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# Variations of Infant and Under-five Child Mortality Rates around the World, the Role of Human Development Index (HDI)

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***Abstracts***

***Background*:** The Human Development Index (HDI) is a composite statistic of life expectancy, education, and income per capita indicators, which apart from measuring the socio-economic development of countries can predict health outcomes. The current study aimed at determination of the effects of HDI individual components on infant and child mortality.

***Materials and Methods*:** At a cross- sectional study, data on infant and child mortality rates and values for HDI individual components were obtained from the World Health Organization (WHO) and the World Bank respectively. The effect of HDI individual components on infant and child mortality were derived from linear regression models.

***Results*:** During 1990-2015, infant and child mortality have declined in all countries. Most proportion of child mortality is attributed to death in infants. All HDI individual components significantly inversely were related to infant mortality rate (IMR) and among them expected years of schooling has the strongest effect with regression coefficient of β= -5.9 (95% CI: -6.63, -5.13).

***Conclusion*:** The highest IMRs have been observed for EMRO and AFRO regions of the WHO. Policies targeting women health and empowerment can have a tremendous impact on reducing child mortality rates around the world.

***Key Words***: Infant mortality, Ecological study, Human development Index.

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## 1- INTRODUCTION

The 20th century had experienced two dramatic changes including the rapid economic growth and plummeted human mortality rates down. Life expectancies doubled, entailing major immediate improvements in human welfare, dramatic declines in fertility and, consequently, transformations of the age structures of populations and their economic environment (1). It is now clear that health (measured by life expectancy or different mortality rates) is an important determinant of economic growth, while economic growth encourages further accumulation of health capital (2). Among different health indicators, child and infant mortality rates are major contributors to the overall global mortality. They also are one of the most important indicators for maternal health, quality and access to medical care, public health practices, and especially socioeconomic conditions (3). It is well established that infant mortality has been observed more frequently among low socioeconomic status communities (4, 5).

In addition, the World Health Organization's Commission on Macroeconomics and Health also clarified that health directly affects economic development through human capital (such as education, job training, physical and cognitive development) and corporate capital (organizing of the labor force, investment opportunities). Therefore, in the process of economic development, the positive association between health and economic growth seems to be an intuitive one (6). A series of panel studies have shown that mortality is procyclical with respect to the business cycle which means that mortality rates tend to increase/ decrease during economic expansion (contraction) (7, 8). Research has also shown that higher levels of inequality in income among nations, states are associated with higher mortality (9). Having investigated economic growth associated with mortality rates (8, 10, 11), unequal distribution of Human Development Index (HDI) has not been investigated yet. HDI is comprised of three components namely education, life expectancy and gross national income (GNI) with ranges between 0 to 1, and is appropriate for defining socio-economic status of the societies (12). This study aimed to identify the variations in infant and under-five mortality rates by HDI levels among world countries.

## 2- MATERIALS AND METHODS

### 2-1. Study design

This is a cross- sectional study on the relation between infant mortality rates (IMR) and child mortality rates with the Human Development Index. Data on mortality rates of countries for year 2015 were obtained from World Health Organization (WHO) available at: http://www.who.int/gho/child_health/mortality/neonatal_infant_text/en/. Data about the HDI and its components were obtained from the World Bank Report 2015 available at: http://databank.worldbank.org/data/reports.aspx.

### 2-2. Data analysis

The analysis was carried out according to 6 regions of WHO' namely: Africa (AFRO), Americas (PAHO), South East Asia (SEARO), Europe (EURO), Eastern Mediterranean (EMRO), and Western Pacific (WPRO). All the analysis were done using components of HDI including: Life Expectancy at Birth, Mean and expected Years of Schooling, and Gross National Income. All countries were stratified into four categories by HDI. Comparisons among HDI categories (very high, high, medium, and low) were done with One-way ANOVA. All analyses were conducted at 0.05 using Stata software version 12 (StataCorp, College Station, Texas, USA).

## 3- RESULTS

Overall 181 countries were included in our analysis. According to World Health Organization, the infant mortality rates (per 1000 live births) for AFRO, PAHO, SEARO, EURO, EMRO and WPRO were: 28, 6.6, 24.3, 6, 26.6 and 6.7 respectively. In compared to 1990, in all parts of the world, IMR has declined dramatically (**Figure.1**).

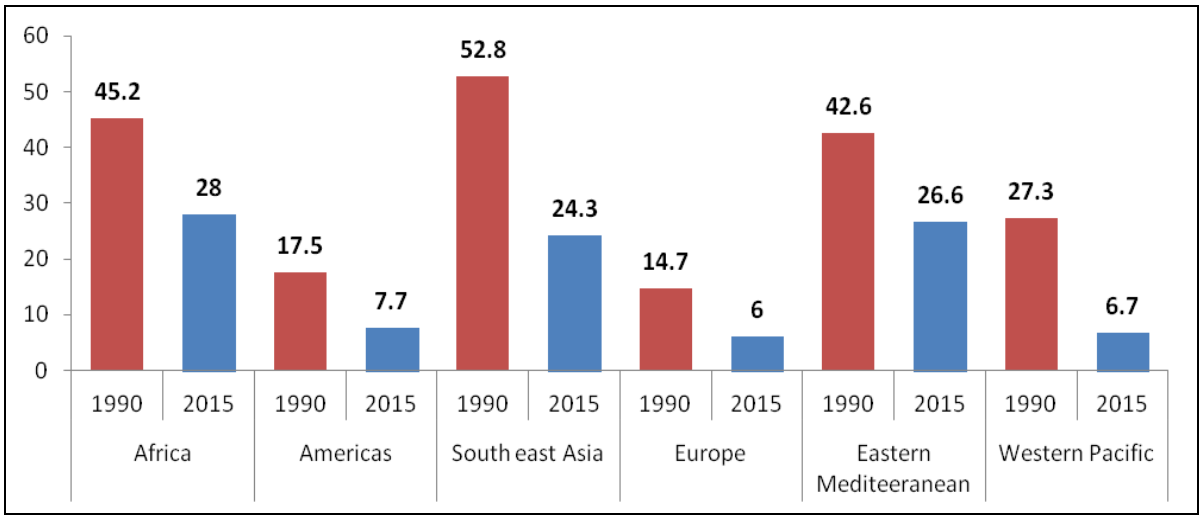


**Fig. 1:** Comparison of Infant mortality rate according to all WHO regions (1990 & 2015)

**Figure.2** shows different causes of death in infants and children under-five. Pneumonia was the main cause of death in respective age groups. Moreover, intrapartum related complications were comprised as the second cause of death.

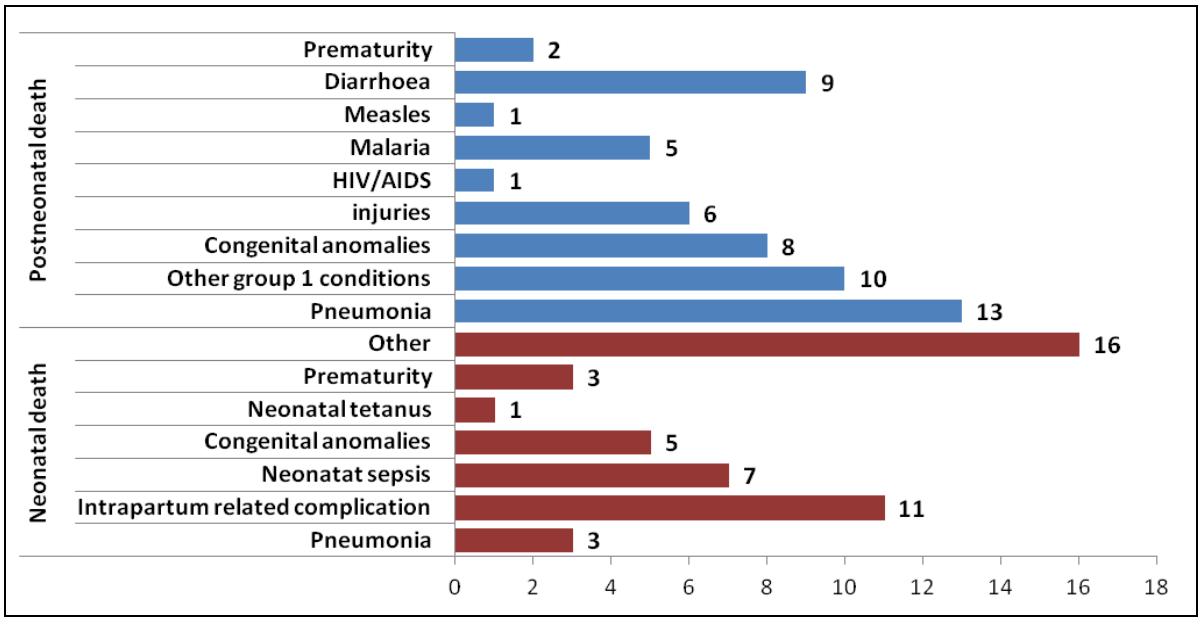


**Fig. 2:** Percentages of causes of death among children's under-five globally, 2015

In 2015, the level of HDI were labeled as *very high* in 12 countries, *high* in 34 countries, *moderate* in 104 countries, and *low* in 31 countries. The mean and standard deviation (SD) of the IMR in respective categories of HDI were 3.3 (0.3), 4.32 (0.44), 23.15 (1.68), 55.4 (2.87), respectively (P-value<0.001). In

addition, the portion of under-five mortality rate attributable to IMR ranged from 35% in AFRO to 54% in WPRO (**Figure.3**).

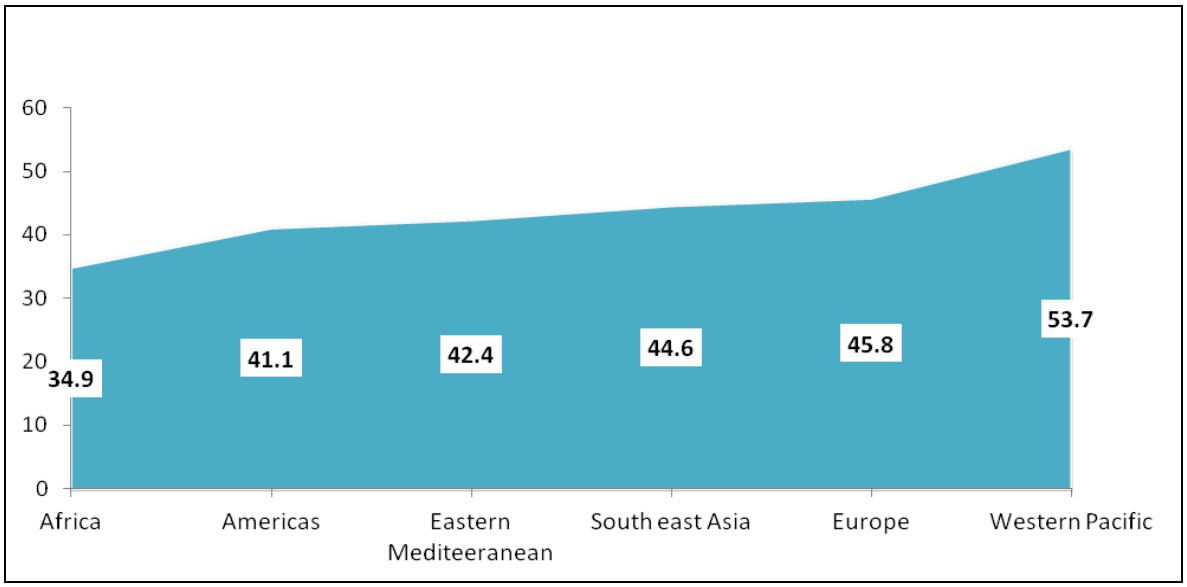


**Fig. 3:** Proportion of infant deaths in under-five mortality rates globally, 2015

All HDI components were found to have significantly negative effects on IMR while Total Fertility Rate (TFR) showed the opposite. Regression coefficients of HDI components with respective 95% Confidence Intervals (CI) on IMR are presented in **(Table.1)**. The results showed that for every 1 unit increase in life expectancy at birth, mean years of schooling, gross national income per 1000 capita and expected years of schooling the levels of IMR will decrease by -2.28, -5.36, -0.7, -5.7 and -5.9 respectively. However for increase 1 unit in TFR, the level of IMR will increase by 13.

**Table 1**: Univariate model of HDI components and TFR on Infant mortality rates, 2015

| HDI components | β | CI | P-value |
|---|---|---|---|
| Life expectancy at birth | -2.28 | (-2.44, -2.12) | <0.05 |
| Mean years of schooling | -5.36 | (-6.07, -4.66) | <0.05 |
| Gross national income per 1000 capita | -0.7 | (-0.86, -0.54) | <0.05 |
| Expected years of schooling | -5.9 | (-6.63, -5.13) | <0.05 |
| Total fertility rate (TFR) | 13 | (11.68, 14.32) | <0.05 |

## 4- DISCUSSION

This ecological study highlighted the relationships between countries development levels and infant and child mortality rates. The results showed that infants and child mortality rates have declined in all countries around the world during 25 years period (1990-2015). Variations in HDI components can influence IMRs. French stated that 41% reduction in under-five mortality based on Millennium Development Goals (MDGs) is not only due to more healthcare or public health interventions but is driven by a coincidental burst of economic growth (13). The rate of infant mortality for

Europe and Americas (6/1000 and 6.6/1000) are similar to what that Organization for Economic Cooperation and Development (OECD) reported for year 2011. They documented that nearly all nations of Central and Eastern Europe except for United Kingdom (UK) and Luxembourg had IMRs below 5.0 per 1000 live births (14).

We found that there was an inverse relationship between IMRs and HDI components levels in the world, such that lowest mean of IMRs belonged to very high HDI levels and vice versa. This finding can be considered from different aspects. The **first**, women in wealthy nations have been empowered (10). The literature showed that three measures of women empowerment including the level of education, participation in household decisions and autonomy in movements contribute significantly to the reduction of infant mortality (15, 16). The **second**, the role of income inequality in mortality differences around the world worth further explanation (17). Several studies have shown that income inequality is indeed a predictor of a variety of measures of population health including mortality (11). The underlying theory is that concentration of economic resources at the top of the income distribution may lead to decline in social capital and cohesion of political power (18). In turn, the cascade of social and economic changes create stressful conditions which may lead to non-healthy behaviors mostly manifested through markers such as low-birth weight or infant mortality (19, 20). However, inequality and health outcomes are not tidy correlated at the population-level among the wealthy nations. Most of the body literature regarding income inequality came from cross-sectional studies which shed light on the problem of confounding variables(21).

**The third**, economic cycles which contain growth and recession periods in least developing countries play a crucial part in child mortality. A decrease in GDP per capita entails a significant rise in child mortality rates, whereas an increase may not have a significant affect(22).

**The forth**, social inequalities in infant mortality are more pronounced among countries in the North Africa and West Asia, where countries have the highest rates of infant mortality (IMR: 28/1000 live births). Social inequalities specifically lower ages of the mother and short birth intervals are generally higher in developing and under-developed countries than other regions of the world (23, 24).

Although reducing infant mortality has been a major objective of national governments and international organizations over the last decades, there is a growing call to address not only average population levels, but also inequalities in child health (25). Understanding the sources of these inequalities is an important next step. Our results suggest that both policies to support completion of secondary education by girls and to reduce early marriage of girls are applicable for low-income households (23). Further studies aimed at identifying factors explaining social inequalities in teenage pregnancy may help to inform appropriate policies to reduce this risk factor among the poor.

### 4-1. Limitation

This study has several limitations, the most important being the aggregated nature of the data that did not allow inclusion of socio-economic variables at the individual level. Furthermore, differences in coding diagnoses and procedures between countries posed another important limitation. Additionally, we are aware that the existing dynamic relationship between health progress and economic growth may be confounded by social, cultural, and lifestyle, and other economic factors (8). Despite a number of limitations, our study provides evidence

from a large and relatively cheap source of real world data on major determinants of mortality.

## 5-CONCLUSION

We found that infant mortality entails a great portion of under-five mortality rates in countries with moderate and low HDI levels. The highest IMRs have been observed for EMRO and AFRO regions of the WHO. Most of deaths in under-five children around the world can be attributable to infections and intrapartum complications. Policies targeting women health and empowerment can have a tremendous impact on reducing child mortality rates around the world.

## 6- CONFLICT OF INTEREST: None.

## 7- ACKNOWLEDGMENTS

This paper used data from the WHO and the World Bank.

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