The Effect of District Health Spending on Disease Rates in Sumatra Island

1ESTRO DARIATNO SIHALOHO, 2DONNY HARDIAWAN,

3ACHMAD KAUTSAR 4CITRA KUMALA 5DINDA AYU MAHARANI

 6INSAN LUTFIANA ALFARIZY 7ADIATMA YM SIREGAR

1 2,4,5,6,7 Center for Economics and Development Studies, Department of Economics, Faculty of Economics and Business, Universitas Padjadjaran

3 Department of Economics, Universitas Pertamina

email: 1estro.sihaloho@unpad.ac.id; 2donnyhardiawan@gmail.com;

3achmad.kautsar@universitaspertamina.ac.id; 4 citrakmla@gmail.com;

5 dindayumhrn@gmail.com; 6 insan.lutfiana@gmail.com; 7adiatma.siregar@unpad.ac.id

**Abstract.** This study aims to find the effect of district health spending on disease rates in 131 districts on Sumatra Island in 2016. This study uses 3 multiple linear regression models for three types of diseases namely dengue fever, diarrhea, and tuberculosis. The study finds that higher district health spending seemed to be associated with lower number of dengue fever, diarrhea, and tuberculosis but not significant. This condition can be caused by the inefficient use of district health expenditure. This study finds that the number of health centers has a negative and significant effect on the number of dengue fever, diarrhea, and tuberculosis. Conversely, population and population density have a positive and significant effect on the number of cases of the diseases.

Keywords: distict health spending, disease rates

Introduction

Currently, the amount of health budget varies greatly among countries, with developing countries usually having relatively low share out of the government expenditure (Ke, Saksena, & Holly, 2011). This is an important issue as health budget is one the important factors to overcome various health problems (Göpffarth & Henke, 2013; Martin, Rice, & Smith, 2008). Higher share of health expenditure may result in sustaining more health care workers. Or, et al. (2005) showed that the large number of doctors can improve health. The ratio of doctors to population in developed countries like the United States amounted to 35.67 doctors per 10,000 population in 2016, whereas for developing countries like Indonesia, the ratio of doctors to population was only 4.27 doctors per 10,000 population in 2018 (WHO, 2020). In addition, health assistance by the government to the community is largely important because it can help to ease the burden on the community to take medication (Manton, Gu, & Lamb, 2006). Health budget should be focusing on ensuring that poor people can get access to better health services (Castro-leal et al., 2000). As the country with large number of population, unfortunately Indonesa health spending is relatively low, showed by the proportion of health spending to GDP remains below average among the low-to-middle-income countries about 2.8% of GDP in 2014 according to 2017 WHO dataase (Mahendradhata et al., 2017).

Funds provided by the government are distributed to all provinces in Indonesia in accordance with the number of population and health needs of each province. Unfortunately, provinces do not always effectively use the fund. In 2016, North Sumatra with a population of 14,102,991 people received funds of around Rp.98.6 billion and was only used at 58.40%. The province of South Sumatra with 8,160,901 populations received health funds of around Rp.64.8 billion and was used at 61.59%. While West Sumatra with 5,259,528 populations received approximately Rp.59.4 billion was used 53.84% (Ministry of Health, 2017). Districts in Sumatra Island still have inequality of health spending. In 2016, the highest expenditure was in Batang Hari District at 368 Billion Rupiah and the lowest was in Southeast Aceh District at 4.4 Billion Rupiah with an average health expenditure of 117.6 Billion Rupiah (Ministry of Finance, 2016).

Dengue fever or dengue is an old disease, first recorded in a Chinese encyclopedia published in the Chin Dynasty (265 to 420 AD). However, the Chinese called the disease water poison and related it to flying insects associated with water (Gubler & Clark, 1995). A dengue-like epidemic has also been recorded in Batavia (now Jakarta) as early as 1779, but it was not confirmed to be dengue fever (Carey Donald. E., 1971). The disease has four distinctive virus serotypes (DEN-1, DEN-2, DEN-3, and DEN-4). Infection from one of these four serotypes does not give the person immunity to the other three, so it is possible for a person to have four dengue infections in their lifetime. Typically occurring in the tropics, this disease can produce various clinical illnesses that is heavily dependent on the strain and the serotype of the virus, the age, immune status, and genetic predisposition of the infected (Gubler & Clark, 1995). Dengue fever is a contagious disease and can cause death in a short time. Ministry of Health in 2010 reported that dengue fever sufferers will develop along with population growth and mobility and population density (Siregar, 2004).

Much like dengue fever, diarrhea has been around since medieval times. To pinpoint where it first started is impossible, but epidemics as early as the Plague of Athens, occurring in 430 BC, was characterized by diarrhea. Since then, diarrhea has been a disease that greatly impacts nations and war as late as the 1991 Gulf War (Lim & Wallace, 2004). Even now, diarrhea still accounts for more than 2 million deaths every year (Thielman & Guerrant, 2004). Infectious diarrhea is not caused by a single virus or bacterium. Instead, there are several types of diarrhea: bacterial, viral, and parasitic. Each type of diarrhea has different mechanisms and affect different cellular functions with research still ongoing to understand them, as they require different treatments (Hodges & Gill, 2010). According to Ministry of Health in 2018, diarrhea is a type of disease that can cause death in infants. Diarrhea can also be transmitted quickly through unclean environments and consuming dirty water (Ragil & Dyah, 2017).

Tuberculosis (TB) is a type of infectious disease. The disease caused by the bacterium called Mycobacterium tuberculosis which is able to infect body especially the lungs. WHO reported that the current condition of TB has gotten worse. In 2017, around 1.7 billion of the total population in the world were infected with Mycobacterium tuberculosis (Houben & Dodd, 2016). This disease is included in the category of the nine main causes of death in the world higher than HIV / AIDS. Every year, an average of ten million people worldwide was dead from tuberculosis. Tuberculosis is currently one of the global health problems, especially in developing countries, including in Indonesia (Jamison, Breman, Measham, Alleyne, & Claeson, 2006). Indonesia ranks the second in the category of five countries with the highest number of tuberculosis cases in the world after India. It can be indicated by new tuberculosis cases found in Indonesia in 2016. The tuberculosis incidence in Indonesia is estimated around 360,770 people in 2017, higher than the previous year which reached 351,893 people (Ministry of Health, 2019).

Data of three common diseases in Indonesia (TB, dengue, and diarrhea) showed that cities/districts in Sumarta Island are high (Badan Pusat Statistik, 2017). The average new cases of dengue fever are 221 cases with a total about 29 thousand new cases in all cities/districts on Sumatra Island. The average number of new cases of diarrhea is higher, at 6.9 thousand cases with a total about 905 thousand new cases in all districts on Sumatra Island. While the average of new tuberculosis cases are 363 cases with total about 47 thousand new cases in all cities/districts in Sumatra Island (Badan Pusat Statistik, 2017)

Given the relatively high health budget inequality and number of TB, dengue and diarrhea cases in cities/districts in Sumatra Island, this study aims to analyze the effect of cities/districts health spending on number of diseases cases in respective cities/districts in Sumatra Island.

Methods

This study uses data from 131 cities/districts spread in eight provinces in Sumatra Island, namely Aceh, North Sumatra, West Sumatra, Riau, Jambi, South Sumatra, Bengkulu and Lampung provinces. We compile data from 131 Badan Pusat Statistik of 131 cities/districts. We used multiple linear regression method with robust standard errors. Multiple regression analysis allows us to explicitly control for factors that affect the dependent variable (Wooldridge, 2015). The general multiple linear regression model can be written as

$$y=β\_{0}+β\_{1}x\_{1}+β\_{2}x\_{2}+β\_{3}x\_{3}+…+β\_{k}x\_{k}+u$$

Where $β\_{0}$ is the intercept, $β\_{1}$ is the parameter associated with X1, $β\_{2}$ is the parameter associated with X2, and so on. Meanwhile, $u$ is the error term or disturbance, containing factors that affect y other than $x\_{1}$, $x\_{2}$,…,$ x\_{k}$.

For the general multiple regression model, the key assumption is as follows

$$E\left(x\_{1}, x\_{2},…,x\_{k}\right)=0$$

In this study, following econometric models were used for our estimation, with respective type of disease having its own econometric model:

$$Dengue/diarrhea/ TB cases =β\_{0}+β\_{1}Health budget+β\_{2}Primary Health Care number+β\_{3}Population density +u $$

The OLS estimation in multiple regression are generally affected by outliers, non-normality, multicollinearity, and missing data. Robust regressions provide resistant results in spite of outliers by limiting its influence. A robust regression technique fits a model that describes information in the majority of data, implying that it would work well on datas both with or without outliers(Alma, 2011).

Result and Discussion

The data comprises of 131 districts in 2016. Our data shows that the largest health budget is in the Batang Hari regency at 368 billion rupiah and the smallest health budget is in Aceh Tenggara regency with a little less than 4.5 billion rupiah. On average, the health budget for all districts on the Sumatra Island is about 117.5 billion rupiah. In terms of dengue cases, regions range from one case to 1,144 cases in a region, with each region having 221.8 cases on average. The range is even larger for diarrhea cases, with regions reporting no incidence to 41,834 cases. On average, each region has 6,913 diarrhea cases. The number of TB cases ranges from 20 cases to 3,915 cases with the average of 363 cases.

**Table 1.**

**Descriptive Statistics (N=131 cities/districts)**

|  |  |  |  |
| --- | --- | --- | --- |
| VARIABLES | mean | min | max |
| Health Spending (Billion Rp) | 117.6 | 4.4 | 368.4 |
| Dengue cases  | 221.8 | 1 | 1,144 |
| Diarrhea cases  | 6,913 | 36 | 41,834 |
| TBC cases  | 363.6 | 20 | 3,915 |
| Primary Health Care number | 16.97 | 4 | 39 |
| Population (people) | 362,891 | 33,622 | 2,072,521 |
| Population density (people/km2) | 531.3 | 16 | 5,126 |

Source: (Badan Pusat Statistik, 2017)

The minimum and maximum number of primary health care is 4 and 39, respectively (mean = 16). Population is not spread evenly over the island, as a region only has a population of 33,622 while another has 2 million of population. On average, cities/district in Sumatra Island are populated by 362,891 people. The population density is also vastly different (16 - 5,126 people per km2), with the average of 531 people per km2.

**Table 2.**

**Regression Result of Dengue, Diarrhea, TBC cases**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   |   |  | Dengue cases | Diarrhea cases | TBC cases |
| Health\_Spending | Coef |  | -0.2676677 | -1.50309 | -0.2616673 |
|  | t |  | (-0.70) | (-0.13) | (-0.43) |
| Primary Health Care Number | Coef |  | -7.480666 \*\*\* | -230.8925 \*\*\* | -15.04507 \*\*\* |
|  | t |  | (-2.60) | (-2.60) | (-3.29) |
| Population | Coef |  | 0.0006893\*\*\* | 0.0238466\*\*\* | 0.0014432\*\*\* |
|  | t |  | 9.25 | 10.38 | 12.2 |
| Population density | Coef |  | 0.0267929\* | 1.363839\*\*\* | 0.0122552 \*\* |
|  | t |  | 1.91 | 3.15 | 2.55 |
| F(4,125) |  |  | 37.17 | 44.99 | 61.37 |
| Prob > F |  |  | 0 | 0 | 0 |
| R-squared |  |  | 0.5433 | 0.5901 | 0.6626 |
| Adj R-squared |   |  | 0.5287 | 0.577 | 0.6518 |

 \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table 2 shows that government health expenditure seemed to has a negative effect on the number of dengue fever, diarrhea, and TB cases, although the relationship is not statistically significant. Number of primary health care has negative and statistically significant relation with the number of cases of all diseases, while population and population density has a reversed and statistically significant relation

Government health expenditure is eminently important in overcoming health problems. However, there are many factors influencing the success of the government in using the budget appropriately and overcoming the number of diseases in a region. This study found that there was a negative but not significant relationship between health spending and disease rates. This can be caused by inefficient use of health budgets. Inefficient use of the budget can be caused by corruption and the quality of public institutions that are not optimal (Novignon, 2015). Efficiency improvements can be done by improving the health service system, optimizing the allocation of material resources and enhancing the level of health of financial resource allocation (Liu, Xia, & Hou, 2019). To improve the scale of optimization levels, the government must increase the use of technology (Liu et al., 2019). The increase in scale optimization will accelerate the resolution of health problems in an area. Administrative expenditure is also one of the causes of inefficient health spending. Greater administrative expenses are frequently blamed for lower health care productivity (Garber & Skinner, 2008). Lower health care productivity causes insignificant effects of health spending to reduce the rate of disease in some district.

From the results of the regression for each prevalent disease across 131 different districts on the Sumatra island, it is found that the number of primary health care, the population, and the population density affect the incidence rate of dengue fever, diarrhea, and TBC in each district. From the four variables used as predictors, only the health budget is not significantly affected all three diseases. Taking from a study done in Aceh Besar region, this might be in the execution of the health programs and where the budget is allocated rather than the amount of budget allocated (Murdani & Suherlan, 2014). The efficiency ratio in the health budget is found to be inefficient from 2008-2012. The budget given to the region is not handled well with some money lost due to corruption as well as suboptimal planning. The money is used, but the results are not optimum.

 Another study done in West Sumatra cited that the lack of budget management training as well as the weak coordination between stakeholders made it ineffective (Kani, Herawati, & Trisnantoro, 2012). The planning does not involve the primary health care as the primary health care provider. Therefore, the execution and the budget for several programs in the primary health care clash with each other. The planned budget made by the West Sumatra Public Health Office is constantly revised by the budgeting team because of budgeting limitations. The budget realization for the 2006, 2007, and 2008 health budget is fairly low. From these two studies, we can conclude that the budget realization is low because of poor planning and budget limitations. Yet, when this budget is realized, it’s not used effectively.

The number of primary health care in each district has a negative relationship with the amount of cases found, all significant at 1% significance level. On average, one public health center reduces the number of dengue fever by 7 cases, diarrhea by 230 cases, and TBC by 15 cases. The Minister of Health Decree No. 128 Year 2004 about the basic policy of Public Health Center state that the ideal ratio between the number of public health center and population of a region is ideally 1:30,000 but the development has been hindered by the lack of monitoring and faulty execution (Winarno et al., 2013). In accordance to the decree, this primary health care does not only provide healthcare, but also information on hygiene and healthy living. More primary health cares make shorter lines and easier access for those living in rural areas, motivating individuals to seek health advice instead of ignoring minor diseases such as diarrhea that may be more serious than it seems.

Population influences the spread of TBC, diarrhea, and dengue fever in some way. As seen from a study in North Minahasa region (Faldy, Kaunang, & Pandelaki, 2015), the more populous districts (Kauditan, Airmadidi, and Kalawat) all have the highest incidence of dengue fever. The same case happens in TBC occurrence Jombang region, with the more populous districts having a greater number of cases. Similarly, the most populous district in Bandung city also has the most occurrence of diarrhea (Bertho Tantular, Ruslaela, Jaya, & Zulhanif, 2018). More populous regions pose the risk of dense neighborhoods, increasing the risk of infection spreading among the neighborhoods. This seems to be in line with findings on population density and its link to the spread of TBC, diarrhea, and dengue fever.

For the relationship between population and the number of dengue fever, diarrhea, and TBC cases found, the results are positive. The results mean that the more population a district has, the more cases of diarrhea, dengue fever, and TBC they will have. This is significant at 1% and in line with the previously mentioned studies where more populous areas tend to have more incidence of dengue fever, diarrhea, and TBC (Faldy et al., 2015; Pratama & Wulandari, 2015; Bertho Tantular et al., 2018). More populous areas generally have dense housing that may speed up the spread of the disease, on top of unfavorable living conditions. Thus, we cannot take away the issue of population from density.

From the regression results, the effect of population density is significant but positive at different levels for each disease. Diarrhea, which is highly related to hygiene in one’s neighborhood, is at 1% significant level. As a disease, diarrhea spreads very fast in a short time and it’s heavily dependent on health behaviors as well as sanitation. Neighborhoods can influence an individual’s health habits (Diez-Roux et al., 2017) and a neighborhood without a proper toilet may put the whole neighborhood at risk (Boadi & Kuitunen, 2002; Kamilla, Suhartono, & W, 2012). The results are in line with precious research using population density to predict the risk of diarrhea incidence in Bandung city (Berto Tantular, Nurfauziyah, Jaya, & Zulhanif, 2007).

This is followed by TBC which is significant at 5%. Denser population mean more people live in small unventilated houses that has little to no sunlight exposure, a perfect place for TBC to breed. An overcrowded house also means easier transmission between household members. Another factor that may influence is that individuals in overcrowded housing are more likely to have risk factors that progress TB infections to disease (M. Clark, Riben, & Nowgesic, 2002). Meanwhile, the effect of population density to the incidence of dengue fever is significant at 10%. Dengue fever occurs in clusters in populated areas, making it easier to spread in dense neighborhoods (Kusuma & Sukendra, 2016).

**The Economic Side**

Most studies on the impact of dengue fever to the economy have focused on single epidemics without considering the burden of the disease on the population and thus tend to underestimate the true economic impact of dengue fever (Gulber, 2002). A study of treated dengue cases in Puerto Rico from 2002 to 2010 found that the overall annual cost of dengue was US$46.45 million (Halasa, Shepard, & Zeng, 2012). The study also found that household bears the largest burden in the economic cost of dengue (48%) compared to the government (24%) and insurance (22%). Another study sought to measure the economic impact of dengue at the family level in Thailand and found that there is a financial loss of US$61 for every family (D. V. Clark, Mammen, Nisalak, Puthimethee, & Endy, 2005). Both the aforementioned studies account for the opportunity cost that may arise from dengue fever.

To find the overall impact of diarrhea on the economy is impossible as diarrhea has different causes and is often a symptom of a more serious disease. However, to find the impact of specific types diarrhea is still possible. Rotavirus diarrhea, a type of viral diarrhea that heavily affects children, is estimated to cause around 454,000 to 705,000 deaths in children from 2000 to 2004 (Parashar, Gibson, Bresee, & Glass, 2006). In Taiwan, rotavirus-associated hospital admission costs US$10.4 million for hospital costs with an additional $13.3 million social cost annually (Chen et al., 2007). Diarrhea caused by the same virus impose US$271.4 million in annual direct cost, US$365.0 million in annual social cost, and US$ 290.0 in annual private cost in eastern China (Jin et al., 2011).

The economic impact of tuberculosis does not only come from the size of the problem, but also that the majority of disease and death in developing countries occur in the most economically active segment of the population (Ahlburg, 2000). A study in the Philippines found that the economic loss due to premature mortality and morbidity caused by tuberculosis is approximately US$145 million. Meanwhile, the cost of treating the cases are between US$8 to US$29 million annually (Peabody, Shimkhada, Tan, & Luck, 2005). In Indonesia, the total economic burden of treated and untreated cases add up to US$6.9 billion, with loss of productivity from premature death being the biggest portion at US$6.0 billion (Collins, Hafidz, & Mustikawati, 2017). Tuberculosis also affect economic growth, corresponding to an annual loss of US$1.4 to 2.8 billion worldwide (Grimard & Harling, 2005).

**Conclusion**

Economic losses due to disease like dengue fever, diarrhea, and tuberculosis are very high. Therefore, the government must use various policies to overcome the problem of existing diseases in the community. This research shows that health spending is still not a significant effect in reducing the number of dengue fever, diarrhea, and tuberculosis in Sumatera Island districts. This is due to inefficient use of the health budget caused by corruption, the quality of institutions, and administrative spending that is too high. For this reason, the government needs to improve the efficiency of using the health budget. The government can increase the number of health services such as primary health care because it has a positive and significant effect in reducing the number of dengue fever, diarrhea, and tuberculosis. The study also found that population and population density actually increase dengue fever, diarrhea, and tuberculosis rates. The government must control birth rates to reduce population growth and encourage transmigration to reduce population density.

**References**

Ahlburg, D. A. (2000). *The Economic Impacts of Tuberculosis*.

Alma, Ö. G. (2011). Comparison of Robust Regression Methods in Linear Regression. *Int. J. Contemp. Math. Sciences*, *6*(9), 409–421.

Badan Pusat Statistik. (2017). *Statistik Indonesia*.

Boadi, K. O., & Kuitunen, M. (2002). Childhood diarrheal morbidity in the Accra Metropolitan Area, Ghana: Socio-economic, environmental and behavioral risk determinants, (January 2016). https://doi.org/10.12927/whp.2005.17646

Carey Donald. E. (1971). Chikungunya and dengue: a case of mistaken identity? *Journal of the History of Medicine and Allied Sciences*, *26*(3), 243 – 262.

Castro-leal, F., Castro-leal, F., Dayton, J., Dayton, J., Demery, L., Demery, L., … Mehra, K. (2000). Public spending on health care in Africa: do the poor benefit? *Bulletin of the World Health Organization*, (0201), 9.

Chen, K. T., Fan, S. F., Tang, R. Bin, Huang, Y. F., Lee, P. I., Chen, P. Y., … Chen, H. C. (2007). Hospital-based study of the economic burden associated with rotavirus diarrhea in Taiwan. *Vaccine*, *25*(21), 4266–4272. https://doi.org/10.1016/j.vaccine.2007.02.056

Clark, M., Riben, P., & Nowgesic, E. (2002). The association of housing density, isolation and tuberculosis in Canadian First Nations communities. *International Journal of Epidemiology*, *31*(5), 940–945. https://doi.org/10.1093/ije/31.5.940

Clark, D. V., Mammen, M. P., Nisalak, A., Puthimethee, V., & Endy, T. P. (2005). Economic impact of dengue fever/dengue hemorrhagic fever in Thailand at the family and population levels. *American Journal of Tropical Medicine and Hygiene*, *72*(6), 786–791. https://doi.org/10.4269/ajtmh.2005.72.786

Collins, D., Hafidz, F., & Mustikawati, D. (2017). The economic burden of tuberculosis in Indonesia. *International Journal of Tuberculosis and Lung Disease*, *21*(9), 1041–1048. https://doi.org/10.5588/ijtld.16.0898

Diez-Roux, A. V., Javier Nieto, F., Muntaner, C., Tyroler, H. A., Comstock, G. W., Shahar, E., … Szklo, M. (2017). Neighborhood Environments and Coronary Heart Disease: A Multilevel Analysis. *American Journal of Epidemiology*, *185*(11), 1187–1202. https://doi.org/10.1093/aje/kwx113

Faldy, R., Kaunang, W. P. J., & Pandelaki, A. J. (2015). Pemetaan Kasus Demam Berdarah Dengue di Kabupaten Minahasa Utara. *Jurnal Kedokteran Komunitas Dan Tropik*, *3*(2), 73–81.

Garber, A. M., & Skinner, J. (2008). Is American health care uniquely inefficient? In *Journal of Economic Perspectives*. https://doi.org/10.1257/jep.22.4.27

Göpffarth, D., & Henke, K. D. (2013). The German Central Health Fund-Recent developments in health care financing in Germany. *Health Policy*, *109*(3), 246–252. https://doi.org/10.1016/j.healthpol.2012.11.001

Grimard, F., & Harling, G. (2005). The Impact of Tuberculosis on Economic Growth. https://doi.org/10.1111/j.1536-7150.1957.tb00182.x

Gubler, D. J., & Clark, G. G. (1995). Dengue/dengue hemorrhagic fever: the emergence of a global health problem. *Emerging Infectious Diseases*, *1*(2), 55–57. https://doi.org/10.3201/eid0102.952004

Gulber, D. J. (2002). Epidemic dengue/dengue hemorrhagic fever as a public health, social and economic problem in the 21st century. *Trends in Microbiology*, *10*(2), 100–103.

Halasa, Y. A., Shepard, D. S., & Zeng, W. (2012). Economic cost of dengue in Puerto Rico. *American Journal of Tropical Medicine and Hygiene*, *86*(5), 745–752. https://doi.org/10.4269/ajtmh.2012.11-0784

Hodges, K., & Gill, R. (2010). Infectious diarrhea: Cellular and molecular mechanisms. *Gut Microbes*, *1*(1), 4–21. https://doi.org/10.4161/gmic.1.1.11036

Houben, R. M. G. J., & Dodd, P. J. (2016). The Global Burden of Latent Tuberculosis Infection: A Re-estimation Using Mathematical Modelling. *PLoS Medicine*, *13*(10), 1–13. https://doi.org/10.1371/journal.pmed.1002152

Jamison, D. T., Breman, J. G., Measham, A. R., Alleyne, G., & Claeson, M. (2006). *Disease Control Priorities in Developing Countries*. *Disease Control Priorities in Developing Countries (2nd Edition)*. https://doi.org/10.1596/978-0-8213-6179- 5

Jin, H., Wang, B., Fang, Z., Duan, Z., Gao, Q., Liu, N., … Wu, Q. (2011). Hospital-based study of the economic burden associated with rotavirus diarrhea in eastern China. *Vaccine*, *29*(44), 7801–7806. https://doi.org/10.1016/j.vaccine.2011.07.104

Kamilla, L., Suhartono, & W, N. E. (2012). Hubungan Praktek Personal Hygiene Ibu dan Kondisi Sanitasi Lingkungan Rumah dengan Kejadian Diare pada Balita di Puskesmas Kampung Dalam Kecamatan Pontianak Timur The Relationship of Maternal Personal Hygiene and Housing Environmental Sanitation to Pontia. *Jurnal Kesehatan Lingkungan Indonesia*, *11*(2).

Kani, A., Herawati, D. M. D., & Trisnantoro, L. (2012). Evaluasi Perencanaan dan Penganggaran Dinas Kesehatan Kabupaten Pesisir Selatan Provinsi Sumatera Barat. *Jurnal Manajemen Pelayanan Kesehatan*, *15*(03), 131–139.

Ke, X., Saksena, P., & Holly, A. (2011). The determinants of health expenditure: a country-level panel data analysis. *Geneva: World Health Organization*, *26*.

Kusuma, A. P., & Sukendra, D. M. (2016). Analisis Spasial Kejadian Demam Berdarah Dengue Berdasarkan Kepadatan Penduduk. *Unnes Journal of Public Health*, *5*(1), 48. https://doi.org/10.15294/ujph.v5i1.9703

Lim, M. L., & Wallace, M. R. (2004). Infectious diarrhea in history. *Infectious Disease Clinics of North America*, *18*(2), 261–274. https://doi.org/10.1016/j.idc.2004.01.006

Liu, W., Xia, Y., & Hou, J. (2019). Health expenditure efficiency in rural China using the super-SBM model and the Malmquist productivity index. *International Journal for Equity in Health*. https://doi.org/10.1186/s12939-019-1003-5

Mahendradhata, Y., Trisnantoro, L., Listyadewi, S., Soewondo, P., Marthias, T., Harimurti, P., & Prawira, J. (2017). The Republic of Indonesia health system review. *Health Systems in Transition*, *7*(1).

Manton, K. G., Gu, X. L., & Lamb, V. L. (2006). Change in chronic disability from 1982 to 2004/2005 as measured by long-term changes in function and health in the U.S. elderly population. *Proceedings of the National Academy of Sciences of the United States of America*, *103*(48), 18374–18379. https://doi.org/10.1073/pnas.0608483103

Martin, S., Rice, N., & Smith, P. C. (2008). Does health care spending improve health outcomes? Evidence from English programme budgeting data. *Journal of Health Economics*, *27*(4), 826–842. https://doi.org/10.1016/j.jhealeco.2007.12.002

Menteri Kesehatan Republik Indonesia. Keputusan Menteri Kesehatan Republik Indonesia Nomor 128 Tahun 2004 (2004). https://doi.org/10.1016/0021-9924(94)90039-6

Ministry of Health. (2017). *Data dan Informasi Profil Kesehatan Indonesia*. Jakarta.

Ministry of Health. (2019). *Profil Kesehatan Indonesia 2018*.

Murdani, & Suherlan, A. (2014). Analisis Efektivitas Dan Efisiensi Penyerapan Anggaran Pendidikan Dan Kesehatan Dalam Apbd Kabupaten Aceh Besar Pada Periode 2008-2012. *Signifikan: Jurnal Ilmu Ekonomi*, *3*(2), 127–148. https://doi.org/10.15408/sigf.v3i2.2057

Novignon, J. (2015). On the efficiency of public health expenditure in Sub-Saharan Africa: Does corruption and quality of public institutions matter? *Munich Personal RePEc Archive*, (39195), 1–21. Retrieved from https://mpra.ub.uni-muenchen.de/39195/2/MPRA\_paper\_39195.pdf

Or, Z., Wang, J., & Jamison, D. (2005). International differences in the impact of doctors on health: A multilevel analysis of OECD countries. *Journal of Health Economics*, *24*(3), 531–560. https://doi.org/10.1016/j.jhealeco.2004.09.003

Parashar, U. D., Gibson, C. J., Bresee, J. S., & Glass, R. I. (2006). Rotavirus and severe childhood diarrhea. *Emerging Infectious Diseases*, *12*(2), 304–306. https://doi.org/10.3201/eid1202.050006

Peabody, J. W., Shimkhada, R., Tan, C., & Luck, J. (2005). The burden of disease, economic costs and clinical consequences of tuberculosis in the Philippines. *Health Policy and Planning*, *20*(6), 347–353. https://doi.org/10.1093/heapol/czi041

Pratama, W., & Wulandari, S. P. (2015). Pemetaan dan Pemodelan Jumlah Kasus Penyakit Tuberculosis ( TBC ) di Provinsi Jawa Barat dengan Pendekatan Geographically Weighted Negative Binomial Regression, *4*(1), 37–42.

Ragil, D. W., & Dyah, Y. P. (2017). Jurnal of Health Education HUBUNGAN ANTARA PENGETAHUAN DAN KEBIASAAN MENCUCI TANGAN PENGASUH DENGAN KEJADIAN DIARE PADA BALITA Info Artikel. *Jhe*, *2*(1), 39–46.

Siregar, F. A. (2004). Epidemiologi Dan Pemberantasan Demam Berdarah Dengue Diindonesia Di Indonesia. *USU Digital Library*, 1–13.

Tantular, Bertho, Ruslaela, E., Jaya, I. G. N. M., & Zulhanif. (2018). PEMETAAN PENYAKIT DIARE DI KOTA BANDUNG DENGAN ANALISIS LOCAL MORAN ’ S. In *Seminar Statistika FMIPA Unpad 2018 (SNS VII)*.

Tantular, Berto, Nurfauziyah, S., Jaya, I. G. N. M., & Zulhanif. (2007). Pemodelan resiko relatif penyakit diare di kota bandung dengan regresi spasial.

Thielman, N. M., & Guerrant, R. L. (2004). Acute infectious diarrhea. *The New England Journal of Medicine*, *350*, 38–47. https://doi.org/10.1017/CBO9780511547454.016

WHO. (2020). Medical Doctor (per 10000 population).

Winarno, K., Hasanbasri, M., Sunjaya, D. K., Kesehatan, D., Kalimantan, P., Studi, P., … Kesehatan, P. (2013). Evaluasi Kebijakan Pembangunan Puskesmas Pembantu di Propinsi Kalimantan Tengah. *Jurnal Kebijakan Kesehatan Indonesia*, *02*(02), 86–94.

Wooldridge. (2015). *Introductory Econometrics* (Vol. 1). https://doi.org/10.1017/CBO9781107415324.004