Health Inequality and Deprivation in Developing Countries: Indonesia, Pakistan and Philippine

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Abstract

This paper looks at health inequality and deprivation among developing countries, namely: Indonesia, Pakistan and Philippine. The analysis is particularly concerned with relationships between health and income, especially the extent to which inequality and deprivation in the former is driven by changes in the latter as there were some program intervention and health system revolution in the three countries. This paper reports increasing disparity in child mortality across income groups, and decreased inequality in life expectancy. The results further showed similarity patterns in life expectancy decline. Analysis of this health indicator data is very useful in tracking progress towards achieving Sustainable Development Goals (SDGs) in the health sector and well-being particularly, also being able to provide recommendations for stakeholders in formulating public policies and health development programs.

Keywords: *Health inequality, Deprivation, SDGs, Life expectancy, Developing countries*

1. Introduction:

Since UNDP had descried the international goal of Human Development (1990) in NY headquarter office, it stated "*to create and enabling environment for people to enjoy long, healthy and creative lives",* which means it is the obligatory on every member country to pursue the goal of development through increase in life expectancy providing health and creative environment. Amarta Sen (2000) Nobel prized on economic in 1998 has emphasised that development is *"a process of expanding the real freedoms that people enjoy"*. These two main ideas actually support that national economic growth is very important in terms of achieving human freedom. Regarding Alkire's idea (2010), which stated that human development itself is kind of a greater process of freedom in order to fulfil the needs and leads to the achievement level of well-being (outcome).

According to Human Development Report Outreach (HDRO) in 2015, "*human development is expanding the richness of human life",* it means not only increasing economic wealth that focuses on creating opportunities and choices fairly for all people, but also give freedom and opportunity for all. Therefore, this paper attempts to understand human development by looking at the relationship between health and economic levels.

Since healthy and longer life is one of the main goals of development, the third Goal of United Nations agreement (2016), stated "*Good health and well-being in order to ensuring healthy lives and promoting the well-being for all at all ages is essential to sustainable development*". Therefore, healthcare of population needs to be a major concern in every country. Moreover, the Covid-19 has put the health system on the top of all agendas worldwide, the developing countries like Indonesia, Philippine and Pakistan. the developing countries have low level of human well-being and the most fundamental challenge to improve the well-being of citizens. Health is one of important dimensions of the well-being. Instead of having individual's well-being value, health also has instrumental value that allowed to pursue on various goals of individual, community and even region with its combination in the SDGs achievement. The improvement of health is not only useful for in its own right, but for its role in facilitating simultaneously other well-being dimensions.

There are certainly many other reasons why health is the most important among other dimensions in the multidimensional well-being. Through most of the last century there has been steady improvement in health outcomes, namely: significantly increased ***life expectancy*** across countries. Globally, , It has increased from a lowly 40s years (1980) to 60s years in 2005, and have reached nearly 70s years currently in many Asia countries (UNs World Population Prospect, 2015). However, there are some countries which exhibit a decline in the life expectancy, it may be due to war, conflicts, and sporadic spread of infectious diseases, i.e. among the three developing countries (Indonesia, Philippine and Pakistan) the life expectancy levels are at variance significantly as consequence of within country health inequalities. For example, in Indonesia the rich people are four times more likely than the poor to have access to health care (SDGs Report of Indonesia, BPS 2018).

As those facts above, it is very important to looks at health inequality and deprivation in developing countries: Indonesia, Pakistan and Philippine. this paper specifically analyses the relationships between health and per capita income, especially the extent to which inequality and deprivation in the former is driven by changes in the latter. Authors have also applied a tracking patterns analysis, which has high demand due to its help in monitoring-evaluation of SDGs achievement on health and well-being, particularly. Also, this method will be very useful for other participant countries, especially developing countries to have lesson learned from these experiences for carrying out similar analysis.

2. Methodology:

2.1 Generalized Additive Model (GAM)

Generalized Additive Model is a statistical model in which the relationship between the response variable and the predictor variable is described as the sum of the functions of the predictor variable (where the function is a nonlinear function). GAM is formulated as follows:

$$y = \delta_0 + \sum_{k=1}^{p} f_k(x_k) \quad (1)$$

where: y is response variable , δ_0 is intercept, x_k is predictor variable at-*k* , p is the number of predictor variable, and $f_k(.)$ the smoothing function of the predictor variable at-*k* .
In this study, the authors use the predetermined B-Spline smoothing (P-Splines) as a smoothing function of the predictor variable.

a. P-Splines

B-splines is a polynomial function that has segmented properties at the x-interval formed by *knots (piecewise polynomial)* which are then estimated locally at these intervals to a certain degree of polynomial (de Boor, 2001). The j[th] B-splines with degrees *v* based on a row of *u knots* $t_0, \dots, t_u$ for $j = 1, \dots, v + u$ (*u* express the number of *knots*) are denoted by the recursive formulation as follows:

$$B_j(x; v) = \frac{x - t_j}{t_{j+v-1} - t_j} B_j(x; v-1) - \frac{x - t_{j+v}}{t_{j+v} - t_{j+1}} B_{j+1}(x; v-1) \quad \dots (2)$$

where: $B_j(x; 0) = \begin{cases} 1 & \text{if} \quad t_j \le x \le t_{j+1} \\ 0 \end{cases}$ ... (3)

$$f(x) \approx \sum_{j=1}^{u+v=m} \alpha_j B_j(x; v) \quad \dots (4)$$

It is assumed that the smooth function is approximated by a linear combination of *B-splines* (*B-splines function*). By a matrix equation can be derived the *least* equation with the estimator for the regression model in equation is:

$$\widehat{\boldsymbol{Y}} = \boldsymbol{B}(\boldsymbol{B}^{\boldsymbol{t}}\boldsymbol{B})^{-1}\boldsymbol{B}^{\boldsymbol{t}}\boldsymbol{Y} = \boldsymbol{AY} \quad \dots (8)$$

The use of too many knots makes the *B-splines* function curve tend to overfit so penalties are needed on the adjacent coefficients of the B-splines (Eilers and Marx, 1996). In general, the objective functions of *B-splines* regression given a penalty or *P-Splines*, as follows:

$$\widehat{\boldsymbol{\alpha}} = \text{argmin}_{\boldsymbol{\alpha}} \sum_{i=1}^{n} \left(y_i - \sum_{j=1}^{m} \alpha_j B_j(x; v) \right)^2 + \lambda \int_{x_{min}}^{x_{max}} \left(\sum_{j=1}^{m} \alpha_j B_j{}''(x; v) \right)^2 dx$$

where $\lambda > 0$ is *smoothing parameter* and $B_j{}''(x; v)$ is the second derivative of $B_j(x; v)$. Here are some derivatives of *B-splines* and *B-splines functions* that are useful in the estimation process. The final result will be 4 formulas: 1) The 1[st] derivative of *B-splines;* 2) The 2[nd] derivative of *B-splines;* 3) The 1[st] derivative of *B-splines* function and 4) The 2[nd] derivative of *B-splines function.*

Determination of Optimal Knots size and *Smoothing parameter*

Conducting *B-splines regression modeling* in research aimed to obtain B-splines smoothing regression is to determine the optimal number of knots (t_{opt}) and optimal *smoothing parameters* (λ_{opt}) based on the GCV (*Generalized Cross Validation*) criteria:

$$\text{GCV}(t, \lambda) = \frac{MSE(t, \lambda)}{n^{-1} trace[\boldsymbol{I} - \boldsymbol{A}(t, \lambda)]}$$

where: $MSE(t,\lambda) = n^{-1}\sum_{i=1}^{n}(y_i - \hat{y}_i(t,\lambda))^2$, $\boldsymbol{I}$ is identity matrix, $\boldsymbol{A}(t)$: $\boldsymbol{A}$ with a number of *knots* $(t_1, \ldots, t_n)$. The optimal number of *knots* and *smoothing parameters* is the number of *knots* and *smoothing parameters* that minimize $\mathrm{GCV}(t,\lambda)$.

2.2 Data Source

The data used in this study are as follows: a) Life expectancy at birth, Mortality Under 5yeras age (per 1000 live birth), GDP per capita (current US $) available downloaded from *[http://datatopics.worldbank.org/world-development-indicators/]* ; b) Gini ratio (Gini index of inequality in equivalized (square root scale) household market (pre-tax, pre-transfer) income, using Luxembourg Income Study data as the standard) derived from the Standardized World Income Inequality Database (SWIID) takes a Bayesian approach to standardizing, available downloaded from *[https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/LM4OWF#]*.

The study analyzed simple descriptive statistics by using graphs and tables. Moreover, the existing literature was also collected and collated in order to enrich and strengthen the quality of analysis for better discussion and appropriate policy suggestions.

Referring to Model (1) is rewritten into several models to facilitate understanding:

$$le = intercept + pb(gdp) \quad (9)$$

$$le = intercept + pb(gini) \quad (10)$$

$$mru5 = intercept + pb(gdp) \quad (11)$$

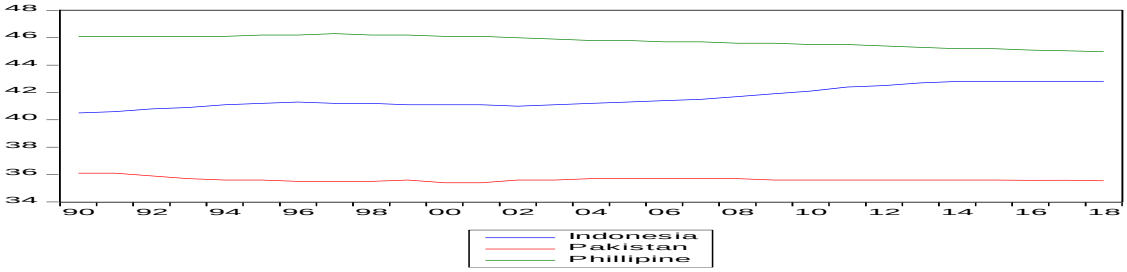
$$mru5 = intercept + pb(gini) \quad (12)$$

where: le is life expectancy at birth; gdp is GDP per capita; $mru5$ is mortality rate under 5 age; $gini$ is Gini ratio; $pb(gdp)$ is the P-Splines function on the GDP per capita variable, refer to $f_k(x_k)$ in the model (1); $pb(gini)$ is the P-Splines function on the Gini Ratio variable, referring to $f_k(x_k)$ in the model (1); *Intercept* is a constant of the model, referring to δ_0 in the model (1).

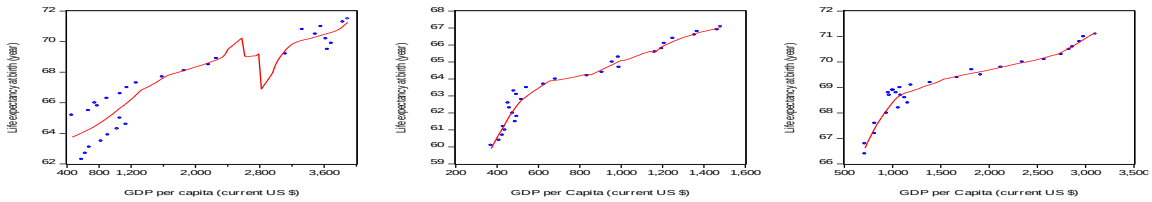
3. Result:

3.a. Inequlaity Among Three Countries

The inequality indicator as shown beneath is Gini Ratio among the three countries (see Graph 1.). The Gini ratio movement for Philippine tends to remain stable in the early years of 1990s, and the slightly increased after 1994 up to 2000 with the peak in 1998, and since then remain inclined slightly. Whilst for Pakistan tends to decline sharply the movement in the early of 90s up to 1994, then remain stable up to 2001 but increased in 1999-2000, since hereafter it remains stable up to present. On the contrary Indonesia's inequality gradually went up in slight increment for almost in two decades (1990 – 2018). So the three countries have a different trend direction of Gini ratio coefficient.

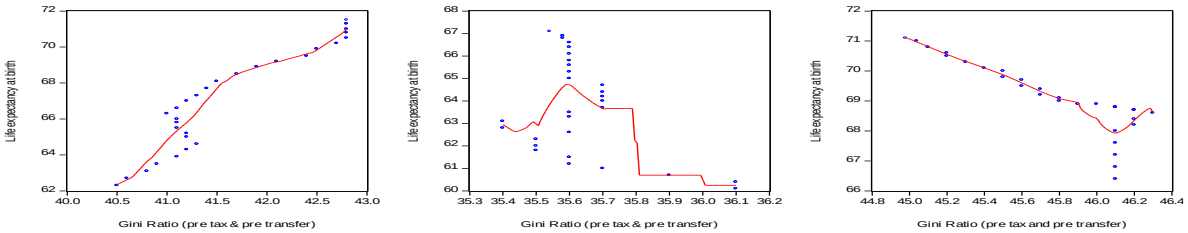


Graph 1. Gini Ratio Movement, 1990 – 2018



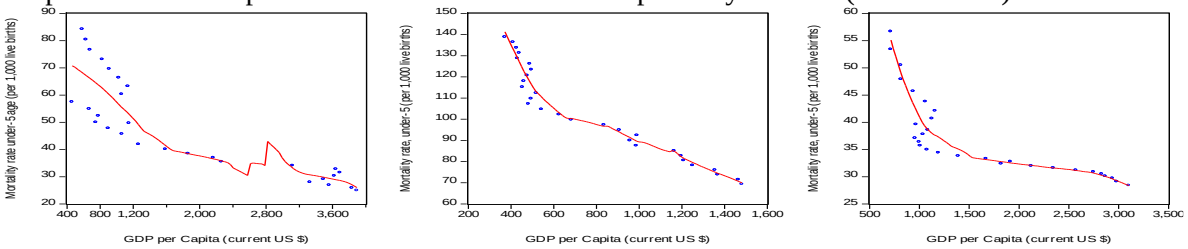
(a) Indonesia (b) Pakistan (c) Philippines

Graph 2. GDP Per Capita and Life Expectancy at Birth (Year) Across Three Countries



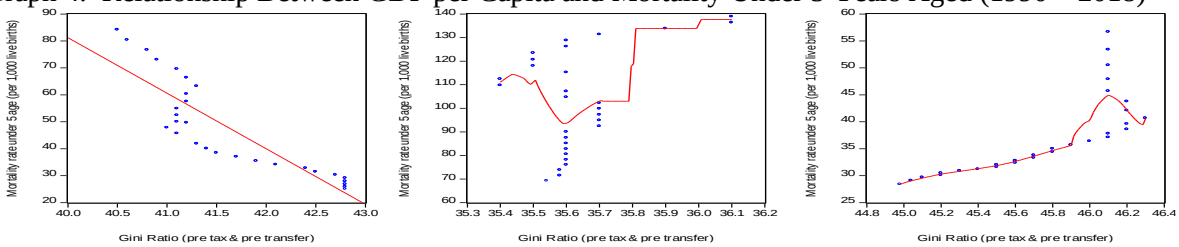
(a) Indonesia (b) Pakistan (c) Philippines

Graph 3. Relationship Between Gini ratio and Life Expectancy at Birth (1990 – 2018)



(a) Indonesia (b) Pakistan (c) Philippines

Graph 4. Relationship Between GDP per Capita and Mortality Under 5 Years Aged (1990 – 2018)



(a) Indonesia (b) Pakistan (c) Philippines

Graph 5. Relationship Between Gini ratio and Mortality Rate Under 5 Years Aged (1990 – 2018)

EETIMATION BASED ON GAM MODEL:

1. **Indonesia :** The results of equation modelling (9) show that at the 5% significance level, the GDP per capita variable has a positive and significant effect on life expectancy in Indonesia. While modelling (10) shows that at the 5% significance level, the Gini ratio variable has a positive and significant effect on life expectancy. Indonesia for model (11) shows that at the 5% significance level, the GDP per capita variable has a negative effect and significant on the mortality rate under 5 years' age. Whereas in the Indonesia case, model (12) shows that at the 5% significance level, the Gini Ratio variable has a negative and significant effect on mortality rate under 5 years' age.
2. **Pakistan:** The results of modelling (9) show that at the 5% level of significance, the GDP per capita variable has an effect, positive and significant on life expectancy. Whereas the modelling (10) shows that at the 5% significance level, the Gini ratio variable has a negative and significant effect on life expectancy. Modelling results (11) show that at the 5% significance level, the GDP per capita variable has a negative and significant effect on mortality rates under 5 years' age. While modelling (12) shows that at the 5% significance level, the Gini Ratio variable has a positive and significant effect on the mortality rate under 5 years' age.
3. **Philippine :** The results of modelling (9) show that at the 5% significance level, the GDP per capita variable has a positive and significant effect on life expectancy. Furthermore, modelling (10) shows that at the 5% significance level, the Gini ratio variable has a negative and significant effect on life expectancy. The results of model (11) show that at the 5% significance level, the GDP per capita variable has an effect, negative and significant on the mortality rate under 5 years' age. Furthermore, the model (12) shows that at the 5% significance level, the Gini Ratio variable has a positive and significant effect on the mortality rate under 5 years' age.

Table 1. beneath shows that the increase in GDP per capita is followed by the reduction in under5 mortality rate in each country of the study. There is negative relationship apparently between the two: child mortality and GDP per capita. The fluctuation increment trend on GDP per capita since 2003 up to 2010 has given a remarkably fluctuation effect up and down the trend. It shows that from 2009 to

2010 there was a jump in state income. Whilst, in 2010 Indonesia has started to enter its window opportunity period It seems directly support to the huge increment of welfare and leads among the three countries. Three years later on Indonesia's child mortality have been even falling off less than Philippine. On the other hand, Pakistan has slow increment and progress for both indicators, then Its development progress seems left behind compared to Indonesia and Philippine.

Table 1. Mortality rate under 5 years age and GDP per capita 1990-2018

Year	GDP per capita (current US$)			Mortality rate, under-5 years age (per 1,000 live births)			Year	GDP per capita (current US$)			Mortality rate, under-5 years age (per 1,000 live births)		
	Indonesia	Pakistan	Philippine	Indonesia	Pakistan	Philippine		Indonesia	Pakistan	Philippine	Indonesia	Pakistan	Philippine
1990	585.08	371.68	715.91	84.20	138.90	56.70	2005	1263.29	683.09	1193.98	41.90	99.80	34.40
1991	631.78	410.30	715.75	80.40	136.40	53.40	2006	1589.80	836.86	1390.52	40.10	97.30	33.80
1992	681.94	426.96	814.77	76.70	133.80	50.50	2007	1860.00	908.10	1670.59	38.50	94.90	33.30
1993	827.91	439.66	816.41	73.10	131.30	47.90	2008	2166.85	990.85	1916.30	37.00	92.40	32.80
1994	912.20	431.15	939.92	69.60	128.80	45.70	2009	2261.25	958.00	1821.52	35.50	90.00	32.40
1995	1026.39	489.88	1062.13	66.40	126.20	43.80	2010	3122.36	987.41	2124.06	34.10	87.50	32.00
1996	1137.41	497.22	1160.31	63.20	123.50	42.10	2011	3643.04	1164.98	2345.33	32.80	85.10	31.60
1997	1063.71	476.38	1127.53	60.30	120.70	40.70	2012	3694.35	1198.11	2572.63	31.50	82.70	31.20
1998	463.95	461.22	966.99	57.50	118.00	39.60	2013	3623.91	1208.90	2749.39	30.30	80.50	30.90
1999	671.10	454.28	1087.38	54.90	115.20	38.60	2014	3491.62	1251.16	2831.32	29.10	78.20	30.50
2000	780.19	519.53	1038.91	52.40	112.40	37.80	2015	3331.70	1356.67	2867.15	28.00	76.00	30.10
2001	748.26	495.35	957.19	50.00	109.80	37.10	2016	3562.85	1368.45	2941.21	26.90	73.80	29.70
2002	900.18	483.50	999.91	47.80	107.20	36.40	2017	3836.91	1464.99	2981.93	25.90	71.50	29.10
2003	1065.65	543.75	1010.31	45.70	104.70	35.70	2018	3893.60	1482.40	3102.71	25.00	69.30	28.40
2004	1150.26	625.40	1078.63	49.70	102.20	35.00							

The gradual decline of mortality rate under 5 years since 2010 hereafter in Indonesia could be predicted as a positive effect of increasing a huge proportion of household income derived from middle income society (bonus demography). In further this population group can afford their health behavioral better as their health services and access is also better than their previous generation, moreover a new universal insurance health program by Indonesia Government been started for implementation. The goal of Universal Health Coverage (UHC) in Indonesia is to help monitor the availability of resources for health and the extent to which they are used efficiently and equitably, instead of guarantee that every citizen of Republic Indonesia (RI) has their rights for health services and better well-being.

3.b. Inequlaity and Deprivation Among Three Countries

This study builds the analysis on famous "Basic needs approach" which regards the access to basic food, shelter, clothing a fundamental aspect of decent living, in our study, apart from food, shelter, and clothing, basic needs include health care facilities. Gordon et al. (2003) presented an approach of deprivation which is regarded as a building block of multidimensional poverty conception; it allows for comparisons between countries but is also able to provide input for policy makers.

O'Donnel, et. al. (2007) reported that Indonesia Government budget on health sector among Asian countries is the lowest government spending on the health sector and utilization of health services in Indonesia, are still lagging behind the countries of the Association of Southeast Asian Nations (ASEAN). Whilst, the Global Health Expenditure Database (GHED) provides the trend on health spending for from 2000 to 2017 that low income countries' expense dominated by Out-of- pocket (the biggest proportion) followed by Government budget then by Donor and smallest proportion is other (WHO, 2020: *https://apps.who.int/nha/database*). On the contrary for high income countries, the biggest proportion spending is by Government followed by Out-of-pocket and the almost zero for the Donor resource on budget contribution. When public resources spend more on health it will affect directly that do households spend less and vice versa accordingly. This is showing on how health value as intrinsic and being directly constitutive of an individual value. Pakistan's Government health spending on the ranging 0.6 – 1.1 % of GDP and fluctuated-declined trend over 2000-2017 period. In the similar time, the Pakistan's spending is the lowest percentage compared to Indonesia ranging 0.6 – 1.5 % of GDP and a stable increased trend; Philippine ranging 1.0 – 1.4 % of GDP and a fluctuated trend on this interval spending budget.

According to Ogwang (2000), the Gini ratio of income can be formulated as follows:

$$G_y = \left(\frac{n^2 - 1}{6n}\right)\frac{\hat{\beta}}{\bar{y}}$$

Where: G_y is the Gini ratio of household income; $\bar{y}$ is the mean of household income (household income before taxes and outgoing transfers). Household income must be ranked from lowest to largest; y is the mean of household income (household income before taxes and transfers out); n is the number of household samples; $\hat{\beta}$ is the OLS estimator of β in the model as follows :

$$y_i = \alpha + \beta i + \varepsilon_i \quad (9)$$

where: y_i is household income on -i ($i = 1, \dots, n$); α is the intercept of model (9) and β is the coefficient of model (9); ε_i is an error term in model (9).

When, the variable Inequality in life expectancy and the Gini ratio are modeled by model (1), it will be produced:

$$ile = intercept + pb(gini) \quad (13)$$

where: ile is inequality in life expectancy at birth. And $gini$ is Gini ratio

Estimated result of equation (13) for three countries are :

Indonesia	Estimate	Std. Error	t-stat	p-value
intercept	126.189	50.437	2.502	0.047
pb(gini)	-2.587	1.183	-2.187	0.072
R2	0.351			

Pakistan	Estimate	Std. Error	t-stat	p-value
intercept	-1043.55	649.70	-1.606	0.159
pb(gini)	30.20	1.8.26	1.654	0.149
R2	0.233			

Philippine	Estimate	Std. Error	t-stat	p-value
intercept	-9.263	41.136	-0.225	0.829
pb(gini)	0.539	0.909	0.593	0.575
R2	0.037			

Regarding the estimation result, neither Indonesia, Pakistan nor the Philippines show strong evidence that the Gini ratio has a significant effect on inequality in life expectancy. This proves that inequality in per capita income have implications on the heath of population, it gives direct effect to citizen whether they will live longer and having healthy life or not. It only happens in Indonesia, the relationship between the Gini ratio and inequality in life expectancy is negative. Meanwhile, in Pakistan and the Philippines, the relationship between Gini ratio and inequality in life expectancy is positive.

4. Discussion and Conclusion:

This paper found the increasing disparity in child mortality among the three countries since 1980s. The results also indicated decreased inequality in life expectancy among countries from early 1980s until the late 1990s and inequality thereafter. A similar pattern in life expectancy deprivation were reported. This paper found that this is partly due to a changing behavioural relationship between income per-capita and life expectancy among the three countries with low achievement in the former variables. Some literatures on health inequality have shown current gap and the important role of health in the development. In the most further important findings have also portrayed the SDGs achievement progress, particularly on the 3rd goal of SDGs.

The central government of the three countries also needs to take into consideration the growing interregional disparities in terms of resources, services and health outcomes, and develop a comprehensive strategy to address these issues. With a large, widespread area and population, and with the commencement of a universal health coverage system, the need for a reliable and integrated information system to support planning and decision-making is becoming even more urgent.

Since 2014, Indonesia has started the implementation of Law No. 40 of 2004 on the National Social Security System, which mandates the introduction of a universal health insurance scheme. Implementation started by merging the public insurance schemes that already existed. In 2014, small businesses and population groups that previously had not had health insurance could enrol in the national social health insurance scheme by paying premiums to the National Health Insurance Agency. However, until early 2014, many districts and provinces continued to provide organized autonomous local schemes (Jamkesda). This all health insurance scheme assumed had given a direct effect and strong correlation to reducing mortality rate significantly since 2013 afterward, as shows in the estimation of model result (13).

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