CORELATIONAL SPATIOTEMPORAL ANALYSIS DENGUE HAEMORRAHAGIC FEVER (DHF) WITH SETTLEMENT CONDITION IN PALEMBANG CITY, INDONESIA

Mariana
Public Health Sains Department, Faculty of Medicine Sriwijaya University, Indonesia
ma.hanifah3@gmail.com

Agita Diora
Public Health Sains Department, Faculty of Medicine Sriwijaya University, Indonesia
agith.diora@gmail.com

Zata Ismah
Epidemiology and Biostatistics Department, Faculty of Public Health Sriwijaya University, Indonesia
zataismah@gmail.com

Tri Hari Irpani
Public Health Sains Department, Faculty of Medicine Sriwijaya University, Indonesia
trihari.irfani@gmail.com

Rahardian Dwi Cahyo
Faculty of Medicine Sriwijaya University, Indonesia
rahardiandcahyo@gmail.com

Mandeep Singh Mukand Singh
Faculty of Medicine Sriwijaya University, Indonesia
mandeepmyth@outlook.com

Abstract

Analysis with spatial method has an role important for describing the health problems between regions, and knowing the determinant of problem. However, the research of Dengue Hemorrhagic Fever (DHF) with this method was rarely founded in Palembang.The objective of this study was to determine identify the incidence of DHF through spatio-temporal, compared with population density, healty housing proportion and slums area in years 2009-2013.The study was observasional with ecological design. Secondary data got from data weekly reports Health Department Palembang City and reports Spatial and Housing Department. The data was processed into tabular and spatial. Spatial data was processed by using ArcView and GIS. Statistic corelation analysis with Spearman and Pearson analysis. Subjects research and unit analysis were all health centers in city (39 unit). The results is spatial distribution showed the high of DHF cases in Seberang Ilir area specially Centre area and Northern area. It was the area predominantly has many water reservoir. The high case of DHF (IR >50 per 100.000 population) shows at : population density areas (relation in year 2010 P=0.039, r=-0.332), and healty housing proportion (relation in year 2009 P=0.010 r=0.554; in year 2010P=0.007 r = 0.445; in year 2011 p=0.015 r = 0.404) and slum area P=0.034**, r= -0.345.Temporally distribution showed the decrease of DHF cases during the last 5 years.Interventions of preventing DHF is needed in priority areas, that is in North and Centre area. Preferred improvement of water supply, Collaborative activity between GERTAK PSN DBD and PSN 60 minutes, Inviting cadres of middle and upper economic class society, and doing alert for 5-years cycle.

Keywords

1. Introduction

The International Health Regulations (IHR) 2005 state that Dengue Hemorrhagic Fever (DHF) was an implication for health security because of disruptions and epidemics that rapidly spread beyond national borders. The incidence rate (IR) of dengue disease in Indonesia itself tends to increase in 2005 by 43.31 per 100,000 populations up to 2010 reaching 65.07 per 100,000 populations. In Palembang, DHF was a health problem that never finished. At the district level, the

city of Palembang was found 21 out of 107 urban villages or 18.6% district whose incidence reached >50 per 100.000 population(Field PMK Palembang, 2013).

The risk factor for DHF transmission was very complex. The inter-area risk factors were usually different. However, in general the area that had a potential environment for larvae Aedes aegypti would be at risk of having a high IR number. From several previous studies indicated that spatial analysis of spatial diseases in the spread of DHF plays a role to provide information on the number of infected and dangerous areas of DHF outbreaks. This method can see the development of DHF incidence based on the potential location from year to year so it will be known which the village was vulnerable and not vulnerable (Astuti, 2010).

In Indonesia almost all cities health offices had DHF vulnerable maps but in puskesmas, as a services units, vulnerable maps were not always available. Palembang City Health Bank itself only has DHF vulnerable maps based on sub-districts, whereas vulnerable maps based on kelurahan were not available. Yet when traced to the district, this figure was very worried because the highest DHF IR at the district level reached 230.59 per 100,000 populations in 2013. For that the purposed of this study was conducted to obtain the map of DBD prone and correlation with population density, healthy housing proportion and slums area in years 2009-2013.

2. Methods

2.1 Materials and Procedures

This study used the design of ecological studies. Secondary data was collected from weekly report data of Palembang City Health Office (2009-2013) and Housing Silence Survey Report from Palembang City Planning and Housing Agency (2009). Data was processed into non spatial and spatial data. Spatial data was data had spatial value while non-spatial data was tabular data which have no spatial value. Further spatial data was processed using GIS software (Geographic Information System). In spatial data processing, the data will be categorized according to the cutoff point of the target achievement of the success of the relevant agencies.

2.2 Data analysis

Spatial temporal distribution in the study was presented and visualized conclusions (map drawing). Geographic information system was used as a tool to map out the spread of Rate DBD Incidence and its risk factors. Variable DHF distributions as well as risk factor variables were displayed in the map area based on the results of categories that had been done at the time of data processing. Overlapping between DHF distribution variables and risk factors shows the

distribution of dengue incidence based on each characteristic of the working area of the puskesmas.

Correlation statistics used Pearson analysis (normal distributed data type) and Spearman (abnormally distributed data type). Data that did not normally distribute was the population density of 2009 and 2012. The samples of research and analysis unit were all Puskesmas areas in the city of 39 Puskemas. In slum variables can only be analyzed at 1 year that was year 2009. This was because the slum data was survey data which collected 5 yearly. Healthy home variables were also only analyzed until 2012, due to limited data available by relevant agencies.

Finally, the results of data analysis confirmed to the holder of dengue program health department in Palembang City. Then interviewed to 1 sanitarian from the highest Puskesmas on DHF (Puskesmas Sei Baung), and 1 sanitarian from the lowest clinic of DHF (Puskesmas Taman Bacaan). This interview was conducted to determine the environment and lifestyle of the local population that led to high or low incidence of DHF in the area.

3. Result and Discussion

Based on the results of research that had been implemented, the information obtained Incident Dengue Rate, population density, healthy house, and slum level score in the work area of Palembang Health Centre (can be seen in Table 1). The average incidence of DHF and the proportion of healthy homes decreased from 2009-2013 but for population density did not show a clear pattern. In slum variables, the average city of Palembang had a score of 2.2 (slum medium), and the highest score 4.9 (slum weight).

Temporary DHF incidence rates for 5 years tend to decrease (seen in map 1). The decrease in the number of puskesmas with the incidence of DHF <50 per 100,000 population from 24 puskesmas in 2009 to only 13 in 2013. While spatially for 5 years seen the incidence of DHF consistently attacked the City of Seberang Ilir (City Center to North City).

For denser density shown an unclear pattern with DHF incidence (seen in map 2). However, the average incidence of dengue fever was in the working area of puskesmas that had a moderate population density. While the working area of puskesmas with high healthy house category actually shows the incidence of high DHF (seen on map 3). This was also the same in the region slum, DHF incidence actually attacked a lot of slums in the middle compared with heavy slum (seen on map 4).

The overlay relationship on the mapping was statistically proven (table 2), population density areas (relation in year 2010 P = 0.039, r = -0.332), and healthy housing proportion (relation in year 2009 P = 0.010 r = 0.554; = 0.007 r = 0.445; in year 2011 p = 0.015 r = 0.404) and slum area P = 0.034 **, r = -0.345. The relationship between dengue fever with variable density of population with slum score was negative correlation. The more densely populated and bigger the slum score, the less dengue incidence was encountered. It is also supported by the direction of positive relationship between healthy houses with DHF incidence. The healthier homes the more dengue incidence.

**Table 1:** *DHF Incidence Rate Distribution and Settlement Conditions*

Variable	n	Minimum	Mean	Median	Maximum	SD
Incidence Rate 2009(per 100.000 person)	39	0.00	71.25	60.52	187.34	44.40
Incidence Rate 2010(per 100.000 person)	39	0.00	49.39	41.43	186.49	33.38
Incidence Rate 2011(per 100.000 person)	39	0.00	50.59	44.28	149.85	33.46
Incidence Rate 2012(per 100.000 person)	39	0.00	59.91	60.67	177.97	32.46
Incidence Rate 2013(per 100.000 person)	39	0.00	34.85	30.71	106.08	22.39
Population density 2009 (people per km^2)	39	12	98.82	65.56	273	79.12
Population density 2010(people per km^2)	39	4.29	94.26	62.07	286.06	75.71
Population density 2011(people per km^2)	39	4.40	94.94	63.29	290.93	76.92
Population density 2012(people per km^2)	39	5.32	94.55	73.51	284.53	72.73
Population density 2013(people per km^2)	39	3.79	99.24	69.17	352.30	90.48
Proportion of healthy house 2009(%)	39	66.40	83.84	84.60	95.00	6.17
Proportion of healthy house 2010(%)	39	56.56	80.30	84.75	98.82	11.63
Proportion of healthy house 2011(%)	39	56.56	79.96	84.31	98.82	11.68
Proportion of healthy house 2012(%)	39	22.40	75.76	80.92	99.57	18.38
Score of slum	39	1.00	2.2053	1.93	4.98	1.14
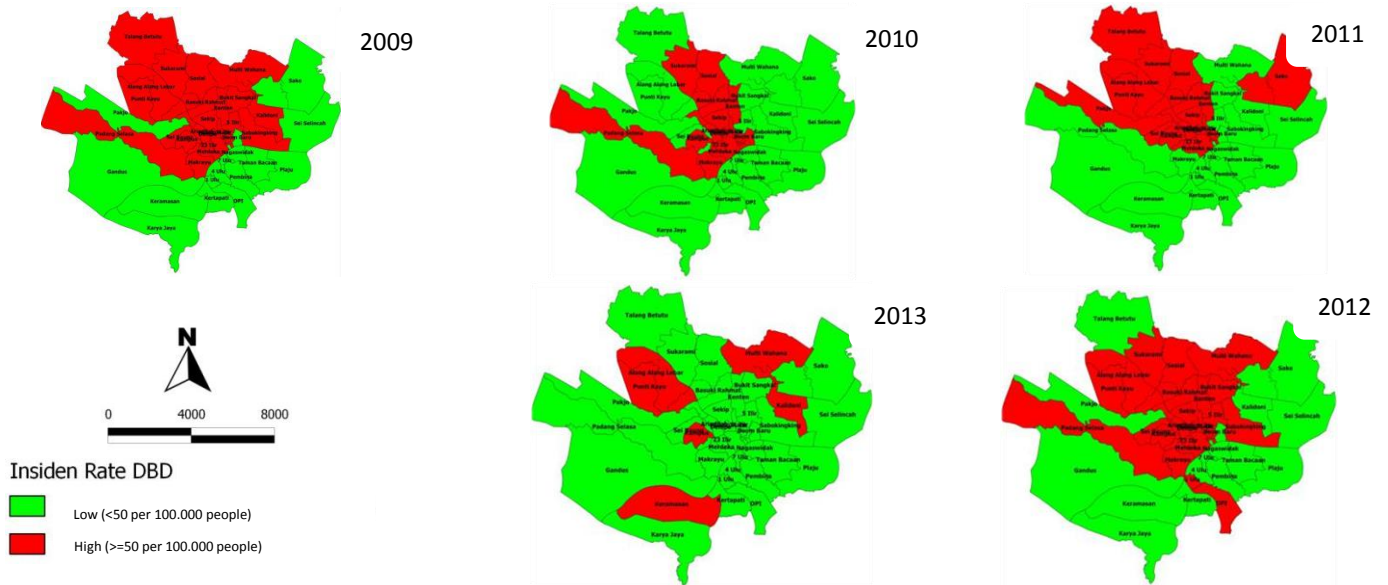
Map 1: *Spatiotemporal DHF Incidence Rate per 100,000 population in Work Area of Puskesmas Palembang from 2009-2013*
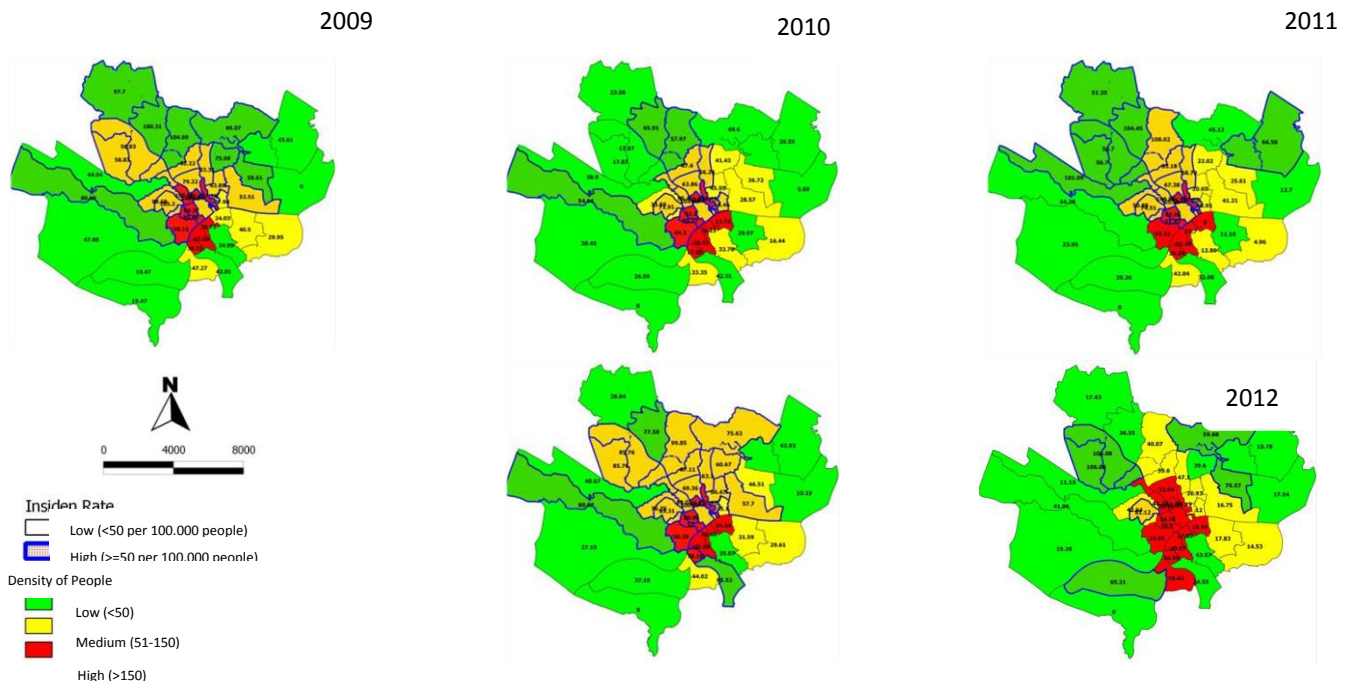
MAP 2: *Distribution of Spatiotemporal IR DHF with Density of Population in Work Area of Puskesmas Palembang from 2009-2013*
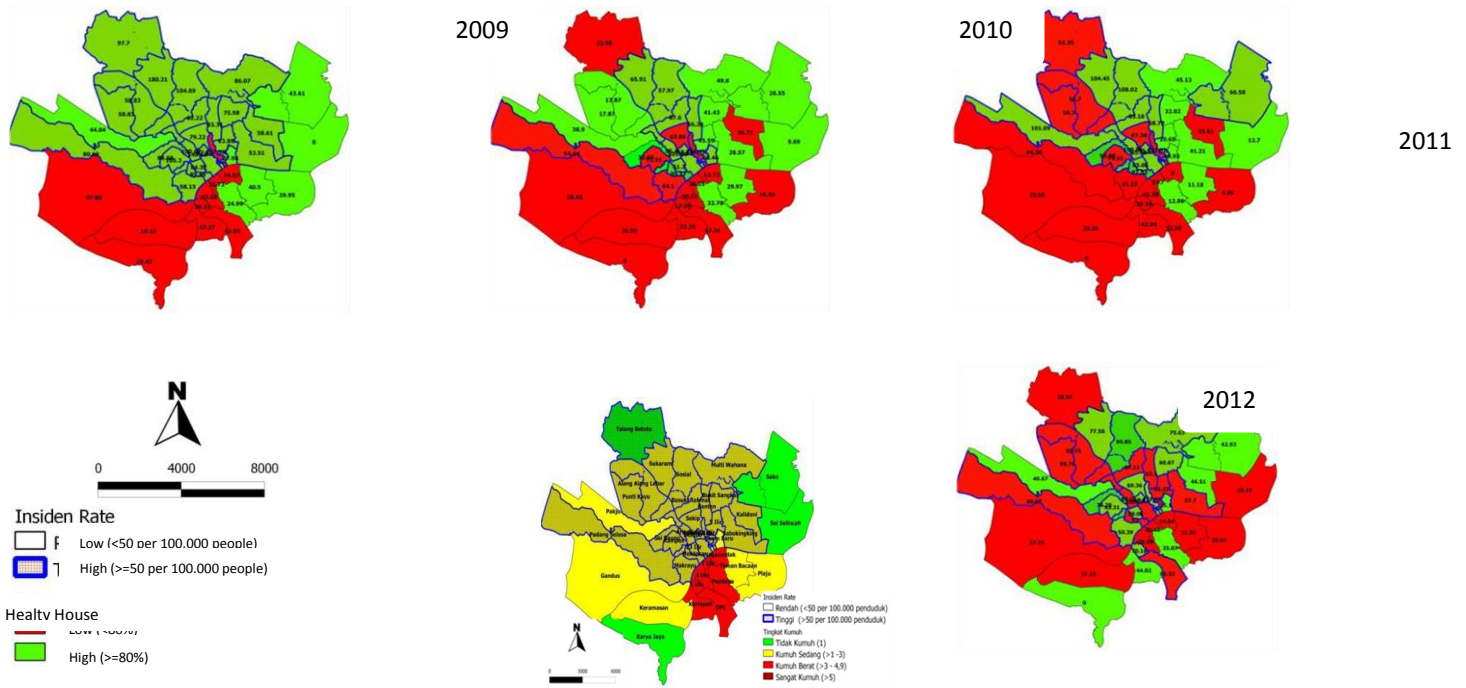
MAP 3: *Spatial Distribution of Dengue Rate Incidence with Slum Degree in Work Area of Puskesmas Palembang in 2009*

Table 2: *Correlation Analysis of Dengue Fever with Settlement Conditions*

Variable	IR 2009		IR 2010		IR 2011		IR 2012		IR 2013	
	Sig.	r	Sig.	r	Sig.	r	Sig.	r	Sig.	R
Population density 2009 (people per km^2)	0.765	0.050	-	-	-	-	-	-	-	-
Population density 2010 (people per km^2)	-	-	0.039	0.332*	-	-	-	-	-	-
Population density 2011 (people per km^2)	-	-	-	-	0.586	0.090	-	-	-	-
Population density 2012 (people per km^2)	-	-	-	-	-	-	0.235	0.195	-	-
Population density 2013 (people per km^2)	-	-	-	-	-	-	-	-	0.195	0.212
Proportion of healthy house 2009 (%)	0.000	0.554**	-	-	-	-	-	-	-	-
Proportion of healthy house 2010	-	-	0.007	0.445**	-	-	-	-	-	-

Variable	IR 2009		IR 2010		IR 2011		IR 2012		IR 2013	
	Sig.	r	Sig.	r	Sig.	r	Sig.	r	Sig.	R
(%)										
Proportion of healthy house 2011 (%)	-	-	-	-	0.015	0.404*	-	-	-	-
Proportion of healthy house 2012 (%)	-	-	-	-	-	-	0.446	0.126	-	-
Slum Score	0.034	-0.345*	-	-	-	-	-	-	-	-

** Significant α 0.05% , strong correlation
* Significant α 0.05% , moderate correlation

Spatially visible slum area is located in the working area of puskesmas in Seberang Ulu, while the slums are scattered around. Poor working area of Puskesmas, high population density, and fewer healthy homes have a lower incidence of DHF. This phenomenon is also evidenced by the statistical results of the negative correlation between the distribution of dengue incidence with density and slum level.

The cause of this phenomenon can be answered based on an interview with one sanitarian sanitation officer that the area is not slum or that is in the North City is an area with elite-type housing and not bypassed by the musi river. It is estimated that the housing has many water reservoirs to hold water from PDAM. This is in line with the results of research Wahyuni (2013) states that people who suffer from DHF actually have good water supply. They use clean water through the supply of PDAMs, so it still needs water reservoirs both large and tubs as well as buckets and pans. This shelter becomes a medium for laying mosquito eggs so that mosquito vectors can breed well (Wahyuni, 2013).

The same thing happened in West Jakarta; the local government reported that in January to March 2011, found 11 residents in elite housing in West Jakarta simultaneously attacked by DHF. According to West Jakarta Head of Sub-dept., The DHF attack in this elite housing is caused by the number of water reservoirs where mosquito breeders like flower pots and empty ponds. From Schmidt (2011), Hasyim (2010), Adifian (2013), and Sukamto (2007) about Aedes aegypti mosquito behavior, that the incidence of high DHF in areas that are not slums due to Aedes aegypti vectors. This Aedes aegypti vector likes clean water to spawn. The existence of clean water is certainly found in areas that are not slums.

Economic factors related to DHF are not only seen in a material way as the ability of inter-economic classes in accessing health services (Nadesul, 2004). However, economic

conditions will also affect the lifestyle and individual behavior. It can be estimated that the high incidence of DHF in the Central and Northern regions of the City one of them is influenced by lifestyle. DHF attacks all groups of groups. The poor make it impossible for people to have the capacity to provide proper and healthy housing, proper drinking water supply and garbage disposal. However, dengue can also attack more affluent people because of their intensity in the home (Candra, 2010).

People with higher economic status are more exposed to the Aedes aegypti vector because of their more activity in the building and inside the house. The average head of households in this area work in the offices and mothers as not working. In contrast to the Seberang Ulu region where the incidence of low DHF, the livelihood of the population was more activity outside the room such as trading in Market. Hal was in line with research Djati (2011) that working conditions were more sitting idle in the building at risk of exposure to DHF 4,930 times than in the field. Then the working conditions that go around in the building 15,719 times the risk of getting dengue than in the field[13]. The government in this case the Health Office of Palembang city, can approach the middle and upper middle class population by inviting them to become cadres. Mothers from the middle-tiered economy in many elite housing were not working (housewives), so they can be involved. The mothers will also easily interfere with their fellow groups.

According to Ministry of Health RI (2011) there was currently no other way to combat dengue fever except to eradicate the vector of the disease. This factor makes vector density a part of DHF eradication indicator[14]. Palembang itself already had a distribution program iwak tempalo as a natural predator in every activity GERTAK PSN DBD. However, the distribution and utilization was not maximal and not on target. According to the Healthy Organization Expert Committee on vector biology and control in WHO (2010), how to reduce vector density was one of them with long-term physical transformation of vector habitat and environmental manipulation (temporary changes in vector habitat as a result of planned activities to produce undesirable conditions in vector breeding). For example, improving the water supply system. Where water should not be accommodated in large containers. thus need a breakthrough how the water supply in the north and downtown flows smoothly every day without having to be accommodated to meet the needs of 2-3 days ahead.

According to National Development Planning Agency (2006) in addition to environmental modification, changes in human behavior to clean the larva will also reduce the population of mosquitoes. As in the State of Singapore and Malaysia set a punishment on a house that has larvae.

In addition to making the cadres, Health Office of Palembang City can also provide punishment/punishment in every home that found larva. In each periodic larvae examination, Kader noted the houses found larvae and monitored the condition of the iwak tempalo. The results of the inspection are immediately reported to the RT head. The house that was found larva then was given a punishment. Forms punishment can be imitated from the program PSN 60 minutes Mojokerto City, which gives a red flag on the house. Thus the homeowner will feel ashamed and immediately clean his house from larva.

4. Conclusion

Distribution of DHF incidence in Palembang City spatially occurs in Central City area, and North of City. While the temporal (trend) occurred decrease in dengue cases during the last 5 years. There is a negative correlation between dengue incidence and population density. Low population density indicates a high incidence of DHF.There is a positive correlation between DHF incidences with the proportion of healthy homes. area with the proportion of healthy homes that many show the incidence of high DHF. There is a negative correlation between dengue incidences based on degrees of slum. Areas with slums are showing a high incidence of DHF.

Suggestion that can be given that intervention of DHF is needed in priority area that is city center and north of city. Preferably improving water supply, collaboration of GNT activities of PSN DBD with PSN 60 minutes, and inviting cadre from middle and upper economic class society.

Limited research in this study the authors faced some limitations that may affect the condition of the research undertaken. the limitations include: the time available to complete this research which is relatively short when the sample needs were very large and the samples was not plotted by address but just by puskesmas areas.

For the future research extending the study period to 10 years. plotting sample not only per area of puskesmas but per address.

Acknowledgments

References

Adifian. (2013). Ability of Aedes Aegypti and Aedes Albopictus Mosquito Adaptation Based on Water Type. Environmental Health FKM UNHAS.

Astuti, H. D. (2010). Design of GIS application program in areas affected by dengue hemorrhagic fever (DHF)

Beritajakarta.com. (2014, March 8). Official Website of DKI Jakarta Provincial Government. Ticked July 6, 2014, from Residents of Elite Housing in West Dengue Fever: http://beritajakarta.com/read/893/Warga_Perumahan_Elit_di_Jakbar_Terserang_DBD

Candra, A. (2010). Dengue Hemorrhagic Fever: Epidemiology, Pathogenesis, and Transmission Risk Factors. Aspirator Vol 2.

Djati, A. P., Rahayujati, B., & Raharto, S. (2010). Risk Factors Dengue Hemorrhagic Fever in Wonosari District Gunung Kidul Regency of DIY Province Year. Proceedings of the National Seminar on Health; Research Center for Disease Control and Development of Banjarnegara Animal Zone

Field PMK Palembang City Health Office. (2013). Weekly Report on Dengue Cases. Palembang: Palembang City Health Office

Hasyim, H. (2009). Spatial Analysis of DHF In South Sumatra Province 2003-2007. Jurnal Kesehatan Indonesia.

Ministry of Health RI. (2011). Profile of Disease Control and Environmental Health 2010. In Arbovirus Disease Control (page 143). Jakarta: Ministry of Health RI.

Nadesul, H. (2004). 100 Questions + Answers Dengue Fever. Jakarta: Compass.

National Development Planning Agency. (2006). Assessment of Infectious Disease (PLW) Policy for Infectious Diseases Case Study of DHF

Schmidt, W. e. (2011). Population Density, Water Supply, and the Risk of Dengue Fever in Vietnam: Cohort Study and Spatial Analysis. [online] PLoS Medicine. Volume 8 https://doi.org/10.1371/journal.pmed.1001082

Sukamto. (2007). Study of Area Characteristics with Dengue Event in Kecamatan Cilacap Selatan Kabupaten Cilacap. Thesis

Wahyuni, N. I. (2013). environmental sanitation risk factors to the incidence of Dengue Hemorrhagic Fever (DBD) in Limboto Community Health Center of Limboto Sub-district, Gorontalo District. Kim.ung.ac.id