Convergence and Determinants of Health Development in North Sumatera Province

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Abstract

Health contributes to increasing productivity in generating quality human resources. Health development aims to attain the highest public health degree fairly and equally. Convergence reduces the gap between regions and makes development more equitable. One of the booming health development indicators is life expectancy. The government must collaborate across sectors, namely the social and economic sectors, to accelerate the convergence process. This study aims to identify convergence and analyze the determinants of health development in North Sumatera Province. To this purpose, panel data of 33 districts/cities in North Sumatera Province over 2012-2019 is investigated using the Generalized Method of Moment (GMM) as dynamic panel data analysis. The results showed that convergence in health development measured by life expectancy occurred in North Sumatera Province. The most influential variables in health development were socio-economic variables.

Keywords:
convergence, GMM, health development, life expectancy

How to Cite:

INTRODUCTION

Health is the core of well-being and a prerequisite for increased productivity (Todaro & Smith 2011). Human capital is strongly influenced by education and health problems. It contributes to economic growth by increasing the skills and production capabilities of the workforce. Health development is one of the agendas in realizing the Sustainable Development Goals (SDGs). It is reflected in the third goal of ensuring a healthy life and improving the well-being of all at all ages.

Health development aims to attain the highest public health degree. The success of health development can be seen through life expectancy, the infant mortality rate (IMR), the maternal mortality rate (MMR), and nutritional status. Life expectancy is one of the primary vital indicators of a country’s population health and economic development (Mahumud et al., 2013). As an indicator of health status, life expectancy is used as one of the bases in health program planning and to evaluate government performance in improving the health and well-being of its population (BPS, 2019).

Foreman et al. (2018) research show that life expectancy is expected to grow worldwide by 2040. In that year, Indonesia’s life expectancy is estimated to reach 76.77 years and will be ranked 6th for the Southeast Asia region. Life expectancy in Indonesia has continuously increased from 2015 to 2019 from 70.78 in 2015 to 71.34 in 2019. Although it continues to increase, unequal achievement of life expectancy among provinces in Indonesia may raise a problem in the long term since it can increase inequality in health development.

Life expectancy in all provinces on the island of Sumatera is below the national figure in 2019 except Riau province, and North Sumatera Province is the lowest one. North Sumatera is a province with the fourth largest population in Indonesia. The low life expectancy in the North Sumatera Province will undoubtedly affect the human development index, which measures the quality of human resources. Of course, it will also affect the achievement of the national human development index.

![Figure 1. The trend of Life Expectancy in Indonesia and North Sumatera](image-url)
During the 2015-2019 period, life expectancy in North Sumatera Province has always been below the national figure. This needs to be a concern because life expectancy is one indicator of the success of health development. The life expectancy of North Sumatera Province, which is relatively low compared to other provinces, certainly affects the achievement of national health development. In 2019, the life expectancy in North Sumatera Province ranked 24 out of 34 Provinces in Indonesia. Moreover, it was the lowest one during Sumatera Island’s 2015 to 2019 period. On the contrary, during the 2016 to 2019 period, North Sumatera Province recorded the highest Gross Regional Domestic Product (GRDP) based on the constant prices in Sumatera Island and ranked fifth in Indonesia in 2019. This phenomenon showed that increased income did not positively affect the life expectancy in North Sumatera Province, thus, differing from the research conducted by Paripurna (2017) and Bilas et al. (2014), where per capita income has a positive effect on life expectancy.

One of health development principles is fairness and equality, which means everyone has the same rights in obtaining the highest degree of health. However, the challenge for long-term development in the health sector is reducing the gap in public health status. The expected health development outcome is equitable development throughout Indonesia. Convergent health development shows that areas with low health development can catch up with areas with high health development.

There was a tendency that the difference between the highest and the lowest life expectancy was likely to decrease from 2012 to 2019. In 2011, the difference was 11.13 years, decreased to 10.82 years in 2019. Regions with the lowest life expectancy from 2012 to 2019 had a faster average growth rate than regions with the highest life expectancy. This phenomenon shows a tendency for health convergence in North Sumatera Province.

As convergence reduces the gap between regions and makes development more equitable, convergence is expected in health development and economic development.
The Lancet Commission states that a "Grand Convergence" in health will be achieved by 2035. Achievement of convergence would prevent about 10 million deaths in 2035 across low-income and lower-middle-income countries relative to a scenario of stagnant investments and no improvements in technology (Jamison et al., 2013).

To advance the goal of “Grand Convergence” in global health by 2035, Goli et al. (2019) tested the convergence hypothesis in the progress of the health status of individuals from 193 countries and found that with a current rate of progress (2.2% per annum), the “Grand Convergence” in global health can be achieved only by 2060 instead of 2035. Using the MIMIC (Multiple Indicator Multiple Causes) models to estimate health status in the European Union, Stańczyk (2016) found beta convergence in 2002-2012 period, with a convergence rate of 1% and the half-life being about 60 years, and found the evidence of spatial dependence in the analyzed phenomenon.

Research conducted by Goli et al. (2019) found that the "Grand Convergence" in global health can be achieved only by 2060 instead of 2035 if the current rate of progress (2.2% per annum) persists. The convergence rate was found to have decreased from 1950 to 2015, while the non-parametric test of convergence shows an emerging process of regional convergence rather than global convergence.

Maynou et al. (2014) state that their study was the first that showed a lack of convergence in health across the European Union (EU) region. Although they found (beta) convergence, they also identified significant differences across both time and regions in the catching-up process. Moreover, they tested (sigma) convergence and found no reduction on average in dispersion levels of mortality and life expectancy.

Goli et al. (2013) have found β convergence regarding life expectancy, child immunization, and underweight children across central states in India. Cavalieri and Ferrante (2019) also found β convergence for infant mortality rate and life expectancy at birth in Italy. The results showed that fiscal decentralization enhanced ‘catching-up’
effects for both health outcomes. Using the mortality rate by age as an indicator of health status, Gachter and Theur (2011) found mixed results in the sigma convergence in their research on the convergence of health status in Austria. Meanwhile, the weighted standard deviation increases inequality for the four examined variables.

However, several studies have found no convergence in health. Kumar (2015) found that infant mortality and life expectancy had not been converged in 1996-2012, and no club convergence was formed in South Asian countries. The analyses highlight that the relative positions of countries in South Asia have changed little, and the trend of significant inequalities among the countries continues. Clark (2011) found that convergence occurs in life expectancy but diverges in infant mortality in 195 countries in the period 1955-2005. In developing countries, economic development improves life expectancy more than reduces infant mortality. His research concluded that health outcomes follow the 'Kuznets Welfare Curve.' Blum’s model of health determinants explains that four main factors contribute to overall health status. These are environment, behavior, health care, and heredity. Folland et al. (2013) argue that health status is an increasing function of health care which is affected by biological characteristics, environment, and lifestyle.

In a study on Indonesian Life Expectancy, Kristanto et al. (2019) found that health personnel and health insurance positively and significantly affect life expectancy. Dependency ratio and poverty have a negative and significant relationship with life expectancy. Meanwhile, the availability of health facilities and income inequality have a weak relationship with life expectancy. Using Geographically Weighted Regression (GWR) to identify variables that affect life expectancy in every district in East Java, Aidi et al. (2014) found that the number of poor people, the number of health facilities, the percentage of health complaints, and the percentage of children under five years old were immunized, had a significant effect on life expectancy. Through a study on strategies to improve health status in Banten Province, Paripurna (2017) found that immunization, GDP per capita, number of hospitals, number of doctors had a positive and significant effect on life expectancy, while district/city government health spending had no significant effect.

Research on health convergence has been widely carried out around the world, among others by Goli et al. (2019), Stańczyk (2016), and Maynou et al. (2014). However, similar research is rarely carried out in Indonesia. Previous studies were generally conducted at the national level, but this research was conducted at the provincial (regional) level because, in general, development policies are determined in each province (region). Research on the determinants of life expectancy has been carried out, among others by Bilas et al. (2014), Aidi et al. (2014), and Paripurna (2017). Meanwhile, research that analyzes the convergence of health development and the factors that influence health development has never been carried out in Indonesia, especially in North Sumatera Province. This study uses the Generalized Method of Moments (GMM) method to identify convergence and analyze the factors that influence health development. Based on previous descriptions, this study aims to identify the convergence of health development in North Sumatera Province and analyze factors that influence it.
METHODS

The data used in this study were secondary in the form of panel data, encompassing data from 33 districts/cities in North Sumatera Province for eight years from 2012 to 2019. Secondary data were obtained from the Central Statistics Agency of North Sumatera Province and the Health Office of North Sumatera Province. The variables used in this study were life expectancy (LE) as the dependent variable and seven independent variables, namely GRDP per capita, government spending on health, expected years of schooling, proper sanitation, health facilities, health resources, and immunization coverage.

Dynamic panel data analysis is used in this research as panel data analysis, using the Generalized Method of Moments (GMM) with the Sys-GMM approach. The dynamic relationship results in the emergence of endogeneity problems so that if the model is estimated with static panel data analysis, it will produce biased and inconsistent estimators (Firdaus, 2011). This is due to the lag of the dependent variable, namely life expectancy, as the independent variable in the model specifications.

The best GMM dynamic panel data models must meet three criteria. First, there is no bias, and the estimator must be between the fixed effect and pooled least square (PLS). Second, valid instruments are checked using the Sargan test. Third, it is consistent. If the m1 statistic shows that the null hypothesis is rejected, m2 shows that the null hypothesis is not rejected.

The model specifications used to test convergence hypothesis, and determinants of health development in North Sumatera Province is:

\[ LE_{it} = \alpha + \beta_1 LE_{it-1} + \beta_2 \ln GRDP_{cap} + \beta_3 \text{Govspending}_{it} + \beta_4 \text{EYS}_{it} + \beta_5 \text{San}_{it} + \beta_6 \text{Healthfac}_{it} + \beta_7 \text{Healthres}_{it} + \beta_8 \text{Immun}_{it} + \epsilon_{it} \]

The GMM model was used to identify conditional \( \beta \) convergence. The convergence process of health development occurs when the \( \beta_1 \) coefficient is less than one. According to Azijah et al. (2015), the rate of convergence velocity (\( \lambda \)) is expressed as \( -\ln (\beta_1) \). According to Jan and Chaundhary (2011), the time needed to close the initial half gap (\( H \)) is calculated by the formula ln(2)/\( \lambda \).

RESULT AND DISCUSSION

Life expectancy in North Sumatera Province in 2019 was 68.95 years, which increased by 1.14 points compared to 2012. It means a newborn baby who was born in 2019 has an opportunity to stay alive/survive until 69 years old on average. Life expectancy in North Sumatera Province continued to increase from 2012 to 2019. The same thing happened in districts/cities of North Sumatera Province.

As shown in Figure 4, 17 districts/cities (51.51%) have a life expectancy rate below the provincial rate. Pematang Siantar had the highest life expectancy (73.33) in North Sumatera Province in 2019, while Mandaliling Natal had the lowest one (62.51). The gap between them is 10.82 years. The target of life expectancy in the Medium-Term Development Plan in North Sumatera Province Year 2018-2023 is 70.00 years in 2023.
There are 9 districts/cities that have been able to achieve this target in 2019, namely Simalungun, Karo, Deli Serdang, Samosir, Pematangsiantar, Tebing Tinggi, Medan, Binjai, and Gunung Sitoli.

The GMM model with the Sys-GMM approach was used to identify convergence in health development in North Sumatera Province in estimating the dynamic panel data model. The best GMM model must meet three criteria, namely: First, unbiased. If the estimator is between the estimator Pooled Least Square (PLS) and Fixed Effect Models (FEM). The lag coefficient of dependent variables generated by PLS will be biased upward, while the lag coefficient of dependent variables generated from FEM will be downward biased. The estimated result of the lag coefficient of the dependent variable with Sys-GMM indicates a value of 0.9577. It is between the FEM (0.7897), and PLS (0.9915) estimates. This means that the resulting estimator is not biased.

![Figure 4. Life Expectancy by Districts/Cities in North Sumatera Province Year 2019](source)

Second, consistent. The Arellano-Bond test is an autocorrelation test on the GMM approach to determine estimation consistency. In the Arellano-Bond test, m(1) statistics showed that the null hypothesis was rejected (p-value = 0.0013 < 0.05), and m(2) showed no rejection of the null hypothesis (p-value = 0.1303 > 0.05). Thus, it can be
concluded that the estimation of dynamic panel data with the Sys-GMM approach has been consistent.

Third, valid instrument. The Sargant test conducts the instrument validity test. If the Sargant test value is more significant than alpha 5%, then $H_0$ is accepted, which means that the instrument used in the study is valid and usable. The results obtained from the Sargan test show that the value is 0.9989, greater than alpha (0.05), then $H_0$ is accepted. It means that the instrument used in this study has been validated and can be used.

The test results of the best dynamic panel data model show that the criteria are not biased, consistent, and valid instruments have been met, which means that the dynamic panel data model used is already the best. The dependent variable lag coefficient (L1. LE) is worth 0.9577. The estimated parameter is statistically significant because of the probability value of 0.0000, with the standard error value of 0.0186.

The dependent variable lag coefficient ($\beta_1$) is 0.9577 or less than 1, indicating that the conditional $\beta$ convergence of health development persists among districts/cities in North Sumatera Province. This demonstrates that areas with lower life expectancy have faster growth to catch up with areas with higher life expectancy rates. Convergence reduces the gap between regions. Thereby, health development becomes more evenly distributed. It indicates a decrease in health inequalities during the analyzed period. Jamison et al. (2013) stated that achieving convergence would prevent about 10 million deaths by 2035 in low- and middle-income countries. Goli et al. (2019) stated that reduction in mortality reflects improvements in the health and well-being of populations. The convergence of health development in North Sumatera Province will reduce mortality rates so that the highest degree of public health can be achieved.

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>m1</td>
<td>-3.21</td>
<td>0.0013</td>
</tr>
<tr>
<td>m2</td>
<td>-1.51</td>
<td>0.1303</td>
</tr>
<tr>
<td>Sargan Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1. LE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLS</td>
<td>0.9915</td>
<td>0.0000</td>
</tr>
<tr>
<td>Sys-GMM</td>
<td>0.9577</td>
<td>0.0000</td>
</tr>
<tr>
<td>FEM</td>
<td>0.7897</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Currently, Indonesia, including the Province of North Sumatera, is still facing the threat of a double burden of disease where the trend of non-communicable diseases (NCD) is increasing every year while infectious diseases are still not wholly overcome, such as tuberculosis, HIV/AIDS, malaria, and so on. This is further exacerbated by the
emergence of a new disease (New Emerging Disease) at the end of 2019, known as Corona Virus Disease (Covid 19). In March 2020, WHO declared this incident a pandemic and ongoing. This pandemic occurred throughout the world, including Indonesia, resulting in a health crisis that increased morbidity and mortality rates.

Previous studies conducted by Gachter and Theurl (2011), Maynou et al. (2014), Goli et al. (2013), Hembram and Halder (2014), Stańczyk (2016), and Goli et al. (2019) have also found health convergences. In general, studies of health convergence use life expectancy and infant mortality rates as health variables. The convergence speed of health development in North Sumatera Province is 4.32 percent. With this rate of convergence speed, the half-life is about 16.04 years *ceteris paribus*. This convergence speed is faster when compared to the convergence speed in Stańczyk (2016), which found convergence at a speed of 1.16 percent per year, with the half-life being about 60 years in the European Union.

The convergence model in Table 2 provides information on factors affecting health development in North Sumatera Province. Based on the convergence estimates, GRDP per capita, education, proper sanitation, health facilities, and immunization coverage variables have a significant effect on health development in North Sumatera Province. GRDP per capita has a positive and significant effect on health development in North Sumatera Province at a significance level of 0.05. A positive influence of GRDP per capita on health was found in many studies, among others conducted by Bilas et al. (2014), Delavari et al. (2016), Paripurna (2017), and Miladinov (2020). Clark (2011) stated that GRDP per capita exerts significant positive effects on a country’s life expectancy average, but it more effectively improves life expectancy among poorer nations than among wealthier nations. Bayati et al. (2013) stated that income affects people’s lives and is a major socio-economic factor affecting health. Therefore, health development conducted in North Sumatera Province should pay more attention to economic factors, namely income. The higher a person’s income, the more person’s spending on health. Thus, it will contribute to the improvement of health status.

### Table 2. Estimation of Life Expectancy Convergence Model of North Sumatera Province with Sys-GMM Dynamic Panel Data Method

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LE L.1</td>
<td>0.957699</td>
<td>0.01865</td>
<td>0.000</td>
</tr>
<tr>
<td>ln Grdp per capita</td>
<td>0.225988</td>
<td>0.07607</td>
<td>0.003</td>
</tr>
<tr>
<td>government spending on health</td>
<td>-0.000141</td>
<td>0.00014</td>
<td>0.330</td>
</tr>
<tr>
<td>EYS</td>
<td>0.135768</td>
<td>0.02301</td>
<td>0.000</td>
</tr>
<tr>
<td>sanitation</td>
<td>0.002758</td>
<td>0.00074</td>
<td>0.000</td>
</tr>
<tr>
<td>health facility</td>
<td>0.087683</td>
<td>0.00216</td>
<td>0.000</td>
</tr>
<tr>
<td>health resources</td>
<td>-0.000013</td>
<td>0.00002</td>
<td>0.567</td>
</tr>
<tr>
<td>immunization</td>
<td>0.002417</td>
<td>0.00033</td>
<td>0.000</td>
</tr>
<tr>
<td>Convergence speed</td>
<td>0.04322</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Half-life</td>
<td>16.037</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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https://doi.org/10.15408/sjie.v11i1.20576
Education, which was represented by the expected years of schooling in this study, is a variable that gives the most considerable influence on life expectancy. The positive influence of education on life expectancy is in line with previous studies that have been conducted, yet using different variables as a proxy of education. Ali et al. (2016) exploited school participation figures while Delavari et al. (2016) engaged literacy figures, and Bayati (2013) utilized the education index. In general, people with higher education have access to better health information, so it tends to apply it to achieve better health conditions.

Proper sanitation has a positive and significant effect on life expectancy. This is matched with research conducted by Pratiwi and Wibowo (2016) and by Kustanto (2015). North Sumatera Province still has 12 districts/cities with the percentage of households with proper sanitation below 50%. During 2015-2019, the percentage of households who have access to proper sanitation in North Sumatera Province continued to increase. However, the increase has slowed since 2017. Sanitation is one of the most common health problems in developing countries. The availability of proper sanitation must be continuously enhanced because it is related to increasing the quality of environmental health, which is one of the most influential factors to health degree improvement.

Health facilities, represented by the number of primary health care, have a positive and significant effect on health development in North Sumatera Province at the significance level of 0.05. This follows research conducted by Paripurna (2017) and Aidi et al. (2014), which found that health facilities significantly affect life expectancy. Primary Health Care is the first level of health facilities that are most accessible for the community because of its availability up to the sub-district level. People who experience health complaints can check themselves to the nearest health center. Thus, the health problems experienced might be resolved more quickly.

In general, the fulfillment of primary health care needs can be seen from the ratio of Primary Health Care to sub-districts. The ratio of Primary Health Care to sub-districts in North Sumatera Province in 2019 was 1.33. This illustrates that the ideal ratio of Primary Health Care to sub-districts, namely 1 Primary Health Care in 1 sub-district, has been fulfilled. The ratio of Primary Health Care per sub-district can describe the condition of public accessibility to primary health services (Dinkes Sumut 2019). Putri (2015) states that if the addition of health facilities and services is not accompanied by improvements in the service system equal distribution of facility affordability per 100,000 population in each region, the additional output expected to increase health status will not be optimal.

Immunization coverage has a positive and significant effect on health development in North Sumatera Province at a significance level of 0.005. These results follow previous studies conducted by Paripurna (2017) and Aidi et al. (2014). According to data obtained from the Provincial Health Office of North Sumatera in 2019, 4,922 out of 6,133 existing villages are Universally Child Immunization (UCI). This achievement has not met the target of 83% following the Strategic Plan of the Provincial Health Office of North Sumatera. Therefore, the Province of North Sumatera must continue to strive to
improve its immunization coverage to meet the target that has been set, in line with the results of research that enhancing immunization coverage has a significant effect on improving health development in North Sumatera Province.

Government spending on health has no significant effect on life expectancy. This finding differs from Sihaloho (2016) and Sari et al. (2016) research. The proxy of government spending in the health sector used in this study is the percentage of health sector budgets to the total regional budgets and expenditures (APBD). Article 171 paragraph (2) of Law Number 36 of 2009 on Health states that the government’s health budget, district/city, is allocated at least 10 percent of the regional budgets and expenditures (APBD) beyond salary. However, the health budget data used in this study still include the salary component.

Human resources, represented in this study by the number of doctors and midwives for each district/city, also have no significant effect on life expectancy. This could be due to the uneven distribution of health workers in each district/city of North Sumatera Province. This result differs from previous research conducted by Paripurna (2017) and Kristanto et al. (2019). In line with this study, Tanadjaja et al. (2017) found that the ratio of general practitioners and the ratio of nurses per 10,000 inhabitants had no significant effect on life expectancy in Papua.

Health problems are complex problems because they can be influenced by many health-related factors and factors outside the health sector. The results showed that the main factors affecting health development in North Sumatera Province are socio-economic factors. Therefore, health development in North Sumatera Province must address these issues and be implemented across sectors, involving other sectors outside the health sector; thus, health development aims to improve the level of public health as high as possible.

CONCLUSION

Based on the analysis of results that have been presented, some conclusions can be drawn. First, the convergence of health development in North Sumatera Province occurred during 2012-2019, with a convergence rate of 4.32 percent and the half-life being about 16.04 years. Second, determinants of health development in North Sumatera Province in 2012-2019 are GRDP per capita, expected years of schooling, sanitation, health facilities, and immunization, where all of those variables have a positive effect.

The government must carry out cross-sectoral cooperation, especially in the social and economic sectors, to accelerate the convergence process of health development in North Sumatera Province. In order to improve the health development achievements, the government needs to increase promotive and preventive health efforts because, in line with the results, sanitation and immunization coverage have a positive effect on health development in North Sumatera Province. In addition, it is also necessary to increase the health sector budget, especially for activities that directly impact public health, so that it can have a positive influence on health development in North Sumatera Province.
REFERENCES


