Spatiotemporal mapping of dengue cases in Sleman district, Indonesia year 2014-2017

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Original Research Article

Spatiotemporal mapping of dengue cases in Sleman district, Indonesia year 2014-2017

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ABSTRACT

Background: Dengue is a significant public health problem in the mostly tropical country such as Indonesia. Even though many efforts have been established in Indonesia, in fact, dengue remains drawing attention from the health sector. Geographic Information System (GIS) is a powerful tool to support dengue surveillance on understanding the dengue pattern with the goal to give input for the decision maker. Accordingly, there is a need to providing the presence and the dynamic of dengue case particularly in Sleman district to establish evidence on building dengue control strategy.
Methods: A descriptive study using GIS was performed to provide a spatial-temporal mapping of dengue case. Secondary data which sourced from Sleman district health office was collected for period 2014-2017. This data was grounded into subdistrict level. Quantum GIS and Microsoft Excel were used to analyse the data.
Results: During 2014-2017 dengue spreads over the Sleman district. In 2016, found the increased of subdistrict with high dengue case. The high dengue case found in sub-district with an urban characteristic.
Conclusions: Mapping of dengue using GIS is helpful to understanding the disease presence and dynamic disease over time.

Keywords: Dengue, Mapping, GIS, Sleman, Indonesia

INTRODUCTION

Dengue has become a serious public health problem, especially for tropical countries due to the conformity with mosquito habitat, such as in Indonesia. Dengue will remain a problem as long the human, mosquito, virus and environment are present in the same place and time in the world. According to WHO report, dengue spread over 100 tropical countries worldwide while Indonesia has the second highest of Dengue cases among 30 other endemic countries in Asia Pacific Region.[1,2] Nevertheless, in 2017, Indonesia's incidence rate which is a number of new cases per population at risk in a given period was 50.75/100.000 citizen.[3] Meanwhile, In Sleman district, by 2017, they already accomplish national target with 40.75 dengue incidence per 100.000 population.

Mapping disease is vital to support dengue surveillance because this tool allows the user to customise the disease picture across time in specific space or population.[4] This map to follow the disease dynamic also to give insight to the policymaker. The spatial information is essential information to know the presence of disease to create appropriate disease prevention. Some dengue research has performed to support dengue surveillance program. Such as a researcher in India who did cluster map to identify dengue hotspot. This research useful for a policymaker to priorities area of action.[5] Another investigation was conducted in Selangor Malaysia who sought evidence on the benefits of using GIS on dengue study.[6]

Considering the mentioned background, there is a necessity for renew the information on the presence and the dynamic of dengue case, particularly in Sleman district to establish a shred of evidence on establishing dengue control strategy.

Using secondary data of dengue cases reported from Sleman district health office, we performed this study to understand the dengue case distribution in Sleman by subdistrict during 2014-2017.

METHODS

Study design: This study is defined as a descriptive study.

Setting: This study was performed in Sleman district, special region of Yogyakarta, Indonesia, which was involving 17 sub-district. Sleman district is located at the north of Yogyakarta province (110°33′00″, 110°13′ 00″ east longitude, 7°34′5″, 7°47′30″ south latitude). This district covers 574,82 km^2 of area-wide.[7]

Data source and data collection: We used secondary data sets which were derived from a related institution that is aggregated data by subdistrict. First, Dengue case was collected from Dengue monthly report of Sleman District Health Office (Sleman DHO) during 2014-2017. Dengue positive on this study was described as every patient who positive as dengue haemorrhagic fever by laboratory testing in the hospital then reported to Sleman DHO. Second data is population number; this data was used to count the incidence rate. This data was retrieved from Yogyakarta official website (http://www.kependudukan.jogjaprov.go.id/olah.php?module=statistik&periode=10&jenisdata=penduduk&berdasarkan=pendidikan&prop=34&kab=04&kec=2). We recorded population for each sub-district in the second semester 2014-2018.

Data collection was conducted at May-August 2018.

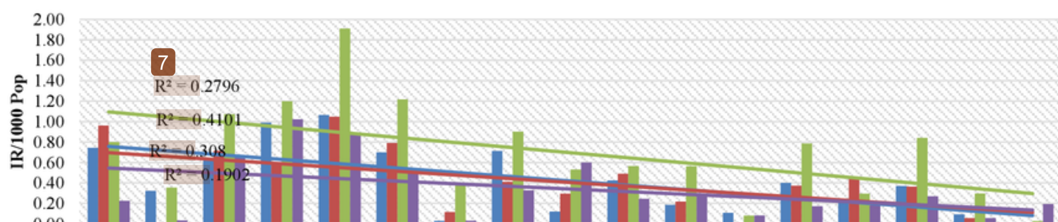
Sample population: We used entirely data recorded in Sleman DHO.

Variables: We describe two variables on this research to explore the distribution of dengue case in Sleman. First, dengue cases which are served as incidence rate per subdistrict by year. Secondly is the population number for each subdistrict.

Analysis strategy: An analysis was performed using Microsoft Excel for trend analysis. Spatio-temporal mapping was generated using Quantum GIS (QGIS).

RESULTS

Trend dengue incidence: Dengue case incidence in Sleman seems declining during 2014-2017. This can be seen from the linear line and R2 in Figure 1.



	Berbah	Cangkringan	Depok	Gamping	Godean	Kalasan	Minggir	Mlati	Moyudan	Ngaglik	Ngemplak	Pakem	Prambanan	Seyegan	Sleman	Tempel	Turi
2014	0.74	0.32	0.62	0.99	1.06	0.70	0.03	0.71	0.12	0.43	0.19	0.11	0.40	0.24	0.37	0.09	0.00
2015	0.96	0.00	0.71	0.59	1.05	0.79	0.12	0.41	0.30	0.49	0.22	0.00	0.37	0.45	0.36	0.06	0.00
2016	0.80	0.35	1.07	1.20	1.91	1.22	0.39	0.90	0.53	0.57	0.56	0.08	0.78	0.30	0.84	0.30	0.03
2017	0.23	0.03	0.67	1.02	0.88	0.53	0.03	0.33	0.60	0.25	0.28	0.08	0.17	0.18	0.27	0.06	0.19

Figure 1: Dengue incidence rate per-subdistrict by 2014-2017 in Sleman, Indonesia.

Spatio-temporal mapping: Throughout 2014-2017 dengue spread over Sleman sub-district. North Sleman which is consisted of the highland area such as Tempel, Turi, Tempel and Cangkringan held between low and medium dengue incidence rate. While south of Sleman which is a flat area at a time is an urban area, the majority of them classified as high incidence rate.

Mapping of population density: Sleman district placed between 549-3069 population density per square meter. Depok sub-district is the highest population density followed by Godean, Gamping, and Mlati. While Turi, Pakem and Cangkringan subdistrict are predicated as the lowest population density.

DISCUSSION

Dengue is a significant health problem for many big cities in a tropical country such as Indonesia because of the urbanisation or human mobility due to the population growth and international travel that support the virus movement to transmit dengue.[8,9] In Indonesia, some cities become dengue endemic such as Banten, Jakarta, Surabaya, Medan, Yogyakarta, etc. In Yogyakarta, which consisted of 5 districts, dengue spreads thoroughly the district included Sleman district. During 2014-2017 dengue cases in Sleman was up and down with the lowest Incidence Rate (IR)/100.000 population was 40.79 in 2017 and the highest IR/100.000 citizen was in 2016 with 81.54. In the meantime, Indonesia government defines the target on dengue case in Indonesia is 49/100.000 population, meaning that sometimes Sleman's IR stands above the national target.[3] Accordingly, understanding of dengue hotspot is essential for Sleman district to maintain the IR number below the national target. In this study, we assessed the spatiotemporal of dengue during 2014-2018. Based on our result, dengue in Sleman majority located in the urban area. On the other hand, Cangkringan subdistrict which situated in the high land at 2014 and 2016 they hold on medium IR.

In spatial context, dengue has spread over Sleman district during the research period. Godean, Gamping, Depok, and Kalasan were subdistrict with high dengue incidence series during 2014-2017. Turi and Pakem were two subdistricts who have low dengue incidence during the same period. While the other subdistricts, they were experiencing with changing the dengue incidence in a specific year (Figure 2). This result implies that Sleman district faces the heterogeneous condition in some areas but at the same time Sleman have high endemic dengue area such as Depok subdistrict that have highest population density (Figure 3) and in the same time placed in the top case dengue incidence.

Population density is well known to have a contribution on dengue transmission, previous research in Sri Lanka found that dengue incidence associated with population density where high dengue incidence has occurred in high population density.[10] In this research, we found a similar result; it seems that the number of dengue incidence has an association with population density. Areas in the urban characteristic such as Depok sub-district then next Mlati, Godean and Gamping are majority have higher cases compared to low population subdistrict which is located in rural or transition rural-urban. Unplanned population growth, mainly in the urban area responsible for the emergence of slum area with insufficient sanitation that supports as the mosquitos breeding site.[11,12]

Sleman is extended outward from north to south which is from the high land area in Merapi to the flat area adjacent with Yogyakarta City. This area lied from less than 100 to more than 1000 meter above sea level (mASL).[13] Cangkringan subdistrict which is laid on 500-1000 mASL classified to medium incidence rate for two years. We guess that there was a contribution of climate change in these cases due to the rising of temperature including in the high land area that susceptible for mosquito live. Some papers have proof that climate change contributed to a direct impact on the increasing the number of vector-borne disease due to the changing of some climatic variables such as temperature, humidity and rainfall.[14,15] In Indonesia, evidence shows the association of climate variability to expanding of dengue transmission. Budi Haryanto well described the association of dengue fever in Indonesia and temperature from 1968-September 2007.[16]

Dengue is emerging disease in some countries in the world for example in the Eastern Mediterranean region.[17] Accordingly, every country who have a vector and supportive environment have to build awareness on dengue continuously. In this research found, as seen in Figure 1, the trend of dengue cases during 2014-2017 seemed declining. However, it does not guarantee dengue will disappear from Sleman. Therefore, routine dengue surveillance and dengue vector control remain needed as prevention action to anticipate unexpected outbreak.

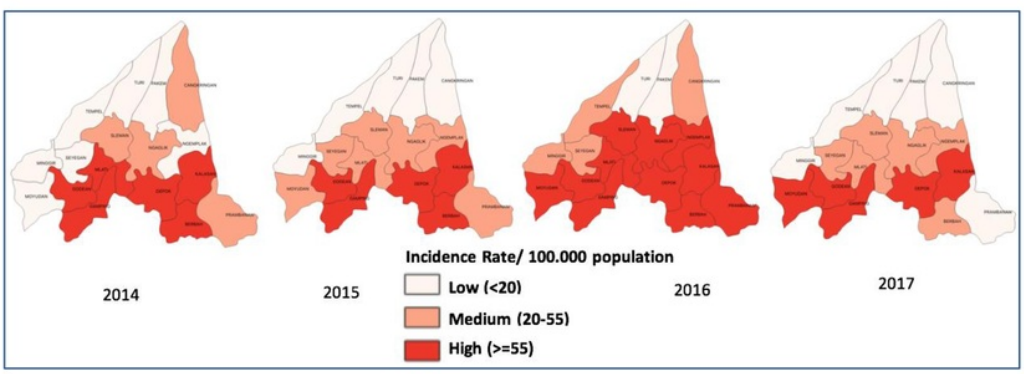


Figure 2: Spatiotemporal mapping of dengue incidence rate by subdistrict in Sleman, 2014-2017.

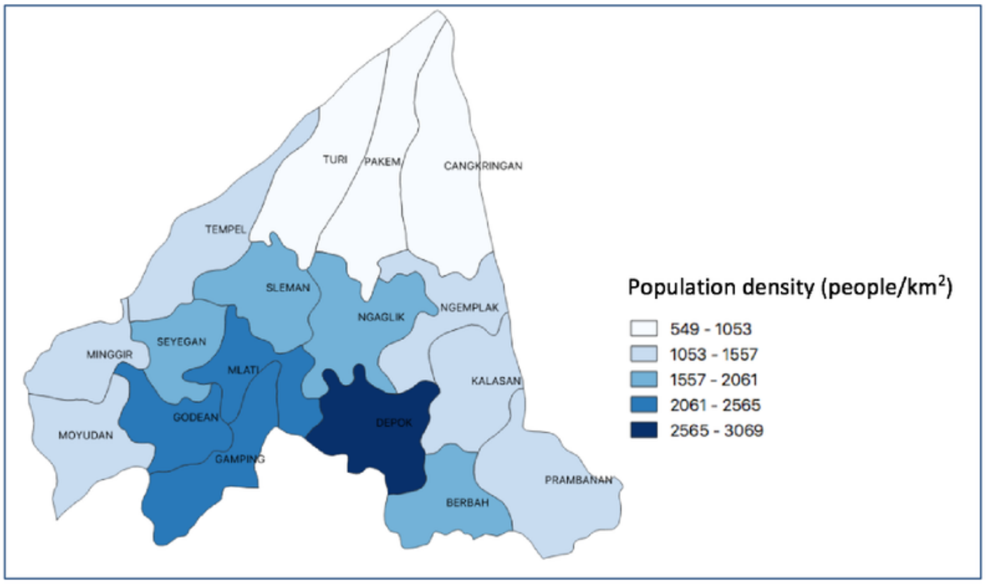


Figure 3: Mapping of Sleman population density by sub-district. Resource: Data retrieved from http://www.kependudukan.jogjaprov.go.id.

Considering this study result, in the next coming research proposing to assess the association of dengue and climatic variation as part of climate change. Second, seeks evidence analytically of association between population density and dengue cases. For health authority, sustainable effort on dengue prevention through integrated surveillance needs to be maintained.

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