrict shows the same description result done by statistic test using Contingency Coefficient, that there is no connection between population density and dengue fever case in Ngeplak Subdistrict, which is shown by minimum case in a village with high population density compared to other districts.

The connection between the width of settlement percentage and the number of dengue fever occurrence

From the result of bivariate analysis in Table 5, it is gotten $p=0.003$. It means that statistically there is a meaningful connection between the width of settlement percentage and the number of dengue fever occurrence.

Spacially, the result of connection analysis between the width of settlement percentage and the number of dengue fever case in Ngeplak Subdistrict shows the same description result done by statistic test using Contingency Coefficient, that there is a connection between the width of settlement percentage and dengue fever case in Ngeplak Subdistrict, which is shown by the height of the case in a village with high percentage of the width settlement percentage.

The dissemination of dengue fever that is only limited in city in the past, now the dissemination can happen in rural too. Land Using/Land Covering is one of risk factors that roles in the distribution of dengue fever.

From the result of the research and the discussion, it can be concluded that:

- The dissemination of dengue fever case in Ngeplak Subdistrict is concentrated in districts with dense settlement percentage and low free mosquito larva status.
- There is a connection between the distribution of dengue fever case and free mosquito larva status in Ngeplak Subdistrict.
- There is a connection between the distribution of dengue fever case and the width of settlement percentage in Ngeplak Subdistrict.

- There is no connection between the distribution of dengue fever case and population density in Ngeplak Subdistrict.

Spacially, the districts that have the highest susceptible level to dengue fever illness are Sindon and Gagakipat village. The map of the districts that have the highest susceptible level to dengue fever illness can be seen in Fig. 5.

Suggestions that can be given from the result of the research is for Public Health Centre. It must do an intensive surveillance activity of illness factors and dengue fever case, specially in a district which has a very high susceptible level to dengue fever case.

Public Health centre needs to do an evaluation of surveillance activity that has been done regularly related to the existence of low free mosquito larva number.

It needs a better management of the environment, specially in villages with very low free mosquito larva status.

It needs to be done a campaign to wipe out mosquito nests continuously and more intensively for the society so that the free mosquito larva status can reach more than 95%.

Conflict of interests

The authors declare no conflict of interest.

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