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# Estimating the Effect of Maternal and Child Health Outcomes to GDP per Capita

**Jandryle U. Trondillo[1*]**

*[1]University of Southeastern Philippines, Obrero, Davao City 8000, Philippines.*

***Author's contribution***

*The sole author designed, analyzed and interpreted and prepared the manuscript.*

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## ABSTRACT

**Background:** Using panel data from 1960 to 2013 of 193 UN countries, this paper explored the effect of maternal and child health outcomes specific to GDP per capita.
**Objective:** To explore the effect of MDG 4 and 5 to per capita GDP of UN countries.
**Methods:** Data gathered from World Bank were averaged from 1960 to 2013 and was normalized using lagged logarithmic form to fit in the parameters required to run multiple linear regression.
**Results:** The combination of variables indicating maternal and child health outcomes significantly predicted the effect to GDP per capita at 99% ($p<0.01$, $F=199.664$, $df=4,171$) with all four variables significantly contributing to the final model. The beta weights suggest that a percentage decrease in infant mortality rate per 1000 live births, maternal mortality rate per 1000 live births and proportion of births attended by skilled personnel contribute a percentage increase in the GDP per capita in US dollars while a percentage increase in the proportion of children immunized with measles contributes a percentage increase in the GDP per capita in US dollars.
**Conclusion:** Utilizing the empirical model, the maternal and child health outcomes have a minimum effect of 2.32% to 4.81% to GDP per capita.

**Corresponding author: E-mail: jandryle@gmail.com;*

*Keywords: Millennium development goals; maternal and child; effect to GDP; maternal and child health; health outcomes; multiple linear regression.*

## 1. INTRODUCTION

Since 1990, numerous researches have emerged to understand the concept of economic growth. Several variables were considered in the process as determinants of being statistically and economically significant factors that would explain economic growth of countries. Theorist identified that human capital is one of the economic variables [1-10]. In fact, the presence of human capital as part of several indicators was regarded as one of the most indispensable engine in achieving economic growth.

According to Weil [11], the improvement in health that has taken place over the last two centuries resulted from three sets of forces: first, improvements in the standard of living, in particular, better nutrition; second, changes in the public health environment, including sanitation and the supply of clean water; and finally, improvements in medical technology, including antibiotics and other medical treatments.

In a study conducted by Bloom, Canning, and Sevilla [12], health has been found to have a positive and statistically significant effect on economic growth. Results of the study suggest that a year of improvement in a population's life expectancy contributes to an increase of 4% in output. They concluded that this is a relatively large effect, indicating that increased expenditures on improving health might be justified purely on the grounds of their impact on labor productivity, quite apart from the direct effect of improved health on welfare. Several studies also suggest that health is one important component of economic growth [13-24].

This paper is focused on estimating the effect of maternal and child health to GDP per capita. Thus, the researcher, prior exploring the effects of the maternal and child health undergone a thorough construct validation between the link of maternal and child health to economic growth. Maternal and child health was individually reviewed for link in economic growth. Based on the review, several studies provided empirical evidences regarding the link of the two health outcomes to the economic activities. Several studies link maternal health [25-31] and child health [15,32,33,23,34] to economic growth. On the other hand, a number of studies talk about the link of maternal and child health to economic growth [35,36,37,38].

One study conducted which is similar to this paper is the study of Amiri and Gerdtham [39]. The paper explored the impact of maternal and child health on economic growth utilizing a new evidence-based granger causality and data envelopment analysis. The study utilized under-five mortality rate (the number of deaths of children under five years old per 1,000 live births) and maternal mortality ratio (the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births) from 1990 to 2010. On the other hand, GDP per capita was used as indicator for economic growth from 1990 to 2000. Findings of the study suggest that (a) in 105 of 180 (58%) countries, the study find a bi-directional relationships. This indicates that in the majority of countries, changes in under-five mortality have an impact on GDP and vice versa. While in 49 countries (27%) have one-way relationships from under-five mortality to GDP.

In 14 countries (8%) the study find one-way relationships from GDP to under-five mortality. And for the remaining 12 countries (7%), no relationships are found. (b) In 68 of 170 (40%) countries they find bi-directional relationships. One-way relationships from maternal mortality to GDP are found in 50 countries (29%) and one-way relationships from GDP to maternal mortality are found in 19 countries (11%). No relationships are found in 33 countries (19%). The study also find that the magnitude of the effect of reductions in child mortality on GDP in high-income countries (HICs) and upper middle-income countries (UMICs) is larger than lower- middle-income countries (LMICs) and low-income countries (LICs).

However, in contrast, the magnitude of the effect of GDP on maternal and child health outcomes in LMICs and LICs are larger relative to HICs and UMICs. Lastly, the results of the DEA analysis to explore the effects of other growth-related factors in the model, reductions in mortality was found to generally have a large effect on GDP growth, since the average overall efficiency rates for all countries in the data are more than 90% (91.1% in 1990-2000 and 92.2% in 2000-2010). As noted above, the results indicate that a decrease in child mortality would lead to a larger effect on

GDP in richer countries compared with poorer countries, although the difference in the average efficiency rate between different groups of countries are not statistically significant.

Furthermore, Bhargava et al. [15] conducted a study about modeling the effects of health to economic growth using the Penn World Table and World Development Indicators. The paper modeled the proximate determinants of economic growth at 5 yearly intervals using panel data on GDP series based on purchasing power comparisons in the Penn World Table, and on exchange rate conversions from the World Development Indicators. In the conceptual framework of the analysis, the demographic literature relating life expectancy to income [40] was integrated with models commonly specified for economic growth [41].

Macroeconomic evidence for an effect on growth is mixed, with evidence of a large effect in some studies. However, there is a possibility that gains from health may be outweighed by the effect of increased survival on population growth, until a fertility transition occurs. The low cost of some health interventions that have large-scale effects on population health makes health investments a promising policy tool for growth in developing countries. In addition, higher priority could be given to tackling widespread "neglected" diseases—that is, diseases with low mortality burdens that are not priorities from a pure health perspective, but that do have substantial effects on productivity.

Bloom et al. [12] estimated a production function model of aggregate economic growth including two variables that microeconomists have identified as fundamental components of human capital: work experience and health. The result suggest that good health has a positive, sizable, and statistically significant effect on aggregate output even when we control for experience of the workforce. The study argue that the life expectancy effect in growth regressions appears to be a real labor productivity effect, and is not the result of life expectancy acting as a proxy for worker experience.

In addition, Bloom and Canning [16] compared the estimated effects of health in a macroeconomic production function model of economic growth with the effects that are found using calibration based on wage regressions. The study recommends that modifying the income level gradually have a known effect to economic growth. The study also find that the estimated macroeconomic effects of health are positive, and not significantly different from the microeconomic estimates. The findings were similar for education provided we instrument schooling levels with literacy rates to correct for measurement error.

The simplest channel of causality running from health to economic growth is via the productivity of workers. Individuals who are healthier are able to work more effectively, both physically and mentally. Further, adults who were healthier as children will have acquired more human capital in the form of education. Weil [42] refers to this as the proximate effect of health on the level of income.

To be specific on the issue concerning health (which is a very broad concept) and economic growth, this paper would like to focus on health as an indicator of development and economic growth as GDP per capita. As stipulated in the Millennium Development Goals, the health outcomes pertaining to women, mothers, and children (improving maternal health and achieving universal access to reproductive health) and (reducing child mortality) are one of the key indicators towards development. Identifying the country's effort to improve maternal and child health will result in greater societal returns especially in the economic dimension. This paper will device a model utilizing maternal and child health outcomes as predictors of GDP per capita to help stakeholders estimate the percentage effect in the GDP per capita with their current maternal and child health.

## 1.1 Significance

This study is focused on exploring the effect of MDG 4 and 5 to per capita GDP of 193 UN countries. The study is relevant in understanding the significant effects of maternal and child health outcomes utilizing the parameters Infant Mortality Rate, Under-five Mortality Rate, Proportion of Children immunized with Measles, Maternal Mortality Ratio and Proportion of Births Attended by Skilled Health Personnel. Particularly, in generating the final model of this study, individuals will gain knowledge on the effects of their current maternal and child health status and will forecast the future effects for them to evaluate. Understanding the effects of the maternal and child health outcomes to the GDP per capita will help in emphasizing the

importance of eradicating contributory factors that will lead to increased mortality and morbidity in maternal and child health. Also, understanding the significant effects of maternal and child health outcomes will help development planners who are interested in public health to formulate strategies to solve maternal and child issues in their respective countries since they already have a baseline information on the contributory effects of these outcomes to their current GDP per capita. Lastly, this study is beneficial because maternal and child health outcomes does not only contribute to the health status of the population but also to the individual economy of countries especially if countries are gearing towards economic growth. Clearly, this dimension should be examined and all issues contributing to the problem of maternal and child health should be resolved.

## 2. METHODOLOGY

### 2.1 Theoretical Model

$$GDP_{Log} = \alpha + \beta_1 IMR_{Log} + \beta_2 UFMR_{Log} + \beta_3 IM_{Log} + \beta_4 MMR_{Log} + \beta_5 HB_{Log} + \mu$$

- $GDP_{Log}$ is the lagged logarithm of average per capita GDP of 193 countries from 1960 to 2013 measured by the quotient of gross domestic product and midyear population
- $IMR_{Log}$ is the lagged logarithm of average infant morality rate of 193 countries from 1960 to 2013 expressed in ratio per 1000 live births
- $UFMR_{Log}$ is the lagged logarithm of average under-five morality rate of 193 countries from 1960 to 2013 expressed in ratio per 1000 live births
- $IM_{Log}$ is the lagged logarithm of proportion of children immunized against measles of 193 countries from 1980 to 2013 expressed in percentage of children from 12-24 months
- $MMR_{Log}$ is the lagged logarithm of average maternal mortality ratio of 193 countries from 1990 to 2013 expressed in ratio per 100,000 live births.
- $HB_{Log}$ is the lagged logarithm of average proportion of births attended by skilled health personnel expressed in percentage from 1984 to 2012

### 2.2 Methodology

A logarithmic functional form was used to achieve the best fit of the variables used in this study. The appropriate lag structure was selected according to the direction of the skewness and kurtusis of the original metadata. Data transformation alone did not correct the problem of normality but since the researcher utilized the entire population in this undertaking, it is assumed that the distribution is normal. The researcher employed all 193 countries to date, excluding one independent and UN recognized country which has no data in all 5 variables namely Nauru and US recognized independent state Vatican. An OLS regression was then conducted to examine the effect of maternal and child health outcome indicators to GDP per capita.

### 2.3 Limitations of Predictor Variable Use

Several indicators of maternal and child health status were available in different sources other than WHO, WB and UNICEF. This study is only limited to the indicators for MDG 4 and 5 set by the United Nations. The Millennium Development Goals and targets come from the Millennium Declaration signed by 189 countries, including 147 Heads of State, in September 2000. The goals and targets are inter-related and should be seen as a whole. They represent a partnership between the developed countries and the developing countries determined, as the Declaration states, “to create an environment – at the national and global levels alike – which is conducive to development and the elimination of poverty” (United Nations [43]).

### 2.4 Data

#### 2.4.1 GDP per capita

GDP per capita is the gross domestic product divided by the midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollar (The World Bank Group, 2015). The econometric approach is based on panel data drawn from the data source of World Bank of the GDP per capita of all UN member countries from 1960 to 2013. The original metadata contains a number of lacking individual country information on a specific year span. Thus, the researcher opted to average the data of countries from 1960 to 2013 to minimize error which was coded GDP.

Countries with missing data on this variable was still included in the analysis.

This study opted to estimate the effect of maternal and child health outcomes to country's GDP per capita. To do such, the researcher made it clear as to which accurate parameters are necessary to be included as indicators of maternal and child health. Based on the handbook released by the United Nations Development Group (2013), the goal number 4 (reduce child mortality) have three indicators namely under-five mortality rate, infant mortality rate, and proportion of children immunized against measles. On the other hand, goal number 5 (improve maternal health) have two indicators namely maternal mortality ratio and proportion of births attended by skilled health personnel. In this study, the researcher utilized all indicators that will serve as variable representation of maternal and child health outcomes that will serve as predictors of GDP per capita which will be discussed below. Like the GDP data obtained from the data repository of World Bank, original metadata of all maternal and child health variables contain a number of lacking individual country information on a specific timeframe. Thus, the researcher averaged the data of individual countries from 1960 to 2013 to minimize error which was coded IMR, UFMR, IM, MMR and HB. Countries with missing data on these variables was still included in the final analysis.

#### 2.4.2 Infant mortality rate

Under-five mortality rate is the number of infants dying before reaching one year of age, per 1,000 live births in a given year. (adopted from World Bank description of data). In this study, the researcher utilized the data from World Bank starting 1960 to 2013.

#### 2.4.3 Under-five morality rate

Under-five mortality rate is the probability per 1,000 that a newborn baby will die before reaching the age five years old, if subject to age-specific mortality rates of the specified year (adapted from World Bank description of data). In this study, the researcher utilized the data from World Bank starting 1960 to 2013.

#### 2.4.4 Proportion of children immunized against measles

Child immunization measures the percentage of children ages 12-23 months who received vaccinations before 12 months or at any time before the survey. A child is considered adequately immunized against measles after receiving one dose of vaccine (adopted from World Bank description of data). This study utilized the data from World Bank from 1980 to 2013.

#### 2.4.5 Maternal mortality ratio

Maternal mortality ratio is the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births. The data are estimated with a regression model using information on the proportion of maternal deaths among non-AIDS deaths in women ages 15-49, fertility, birth attendants, and GDP (adopted from World Bank description of data).

#### 2.4.6 Proportion of births attended by skilled health personnel

Births attended by skilled health staff are the percentage of deliveries attended by personnel trained to give the necessary supervision, care, and advice to women during pregnancy, labor, and the postpartum period; to conduct deliveries on their own; and to care for newborns (adopted from World Bank description of data). In this study, the dataset came from World Bank starting from 1986 to 2012.

Table 1 shows the summary descriptive statistics of the data used in the study. The results in the table are the inverse common logarithm drawn from the common logarithm output of the lagged data. Based on the preliminary inspection, maternal mortality rate has the most number of missing observation with a total of 93% out of 193 countries in this study. The remaining variables garnered above 95% in the total number of observation. Measurement errors are considered an important factor in empirical studies. In this study, measurement errors are minimized by using averages of the data from 1960 to 2013. In addition, the researcher utilized all indicators that will serve as variable representation of maternal and child health outcomes that will serve as predictors of GDP per capita. Data came from data repository of World Bank.

## 3. RESULTS

### 3.1 Status of Maternal and Child Health

Table 2 presents the case summary of average percentage reduction in infant mortality rate,

under-five mortality rate and maternal mortality ratio; and average percentage increase in proportion of children immunized with measles and proportion of births attended with skilled health personnel per continent. Individual country summary is also available upon request.

Based on the findings of this study utilizing World Bank data, the average percentage reduction since the implementation of Millennium Development Goals until 2013 in infant mortality rate in the world is 3.52% (N=191). The highest was noted in Europe with an average of 3.50% reduction since 2000 while the lowest was noted in Oceana with average of 0.94% reduction for the past 13 years.

On the other hand, the under-five mortality rate in the world has an average reduction of 3.75% (*N=192*) for since starting 2000 to 2013. The highest reduction was noted in Oceana with 4.58% reduction while the lowest was noted in Australia. Meanwhile, there is an average reduction of 10.65% in the maternal mortality ratio (*N=181*) across continents. Highest reduction was observed in Oceana with 17.14% followed by Asia with 14.44% while the lowest reduction was observed in North America with an average reduction of 5.59%.

Consequently, there is an average 0.62% (*N=191*) increase in the proportion of children immunized with measles since 2000. The highest in 13 years was documented in Oceana with 2.31% increase. Consequently, an average increase of 79.25% (*N=176*) in the proportion of births attended with skilled health personnel since 2000 until 2013. The highest was documented in Europe with an average of 95.61% increase while the lowest was recorded in Oceana with only 19.40% increase in the past 13 years.

Findings shows that there is a remaining big percentage in the infant mortality rate, under-five mortality rate reduction and proportion of children immunized with measles increase that countries should work out enable to improve child mortality status. Still, the result implies that even though the percentage presented were not that big, we can appreciate that there is an improvement of child mortality in the world which is less than 4% in both infant mortality and under-five mortality rate, and less than 1% increase in the proportion of children immunized with measles.

On the other hand, a significant percentage was noted in the maternal mortality ratio with almost 11% reduction and proportion of births attended with skilled health personnel with 79% increase since 2000. This implies that over the past decade, there is an improvement in the maternal health as evidenced by the percentage reduction and increase in the maternal health indicators. Still, there is a big opportunity to further improve the maternal health in the world.

### 3.2 Effect of Maternal and Child Health Outcomes to GDP Per Capita

Table 3 shows the model summary and coefficient values table of the model of this study. Among the three proposed models, the researcher utilized model three since among the three, model three has the most significant lesser errors. Model 3 has an F statistics of 199.664 which suggest that it is statistically significant at 99% (p-value <0.01) and the data fits the model. Therefore we reject the null hypothesis and decide to use the model since it accounts for significantly more variance in the criterion variable that would be expected by chance (diagnostic procedures carried out are available in the separate attachment).

Findings of this study shows an R=0.908, R Square=0.824, Adjusted R Square= 0.820 and standard error of the estimate=0.26401. Findings suggest that the predictor variables $IMR_{Log10}$, $IM_{Log10}$, $MMR_{Log10}$ and $HB_{Log10}$ accounts for about 82% of the model which implies a very high degree of correlation. The remaining 18% is attributed to other factors other than the indicators specified in the model. On the average, our estimates of GDP per capita with this model will be wrong by 26.4%.

Table 4 also shows the coefficients table of the model. Looking at the p-value of the t-test for each predictor variables, and the standard errors, we can see that each maternal and child indicators contributes to the model. After running a regression of $GDP_{Log10}$ on infant mortality rate, proportion of children immunized with measles, maternal mortality ratio and proportion of births attended with skilled health personnel, the estimated intercept is 4.809 while the estimated slopes of the variables are: $IMR_{Log10}$ = -0.407 (0.136 error), $IM_{Log10}$ = 0.238 (0.082 error), $MMR_{Log10}$ -0.489 (0.078 error) and $HB_{Log10}$ = -0.205 (0.084 error). Using the values presented in the unstandardized coefficient values, the empirical model would be:

$$GDP_{log10} = 4.809 - 0.407\ (IMR_{log10}) + 0.238\ (IM_{log10}) - 0.489\ (MMR_{log10}) - 0.205\ (HB_{log10}).$$

A t-value of -2.98 for $IMR_{log10}$ is significant at 99% ($p<0.01$). This implies that a percent decrease in infant mortality rate per 1000 live births will increase GDP per capita by 0.41% in US dollars. Next, a t-value of 2.90 for $IM_{log10}$ is significant at 99% ($p<0.01$). This means that a percent increase in proportion of children immunized with measles will increase GDP per capita by 0.24% in US dollars. Furthermore, a t-value of -6.250 for $MMR_{log10}$ is significant at 99% ($p<0.01$). Thus, a percent decrease in maternal mortality ratio per 1000 live births will increase GDP per capita by 0.49% in US dollars. Finally, a t-value of -2.456 for $HB_{log10}$ is significant at 95% ($p<0.05$). This means that a percent decrease in proportion of births attended by skilled health personnel will increase GDP per capita by 0.21% in US dollars.

To illustrate further, Table 4 shows the effect of maternal and child health outcomes to the GDP per capita in percentage of the countries grouped according to their continents. (A complete per country maternal and child health outcomes effect to GDP per capita is also available).

Based on the findings, the mean effect of maternal and child health outcomes is 3.38% of the country's GDP per capita. This implies that supported by statistical evidences and utilizing the model generated in this study, there is a minimum of 2.32% and a maximum of 4.81% of a country's GDP per capita is being affected by the maternal and child health outcomes while the remaining more than 97.68% of the GDP per capita is affected by other factors other than maternal and child health outcomes.

## 4. DISCUSSION

In the realizations of this study, it was found that maternal and child health is indeed a very important form of human capital. As discussed in the introduction, several constructs validated health as an important form of human capital. Since human capital's health contributes to economic growth [13,14,17,18,19,20,21,22, 23,24] this findings quantified the effects of these health outcomes in relation to its effects to the GDP per capita across nations.

Several studies support the findings of this study that health contributes an effect to the economic growth [11,18,12,16,44]. Health was believed to enhance the workers' productivity by increasing their physical capacities, such as strength and endurance, as well as their mental capacities, such as cognitive functioning and reasoning ability. It was expected that there should be a positive relationship between health and productivity. Evidence of this link is increasing at the microeconomic level.

It was found out that there is still remaining big percentage in the infant mortality rate, under-five mortality rate reduction and proportion of children immunized with measles that countries should work out enable to improve child mortality status. Consequently, even though the results were minimal, we can appreciate that there is still an improvement of child mortality in the world which is less than 4% in both infant mortality and under-five mortality rate, and less than 1% increase in the proportion of children immunized with measles. Conversely, a significant percentage was noted in the maternal mortality ratio with almost 11% reduction and proportion of births attended with skilled health personnel with 79% increase since 2000. Truly, there is an improvement in the maternal health as evidenced by the percentage reduction and increase in the maternal health indicators.

Finally, maternal and child health was estimated to affect 2.32% to 4.81% of a country's GDP per capita based on the utilization of the empirical model from the data gathered in the UN countries. Improving the maternal and child health services in terms of promotion and prevention are keys to promote maternal and child health especially in countries that have lower reduction in maternal and child mortality or morbidity ratio. A better maternal and child health as evidenced by reduction in health outcomes ratio in terms of mortality and morbidity would greatly contribute in the reduction of its effects to the economic growth. Although there are so many factors that are affecting the economic growth, still, we cannot neglect the existence of this very small percentage. Once not given priority, this could double or even triple in the coming years.

## 5. CONCLUSION

This paper examined the maternal and child health status of countries across the globe and formulated a regression model to estimate the effect of the maternal and child health outcome status to the country's per capita GDP. Since 2000, there is a 3.52% average reduction of infant mortality rate, 3.75% average reduction of under-five mortality, 0.62% average increase in the proportion of children immunized with measles, 10.65% average reduction of maternal

and 79.25% average increase in the proportion of births attended by skilled health personnel.

Lastly, the mean effect of maternal and child health outcomes to GDP per capita is 3.39%. This implies that based on the empirical findings of this study, there is a minimum of 2.32% to a maximum of 4.81% of the country's GDP per capita that is being affected by the maternal and child health outcomes while the remaining more than 95% of the country's GDP per capita is affected by other factors. This implies that 2.32% of the country's GDP are at risk if maternal and child health status is not acceptable and significantly poor.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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## APPENDIX A

### Table 1. Summary of descriptive statistics

| Variables | N | % | Minimum | Maximum | Mean | Std. deviation |
|---|---|---|---|---|---|---|
| GDP per capita | 190 | 98 | 149.50 | 81749.18 | 6338.07 | 10584.15 |
| Infant mortality rate | 191 | 98 | 4.0 | 163.2 | 54.61 | 39.75 |
| Under-five mortality rate | 191 | 98 | .00 | 291.43 | 81.27 | 69.30 |
| Proportion of children immunized with measles | 191 | 98 | 28.37 | 99.00 | 76.82 | 15.77 |
| Maternal mortality ratio | 181 | 93 | 4.33 | 1800.00 | 248.59 | 327.57 |
| Proportion of births attended by skilled health personnel | 184 | 95 | 7.10 | 100.00 | 78.43 | 25.96 |

*Summary of data gathered from World Bank per indicator of MDG 4 (Infant Mortality Rate, Under-five Mortality Rate and Proportion of Children Immunized with Measles) and MDG5 (Maternal Mortality Ratio and Proportion of Births Attended by Skilled health personnel)*
*Source: Author's calculation*

### Table 2. Status of maternal and child health

| Continent | | Average reduction in infant mortality since 2000 in % | Average reduction in under-five mortality since 2000 in % | Average increase in proportion of immunization since 2000 in % | Average reduction of maternal mortality ratio since 2000 in % | Average increase in proportion of skilled health personnel since 2000 in % |
|---|---|---|---|---|---|---|
| Asia | N | 47.00 | 47.00 | 47.00 | 46.00 | 45.00 |
| | Mean | 4.10 | 4.19 | 0.50 | 14.44 | 81.30 |
| | Minimum | -0.69 | -0.33 | -1.77 | -11.87 | 19.06 |
| | Maximum | 10.43 | 10.80 | 3.69 | 50.46 | 100.00 |
| | Std. deviation | 1.92 | 2.18 | 0.99 | 12.16 | 26.48 |
| Africa | N | 54.00 | 54.00 | 54.00 | 53.00 | 53.00 |
| | Mean | 3.21 | 3.92 | 1.08 | 11.65 | 62.01 |
| | Minimum | 0.00 | 1.12 | -0.85 | -14.07 | 7.10 |
| | Maximum | 7.87 | 9.16 | 3.85 | 30.91 | 99.88 |
| | Std. deviation | 1.59 | 1.66 | 1.10 | 7.84 | 23.33 |
| North America | N | 23.00 | 23.00 | 23.00 | 20.00 | 22.00 |
| | Mean | 2.56 | 2.68 | 0.12 | 5.59 | 87.90 |
| | Minimum | 0.87 | -2.22 | -0.69 | -20.48 | 24.95 |
| | Maximum | 5.13 | 5.42 | 1.69 | 22.51 | 99.90 |
| | Std. deviation | 1.20 | 1.58 | 0.56 | 11.16 | 19.98 |
| South America | N | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| | Mean | 3.50 | 3.67 | 0.16 | 6.05 | 90.28 |
| | Minimum | 1.94 | 2.15 | -0.92 | -21.40 | 67.95 |
| | Maximum | 6.38 | 6.52 | 1.00 | 19.28 | 99.80 |
| | Std. deviation | 1.49 | 1.51 | 0.56 | 12.40 | 10.46 |
| Europe | N | 41.00 | 42.00 | 41.00 | 39.00 | 30.00 |
| | Mean | 4.31 | 4.05 | 0.50 | 8.55 | 95.61 |
| | Minimum | 1.73 | 0.00 | -1.54 | -64.67 | 28.90 |
| | Maximum | 8.68 | 8.63 | 6.77 | 39.18 | 100.00 |
| | Std. deviation | 1.63 | 1.88 | 1.24 | 16.52 | 14.75 |

| Continent | | Average reduction in infant mortality since 2000 in % | Average reduction in under-five mortality since 2000 in % | Average increase in proportion of immunization since 2000 in % | Average reduction of maternal mortality ratio since 2000 in % | Average increase in proportion of skilled health personnel since 2000 in % |
|---|---|---|---|---|---|---|
| Australia | N | 13.00 | 13.00 | 13.00 | 10.00 | 13.00 |
| | Mean | 2.10 | 2.39 | 0.73 | 11.09 | 84.42 |
| | Minimum | 0.22 | 0.25 | -1.85 | -10.47 | 23.80 |
| | Maximum | 4.48 | 5.01 | 5.38 | 26.13 | 100.00 |
| | Std. deviation | 1.17 | 1.26 | 1.62 | 9.99 | 24.10 |
| Oceana | N | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | Mean | 0.94 | 4.58 | 2.31 | 17.14 | 19.40 |
| | Minimum | 0.94 | 4.58 | 2.31 | 17.14 | 19.40 |
| | Maximum | 0.94 | 4.58 | 2.31 | 17.14 | 19.40 |
| | Std. deviation | | | | | |
| Total | N | 191.00 | 192.00 | 191.00 | 181.00 | 176.00 |
| | Mean | 3.52 | 3.75 | 0.62 | 10.65 | 79.25 |
| | Minimum | -0.69 | -2.22 | -1.85 | -64.67 | 7.10 |
| | Maximum | 10.43 | 10.80 | 6.77 | 50.46 | 100.00 |

*Percentage case summaries per continent. The author averaged the reduction and increase of cases since 2000 (where the MDG started) to explore the average reduction of regions per indicator if MDG after 13 years. Reduction was calculated by subtracting the year from the previous year starting 2000 and was averaged until 2013.*
*Per country result is available upon request*
*Source: Author's calculation*

**Table 3. Model summary and coefficient values**

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| (Constant) | 4.817 | 4.734 | 4.809 |
| | 0.161 | 0.160 | 0.162 |
| IMR_Log | -1.383** | - | -0.407*** |
| | 0.559 | - | 0.136 |
| UFMR_log | 0.957* | -0.319** | - |
| | 0.531 | 0.131 | - |
| IM_log | 0.226*** | 0.246*** | 0.238*** |
| | 0.082 | 0.082 | 0.082 |
| MMR_log | -0.522*** | -0.501*** | -0.489*** |
| | 0.080 | 0.081 | 0.078 |
| HB_log | -0.232*** | -0.217** | -0.205** |
| | 0.084 | 0.085 | 0.084 |
| F statistics | 162.477 | 195.697 | 199.664 |
| R | 0.909 | 0.906 | 0.908 |
| R Square | 0.827 | 0.821 | 0.824 |
| Adjusted R | 0.822 | 0.817 | 0.820 |
| Standard error of estimate | 0.26230 | 0.26620 | 0.26401 |
| P-value | Significant at 10% | Significant at 10% | Significant at 10% |

*Source: Author's calculation.*

**Table 4. Effects of maternal and child health outcomes to GDP per capita in percentage**

| Continent | N | Minimum | Maximum | Std. deviation | Mean | % of total N |
|---|---|---|---|---|---|---|
| Asia | 47 | 2.54 | 4.24 | .45449 | 3.3624 | 24.5% |
| Africa | 54 | 2.32 | 4.43 | .34371 | 2.7627 | 28.1% |
| North America | 23 | 2.67 | 4.54 | .47510 | 3.5576 | 12.0% |
| South America | 12 | 2.81 | 3.72 | .25274 | 3.2695 | 6.3% |
| Europe | 42 | 3.45 | 4.81 | .30614 | 4.0954 | 21.9% |
| Australia | 13 | 2.61 | 4.49 | .62468 | 3.6024 | 6.8% |
| Oceana | 1 | 3.09 | 3.09 | . | 3.0890 | 0.5% |
| **Total** | **192** | **2.32** | **4.81** | **.62090** | **3.3865** | **100.0%** |

*Results were forecasted from the model generated from this research utilizing the averaged GDP per capita data of countries from World Bank. Individual country result is available upon request*
*Source: Author's calculation*

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