56-Determinants of health complaints on bodetabek commuter workers using bayesian multilevel logistic regression

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ABSTRACT: Commuting cannot be separated from worker's routine. By doing this mobility, workers can obtain some benefits such as getting higher wages from the city and lower living cost in the suburbs. However, these benefits must be paid by disruption of commuter worker's health. This poor health condition will harm the company and commuter itself. This study aims to determine the variables that affect health complaints on commuter workers from Bogor, Depok, Tangerang, and Bekasi (Bodetabek) to Jakarta. Data was obtained from 2014 Jabodetabek Commuter Survey. The data used in this study has a hierarchical structure because selected by Two-Stage Sampling. Hierarchical structured data is more appropriate when analyzed using multilevel logistic regression. The limited units at the level two causes the Bayesian method must be used in parameter estimation. The results show that commuting distance, commuting time, commuting mode, stress due to travel, traffic congestion, education level, and employment status are important factors that affect health complaints of Bodetabek commuter workers. Thus, government is expected to improve the quality of public transportation services in terms of convenience, timeliness, ease of access, and low cost especially for commuters.

1 INTRODUCTION

Number of commuters have increased, especially in metropolitan region, such as Jabodetabek (Jakarta, Bogor, Depok, Tangerang, and Bekasi). Jabodetabek has the highest rate of commuters among metropolitan regions in Indonesia (Handiyatmo, 2009). According to the Central Statistics Agency of Indonesia as known as Badan Pusat Statistik (BPS), the pattern of commuter movement in metropolitan regions is to go to the center of the area in the morning and return to the suburbs in the afternoon and evening (BPS, 2009). This condition also happens in Jabodetabek region. Commuters in this region is dominated by commuters from Bodetabek (Bogor, Depok, Tangerang and Bekasi) who conduct activities in the center of the region, namely Jakarta.

As the capital of the country, Jakarta not only becomes the government center but also economic center of Indonesia. It has an impact on the more rapid development in Jakarta than other regions in Indonesia. The various advantages offered by Jakarta have become the main attraction for migrants from various regions in Indonesia. The increase of migrants entering Jakarta year by year will cause limited residential land. The unreacheable land price and high living costs in Jakarta, ultimately encourage residents who originally live in Jakarta and also the migrants to find cheaper housing outside Jakarta.

However, the large number of Jakarta residents who moved out of Jakarta was not accompanied by their workplaces shift. The dependence of people's lives in the outskirts of Jakarta which is Bodetabek has caused shuttle mobility (Warsida et al., 2013) which is to go to Jakarta and return to the outskirts of Jakarta on the same day. People who do shuttle mobility are known as commuters.

Commuting has become a regular part of daily routine of most workers (Wener & Evans, 2011a). This mobility is dominated by residents whose main activity is working. Based on data from the 2005 Intercensal Population Survey (SUPAS), it is known that 73.85 percent of commuters in Indonesia is working (BPS, 2010). Handiyatmo (2009) mentioned that working was the main commuter activity in Jabodetabek reached

75.60 percent.

The existence of commuter workers can provide benefits for the city, suburbs, and commuter itself. For the city, the existence of commuters will not add the population administratively (BPS, 2009). It will not increase population density in the city. The suburb's economy will be growing with the existence of commuters who living there (BPS, 2014). In addition, higher wage rates in the city accompanied by the lower cost of living in suburbs will provide benefits for commuter workers (BPS, 2013).

But on the other hand, the expected benefits of commuting must be paid by disruption of commuter workers' health conditions. Physical and mental burdens caused by commuting can trigger health complaints (Urhonen et al., 2016). Commuting can cause health complaints, such as cold or flu, chest pain, affect mood related to job satisfaction, and work absence because of illness (Novaco et al., 1990). In addition, commuting is also associated with health complaints such as increased blood pressure, cardiovascular problems, stroke, back pain, hernia, stomach pain, and visual impairment (Koslowsky et al., 1995).

Health complaints experienced by commuter workers can harm the company where they work. Poor health conditions will decrease the performance of workers and cause loss of productivity. Productivity lost due to poor performance is greater than workers leave due to illness (Kirsten, 2010). It can also reduce the quality and quantity of work output that can be completed. This will have an impact on the income earned by the company. In addition, health complaints experienced by commuter workers will also trigger additional expenditure for medical treatment. The commuter will lose income which should be allocated to other needs.

Based on the negative impacts arising from health complaints experienced by commuter workers, it is necessary to conduct a study to analyze the health complaints of Bodetabek commuter workers. The focus of this research is commuter workers. According to Handiyatmo (2009) commuter in the Jabodetabek region are dominated by commuters with the main activities is working. So that the commuter group that will be most affected by the negative influence of commuting is commuter workers. Commuter workers in this study are focused only on commuter workers from Bodetabek area and work in Jakarta area (live in Bodetabek area but work in Jakarta area). It is also necessary to consider contextual factors in analyzing the relationship between the characteristics of travel and commuter health (Hansson et al., 2011). Therefore, this study aims to determine variables that affect health complaints on commuters Bodetabek. The results of this study are expected to be taken into consideration in formulating a policy development in the Jabodetabek metropolitan region.

2 METHOD

The data used in this study is from the 2014 Jabodetabek Commuter Survey. This survey is the only BPS survey (until now) that specifically gathers the characteristics of commuters with regional coverage in 13 regencies/municipalities, which is South Jakarta City, East Jakarta City, Central Jakarta City, West Jakarta City, North Jakarta City, Bogor Regency, Bogor City, Depok City, Tangerang Regency, Tangerang City, South Tangerang City, Bekasi Regency, and Bekasi City.

The sample is selected with the Two Stages Sampling method. In the first stage, census blocks for each stratum are selected using Systematic Proportional to Size (PPS), with the size used is the number of population aged 15 years and over who work. Then in the second stage, 10 sample households were taken from each census block using systematic sampling. The survey included 13,120 sample households out of a total of 1,312 census blocks. This study focuses on individuals aged 15 years and over who work and routinely commute from Bodetabek area to Jakarta area, and the final sample analyzed are 1922 commuter workers.

The response variable used in this study is health complaints experienced by commuter workers. This variable is a dichotomous, divided into two categories as follows: commuter workers who do not experience health complaints (as references) and commuter workers who experience health complaints. Based on the definition used by BPS, experiencing health complaint is defined as the condition where commuter workers

have experienced at least one of health complaints such as fever, cough, headache, sore throat, eye pain, shortness of breath or asthma, colds, aches, or other complaints in the last 30 days.

The explanatory variables used in this research are commuting distance, commuting time, main commuting mode, stress due to travel, severe congestion, education level, employment status, and growth rate of Gross Regional Domestic Product (GRDP). Commuting distance is obtained from the answer of question "distance traveled from place of residence to the place of activity (in minutes)". This variable is categorized into two categories: less than or equal to 30 km and more than 30 km. According to the study conducted by Kageyama et al. (1998), we categorized commuting time into three categories: below 60 minutes, 60-90 minutes, and 90 minutes or more. Main commuting mode is mode of transportation commonly used to go to the place of activity. We categorized main commuting mode into four groups: two-wheel vehicle, car, train, and bus & minibus. Stress due to travel is obtained from the answer of question: "do you feel stress due to travel from and to the place of activity?" Severe congestion is obtained from the question: "have you ever experienced severe congestion?" Education level was categorized into two categories: senior high school or less and higher than senior high school. We categorized employment status into informal and formal status.

The relationship between the characteristics of commuter workers and health complaints can also be influenced by the characteristics of the regency/municipality where the commuter workers live. A high GRDP growth rate in an area will affect population consumption of commodities that can support health. In addition, the government can also increase spending in the health sector, which includes the provision of health facilities, health workers, and improve transportation facilities to reach these health facilities

The data used in this study has a hierarchical structure because the sample is selected by multistage sampling method, where the first level (level 1) is individual level (commuter workers). Then the second level (level 2) is the area where the commuter workers live (regency/municipality). Multistage sampling causes observation at the individual level not entirely independent (Hox, 2010). A violation of the assumption of independence will generate underestimation of standard error and the estimation would be spurious (Hox, 2010). Therefore, the multilevel regression model will be more appropriately used to accommodate violations of this assumption. Because of the dependent variable in this study is dichotomous, a multilevel binary logistic regression model will be used. If there is an N unit at level 2, then on unit *j* of level 2 (*j* = 1, 2, ..., N) there will be n_j units at level 1. So that the multilevel binary logistic regression model with random intercept can be stated as follow:

$$logit(P_{ij}) = \gamma_{00} + \sum_{h=1}^{p} \gamma_{h0} x_{hij} + \sum_{k=1}^{q} \gamma_{0k} z_{kj} + U_{0j} \quad (1)$$

Where P_{ij} is probability of experiencing health complaints for the commuter worker *i* at level 1 in the regency/municipality *j*. The γ_{00} is fixed intercept or population mean, γ_{h0} is fixed effect of explanatory variable at level 1, γ_{0k} is fixed effect of explanatory variable at level 2, x_{hij} is the explanatory variable *h* for the commuter worker *i* at level 1 in regency/municipality *j*, z_{kj} is the explanatory variable *k* for regency/municipality *j*, and U_{0j} is random deviation from mean for regency/municipality *j* at level 2. The U_{0j} is assumed that they are a normal distribution with mean 0 and variance τ_0^2.

Level 2 units in this study are regencies/municipalities in Bodetabek area, and there are 8 regencies/municipalities for level 2 units. Parameter estimation using maximum likelihood when level 2 units less than 20 units will produce a large bias (Stegmueller, 2013). Solving this problem, the Bayesian approach is applied in parameter estimation. This approach can produce an estimator with lower bias than the maximum likelihood approach (Stegmueller, 2013). According to Box & Tiao (1973), Bayes Theorem can be stated as follow:

$$p(\boldsymbol{\theta}|\boldsymbol{y}) = \frac{p(\boldsymbol{y}|\boldsymbol{\theta})p(\boldsymbol{\theta})}{p(\boldsymbol{y})} \quad (2)$$

In Equation 2, $p(\boldsymbol{\theta})$ states the prior distribution of $\boldsymbol{\theta}$, related to what is known about $\boldsymbol{\theta}$ without previous information of data distribution. Then, $p(\boldsymbol{y}|\boldsymbol{\theta})$ shows a conditional distribution that contains information of the data, while $p(\boldsymbol{\theta}|\boldsymbol{y})$ expresses the posterior distribution of $\boldsymbol{\theta}$ if $\boldsymbol{y}$ is known, related to what is known about $\boldsymbol{\theta}$ with previous information about data (Box & Tiao, 1973). In Bayesian approach, each unknown parameter was assumed to follow a particular distribution, called prior distribution (Browne, 2017). Prior distribution and likelihood function of observed data will be combined to form a posterior distribution (Browne, 2017).

When the posterior distribution was difficult to derive mathematically, it was approximated using Markov Chain Monte Carlo (MCMC) (Hox, 2010). MCMC is a simulation technique that can generate random samples from a complex posterior distribution. Through a large number of simulated random samples, it will be possible to calculate the posterior mean, standard deviation, density plot, and quintiles of this distribution (Browne, 2017). In Bayesian MCMC approach, to test the model fit (goodness of fit), we can compare the Deviance Information Criterion (DIC) from each model.

$$DIC = \overline{D} + pD \tag{3}$$

where $\overline{D}$ = average of deviance from all iteration; pD = effective number of parameters.

We can calculate DIC by adding the average of deviance from all iteration ($\overline{D}$) with the effective number of parameters (pD). The smaller the DIC of a model, the more fit the model. This study also calculates the Intraclass Correlation Coefficient (ICC) from the two-level null model. The ICC indicates the proportion of variance explained by the existence of a hierarchical structure. Many researchers use the uninformative prior, because this prior will not affect the posterior distribution formed (Hox, 2010). In this study, we use 5 percent significance level. When the p-value less than 0.05, it considered statistically significant.

3 RESULT AND DISCUSSION

3.1 *Heath complaint according to commuter workers characteristic*

In general, there are 64.7 percent of Bodetabek commuter workers (who work in Jakarta area) who experience health complaints. Table 1 shows the percentage of a health complaints according to the characteristic of commuter workers. The percentage of commuter workers who experienced health complaints is higher in the group of workers who commute more than 30 km compared to those who commute 30 km or less, reached 71.7 percent. Commuter workers who commute for more than 90 minutes have the highest percentage of health complaints (68.1%) compared by shorter commuting duration.

Two-wheeled vehicles have the highest percentage for commuter workers who experience health complaints, reached 70.2 percent, compared by other main commuting mode. Commuter workers who experience stress due to travel have a higher percentage of health complaints, reached 78.4 percent. The percentage of experiencing health complaints in commuter workers who have experienced severe congestion (67.1%) is higher than workers who have never experienced severe congestion (55%).

Commuter workers with lower levels of education have a higher percentage of health complaints (71.3%) compared to commuter workers with a higher level of education (56.7%). Commuter workers working in the informal sector have a higher percentage of health complaints (81.4%) than those working in the formal sector (63.5%).

Table 1. Percentage of health complaints according to the characteristics of commuter workers

Commuter workers characteristics		Health complaint	
		Not experience	Experience
Commuting distance	≤ 30 km	38.5	61.5
	> 30 km	28.3	71.7
Commuting time	<60 minutes	33.2	66.8
	60-90 minutes	41.5	58.5
	≥ 90 minutes	31.9	68.1
Main commuting mode	Two wheels	29.8	70.2
	Car	51.4	48.6
	Train	34.4	65.6
	Bus & Minibus	38.8	61.2
Stress due to travel	Not stress	43.9	56.1
	Stress	21.6	78.4
Experiencing severe congestion	Never	45.0	55.0
	Ever	32.9	67.1
Education level	Senior high school or less	28.7	71.3
	Higher than senior high school	43.3	56.7
Employment status	Informal	18.6	81.4
	Formal	36.5	63.5

Source: BPS, 2014 Jabodetabek Commuter Survey

3.2 *Model selection and ICC*

Base on the Table 2, the DIC for a one-level null model binary logistic regression is 2530.58. Null model or empty model is a model that does not contain explanatory variables. In the first step, by comparing the DIC of one-level null model with two-level null model, we can conclude that DIC has decreased from 2530.58 to 2394.49. It indicates the two-level regression model with random effects more appropriate to be used. In the next step, we compare the DIC null two-level binary logistic regression model with the two-level DIC conditional model. Conditional model is a model that include all explanatory variables. Base on table 2, the two-level null model DIC is greater than the two-level DIC conditional model. Thus, it can be concluded that a two-level binary logistic regression model containing all explanatory variables is more appropriate to be used to analyze health complaints on Bodetabek commuter workers.

Table 2. Comparison of DIC for each model formed

Model formed	Bayesian Deviance Information Criterion (DIC)			
	Dbar	D(thetabar)	pD	DIC
One level null model	2529.58	2525.58	1.00	2530.58
Two level null model	2386.97	2379.46	7.51	2394.49
Two level conditional model	2224.90	2207.49	17.41	2242.32

3.3 *Determinant of health complaint on Bodetabek commuter workers*

As shown in Table 3, the Intraclass Correlation Coefficient (ICC) is 12.57 percent, which means that the diversity of health complaints for commuter workers in Bodetabek caused by differences in regency/municipality characteristics is 12.57 percent. The ICC value of 12.57 percent also means that the correlation between individuals in the same regency/municipality is 0.1257.

Based on the p-value column of Table 3, commuter workers in Bodetabek area who have commuting distance more than 30 km and commuting time 60-90 minutes, use a car and bus/minibus, experience stress due to travel, ever experience severe congestion, have a higher-education level, and work in the formal sector significantly affect their health complaint experienced.

Table 3. Estimation of parameters, standard error, p-value, and odds ratio for each explanatory variable

Explanatory variables	Two level null model		Two level conditional model			
	Estimate	SE	Estimate	SE	p-value	OR
Cons	0.793	0.273	0.541	1.516		
Level-one explanatory variables						
Commuting distance						
≤ 30 km (ref.)						
>30 km			0.427	0.140	0.002*	1.533
Commuting time						
< 60 minutes (ref.)						
60-90 minutes			-0.458	0.150	0.002*	0.632
≥ 90 minutes			-0.221	0.154	0.151	0.802
Main commuting mode						
Two wheels (ref.)						
Car			-1.003	0.152	0.000*	0.367
Train			-0.179	0.172	0.298	0.836
Bus & minibus			-0.494	0.165	0.003*	0.610
Stress due to travel						
Not stress (ref.)						
Stress			0.867	0.120	0.000*	2.379
Experiencing severe congestion						
Never (ref.)						
Ever			0.623	0.141	0.000*	1.864
Education level						
Senior high school or less (ref.)						
Higher than enior high School			-0.371	0.112	0.001*	0.690
Employment status						
Informal (ref.)						
Formal			-0.688	0.264	0.009*	0.503
Level-two explanatory variable						
Growth rate of GRDP			0.106	0.241	0.660	1.112
Variance of error at level 2	0.473	0.431	0.372	0.341		
ICC	0.1257					
Deviance (MCMC)	2386.97		2224.90			

Source: BPS, 2014 Jabodetabek Commuter Survey

*p-value < 0.05; (ref.) is reference category; OR is Odds Ratio.

At a 5 percent significance level, the growth rate of GRDP has no significant effect on the health complaints experienced by commuter workers in Bodetabek area. GRDP growth will trigger income increase, so it will make it the residents access health services for treatment easier. But the income increase will be in vain if the population's awareness of health is still low. In general, someone will seek treatment at a health facility when the health complaints experience have disrupted their daily activities. The research data shows that 71.9 percent of commuter workers who experienced health complaints states that their daily activities were not interrupted and make them have low motivation to go to a health facility.

The other reason is there is no difference between the commuters with high or low GRDP growth rate in terms of the use of transportation modes. Commuter workers from regions with higher GRDP growth rates such as South Tangerang City and Depok City have similarities of preferring two-wheeled vehicles as well as workers from lower GRDP growth rates regions such as Tangerang City and Tangerang Regency.

This shows that the increase of income reflected by GRDP growth does not make a difference in the choice of transportation modes, even though the choice of modes can affect the health condition of commuters.

Commuter workers who travel across more than 30 km are 1.5 times more likely to experience health complaint compared to those who travel across 30 km or less. The farther of commuter trip, the more likely the commuter faces heavy traffic with high-stress levels. Stress levels were positively associated with physiological complaints such as high blood pressure (Hoehner et al., 2012). Commuter workers who have commuting time between 60-90 minutes are less likely (OR = 0.632) to experience health complaint as compared to those who commute less than 60 minutes. This finding is consistent with evidence from study conducted in Kent and Medway that found commuters who traveled more than 45 minutes reported better health than commuters who traveled less than 45 minutes (Lyons & Chatterjee, 2008).

Commuter workers who commute using a car and bus/minibus are less likely to experience health complaint as compared to those who commute using two wheels. The odds ratio for those using cars and bus/mini bus is less than one, which indicates that commuter workers who use two-wheeled vehicles are more likely to experience health complaints. This happened because those who commute using on-roadway mode like two-wheeled vehicles will be exposed to particulate matter (PM) pollution especially $PM_{2.5}$ with higher concentration as compared with in-cabin mode like car, train, and bus/minibus (Wu et al., 2013).

Commuter workers who experience stress due to travel are 2.4 times more likely to experience health complaint as compared to those who not experience stress. This could be explained by the fact that chronic exposure to stress can reduce circulating lymphocytes (white blood cells that fight disease) and increase levels of the hormone cortisol, a substance that suppresses the function of the immune system (Baron & Branscombe, 2012). As a result, the body becomes more susceptible to an illness. In line with stress due to travel, commuter workers who ever experience severe congestion are 1.9 times more likely to experience health complaint than those who never experience severe congestion. Traffic congestion will increase exposure to vehicle emissions. Exposure to pollutants could cause respiratory and cardiovascular disease (Wener & Evans, 2011b).

Commuter workers who have a higher-education level are less likely (OR = 0.690) to experience health complaint than those who have a lower education level. This is in line with the result of study conducted by Li et al. (2017), Berglund et al. (2016), and Sari H. et al. (2007) which state that people who have lower education level are more likely to have poor health status. In general, people with higher education level better understand how to achieve optimal health status. They know how to prevent an illness and what nutritious foods are (Sari H. et al., 2007). This will lead to achieve good health status. Commuter workers who working at formal sector is less likely (OR = 0.503) to experience health complaint as compared to those who working at informal sector. This condition is caused by differences in workload and workplace environment in the formal sector with the informal sector. According to Rios & Nery (2015), working in the informal sector needed high physical effort, quick, and continuous physical activity. In addition, most workers in the informal sector work under high pressure which can cause fatigue, anxiety, depression and physical complaints. In addition, López-Ruiz et al. (2015) stated that working conditions in the informal sector are usually worse than those in the formal sector. Workers in the informal sector have long working hours, unsafe workplaces, experience musculoskeletal problems, exposure to traffic pollution, and bad weather.

4 CONCLUSION

There are several significant explanatory variables for health complaint on commuter workers in Bodetabek, such as commuting distance, time, and mode, stress due to travel, severe congestion, education level, and employment status. Our result suggested that government or policy makers in the Bodetabek region should improve public transport mode services through the addition of Transjakarta Buses (Bus Rapid Transit) and Commuter Line train during rush hour in the morning and evening, which is proportional to the density of passengers in each corridor and improves the timeliness, ease of access, and convenience aspect of public transportation on suburban area like Bodetabek.

5 REFERENCES

Badan Pusat Statistik. 2009. *Profil Komuter Hasil SUPAS 2005*. Jakarta: BPS.

Badan Pusat Statistik. 2010. *Statistik Mobilitas Penduduk dan Tenaga Kerja 2010*. Jakarta: BPS.

Badan Pusat Statistik. 2013. *Analisis Mobilitas Tenaga Kerja Hasil Sakernas 2012*. Jakarta: BPS.

Badan Pusat Statistik. 2014. *Statistik Komuter Jabodetabek 2014*. Jakarta: BPS.

Baron, R. A. & Branscombe, N. R. 2012. *Social Psychology (13th ed).* New Jersey: Pearson Education, Inc.

Berglund, E., Lytsy, P., & Westerling, R. 2016. Active traveling and its associations with self-rated health, BMI and physical activity: A comparative study in the adult Swedish population. International journal of environmental research and public health, 13(5), 455.

Box, G. E. P. & Tiao, G. C. 1973. Bayesian Inference in Statistical Analysis. Massachusetts: Addison Wesley Publishing Company.

Browne, W.J. 2017. *MCMC Estimation in MLwiN, v3.00*. United Kingdom: University of Bristol.

Handiyatmo, D. 2009. *Penggunaan Jenis Transportasi oleh Pelaku Mobilitas Ulang Alik di Enam Kawasan Metropolitan (Analisis Data SUPAS 2005)* [Tesis]. Depok: Universitas Indonesia.

Hansson, E., Mattisson, K., Björk, J., Östergren, P. O., & Jakobsson, K. 2011. Relationship between commuting and health outcomes in a cross-sectional population survey in southern Sweden. *BMC public health*, 11(1), 834.

Hoehner, C. M., Barlow, C. E., Allen, P., & Schootman, M. 2012. Commuting distance, cardiorespiratory fitness, and metabolic risk. *American journal of preventive medicine*, 42(6), 571-578.

Hox, J. J. 2010. *Multilevel Analysis Techniques and Application (2nd ed).* New York: Routledge Taylor & Francis Group.

Kirsten, W. 2010. Making the Link between Health and Productivity at the Workplace—A Global Perspective. *Industrial health*, 48(3), 251-255.

Kageyama, T., Nishikido, N., Kobayashi, T., Kurokawa, Y., Kaneko, T., & Kabuto, M. 1998. Long commuting time, extensive overtime, and sympathodominant state assessed in terms of short-term heart rate variability among male white-collar workers in the Tokyo megalopolis. *Industrial health*, 36(3), 209-217.

Koslowsky, M., Kluger, A. N., & Reich, M. 1995. *Commuting stress: Causes, effects, and methods of coping*. Springer Science & Business Media.

López-Ruiz, M., Artazcoz, L., Martínez, J. M., Rojas, M., & Benavides, F. G. 2015. Informal employment and health status in Central America. *BMC public health*, 15(1), 698.

Lyons, G., & Chatterjee, K. 2008. A human perspective on the daily commute: costs, benefits and trade-offs. *Transport Reviews*, 28(2), 181-198.

Novaco, R. W., Stokols, D., & Milanesi, L. 1990. Objective and subjective dimensions of travel impedance as determinants of commuting stress. *American journal of community psychology*, 18(2), 231-257.

Rios, M. A., & Nery, A. A. 2015. Working and health conditions reported by informal commerce workers. *Texto & Contexto-Enfermagem*, 24(2), 390-398.

Sari, H. P., Hapsari, T. D., & Pradono, J. 2007. Status Kesehatan Masyarakat dan Faktor - Faktor yang Berhubungan di Nanggroe Aceh Darussalam. *Media Litbang* Kesehatan, 7(1), 38-50.

Stegmueller, D. 2013. How many countries for multilevel modeling? A comparison of frequentist and Bayesian approaches. *American Journal of Political Science*, 57(3), 748-761.

Urhonen, T., Lie, A., & Aamodt, G. 2016. Associations between long commutes and subjective health complaints among railway workers in Norway. *Preventive medicine reports*, 4, 490-495.

Warsida, R.Y., Adioetomo, S.M., & Pardede, E., 2013. Pengaruh Variabel Sosio-Demografis terhadap Mobilitas Ulang-Alik di Jabodetabek. *Jurnal Ekonomi dan Pembangunan Indonesia*, *13*(2), 159-176.

Wener, R. E., & Evans, G. W. 2011a. Comparing stress of car and train commuters. *Transportation research part F: traffic psychology and behaviour*, 14(2), 111-116.

Wener, R. E., & Evans, G. W. 2011b. Transportation and Health: The Impact of Commuting. In A. Diez Roux (Ed.), *Encyclopedia of environmental health*. New York: Elsevier.

Wu, D. L., Lin, M., Chan, C. Y., Li, W. Z., Tao, J., Li, Y. P., Sang, X. F., & Bu, C. W. 2013. Influences of commuting mode, air conditioning mode and meteorological parameters on fine particle ($PM_{2.5}$) exposure levels in traffic microenvironments. *Aerosol and Air Quality Research*, 13, 709-720.