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# The burden of non-communicable diseases in relation to economic status of countries

## Ruqiya Pervaiz[1,2,*], Özlem Ercantan[1]

[1]Near East Universty, Faculty of Health Sciences, Department of Medical Genetics, Nicosia, 99138, North Cyprus

[2]Abdul Wali Khan University, Department of Zoology, Mardan, 23200, Pakistan

## Abstract

**Background:** The aim of this study was to investigate the correlation between mortality from non-communicable diseases (NCDs) and national human development index (HDI) of a country, as well as investigate the correlation between premature mortality from NCDs and national HDI. **Method:** Data for age-standardized mortality rate (ASRM) of NCDs and premature mortality (before age 70 years) in percentage for total NCDs in 2015 were obtained from the World Health Organization (WHO) databases. National HDI data for the year 2015 were obtained from the 2015 Human Development Report. Linear regression model was used for assessment of correlation between HDI and mortality. One-way ANOVA was used to test the difference in mean mortality of various HDI group countries; P ≤ 0.05 was considered significant. **Results:** The results suggested an inverse correlation between HDI and ASRM for both men and women. The negative relation was also reported for percentage premature mortality and HDI. Tukey post hoc test (p < 0.001) indicated that countries with very high HDI have low ASRM and premature mortality (compared to those with high HDI and so on). The greatest mortality was observed in low HDI countries. **Conclusion**: Management of non-communicable diseases is one of the greatest challenges for low and middle HDI countries. In order to control the disease burden, governments should pay serious attention to their economic development.

## Keywords

Age-standardized mortality, Human development index, Non-communicable diseases, Premature mortality

## Introduction

Non-communicable diseases (NCDs) are the leading cause of death worldwide. NCDs comprise cardiac diseases, stroke, diabetes, respiratory diseases, and cancer (WHO 2015). Among these, the fraction of highest mortality is attributed to cardiovascular diseases, followed by cancer, chronic obstructive pulmonary disease, and diabetes (Murray et al., 2012).

The common risk factors for the top four NCDs (cardiovascular disease, cancer, diabetes, and chronic pulmonary diseases) are smoking, alcohol use, lack of physical activity (Lozano et al., 2012), and unhealthy diet (Pervaiz et al., 2017). About 80% of deaths from NCDs result from the above 4 diseases (Lozano et al., 2012).

According to the estimations of the WHO, NCDs are responsible for 36 million deaths in 2008, which represents 63% of all (WHO, 2011). Approximately 80% of these NCD-related mortalities are reported in middle and low Human Development Index (HDI) countries with a high proportion of premature mortality before age 60 (WHO, 2013). By 2020, NCDs are predicted to account for 80% of the global burden of diseases; more than two-thirds of deaths will be in developing countries and half of the deaths will be premature deaths (under 70 years of age) according to the WHO data (WHO, 2013).

Moreover, according to the WHO estimation, in the next ten years, 17% increase in the global burden of NCDs (WHO, 2013). NCDs account for almost half of all deaths in Asia, and represent 47% of the global disease burden (WHO, 2013). In developing countries, the mortality of NCDs is very high; for instance, cardiovascular disease and diabetes account for 80% of mortality cases, chronic lung diseases account for 90%, and two-thirds of all cancer deaths are reported from developing countries (Hancock et al., 2011).

NCDs are obstacles to socioeconomic development (Beaglehole et al., 2011). In developing countries, people are more exposed to behavioral risk factors arising from poverty; consequently, poverty increases due to NCDs (Beaglehole & Yach 2003).

We aim to investigate the correlation between the socioeconomic status of countries and NCD-associated mortality as well as between premature mortality under age 70 years (expressed as % of all NCDs).

## Methods

### Data Acquisition

The ASRM of NCD and premature mortality in percentage of total NCD (WHO, 2015) for 2015 were obtained from the World Health Organization (WHO) databases for 183 countries. Data for National HDI for 2015 were obtained from the Human Development Report 2015 (Jahan et al., 2015). All data were obtained for 183 countries in the world. These countries were categorised into four groups on the basis of HDI. Three parameters (i.e. life expectancy at birth, mean years and expected years of schooling, and gross national income per capita) collectively comprise the HDI. The values range from 0 to 1 and there are four categories (Low HDI < 0.536, medium HDI 0.536-0.711, high HDI 0.712-0.804, and very high HDI ≥ 0.805). These countries of the world were classified into the above four categories.

### Analysis

Linear regression model was used for the assessment of correlation between HDI and NCD-related mortality (ASRM and premature mortality % of all NCDs). One-way ANOVA is used to test the difference in mean mortality of the four different HDI groups countries; $P \leq 0.05$ is considered significant. SPSS version 20 was used for all statistical analyses.
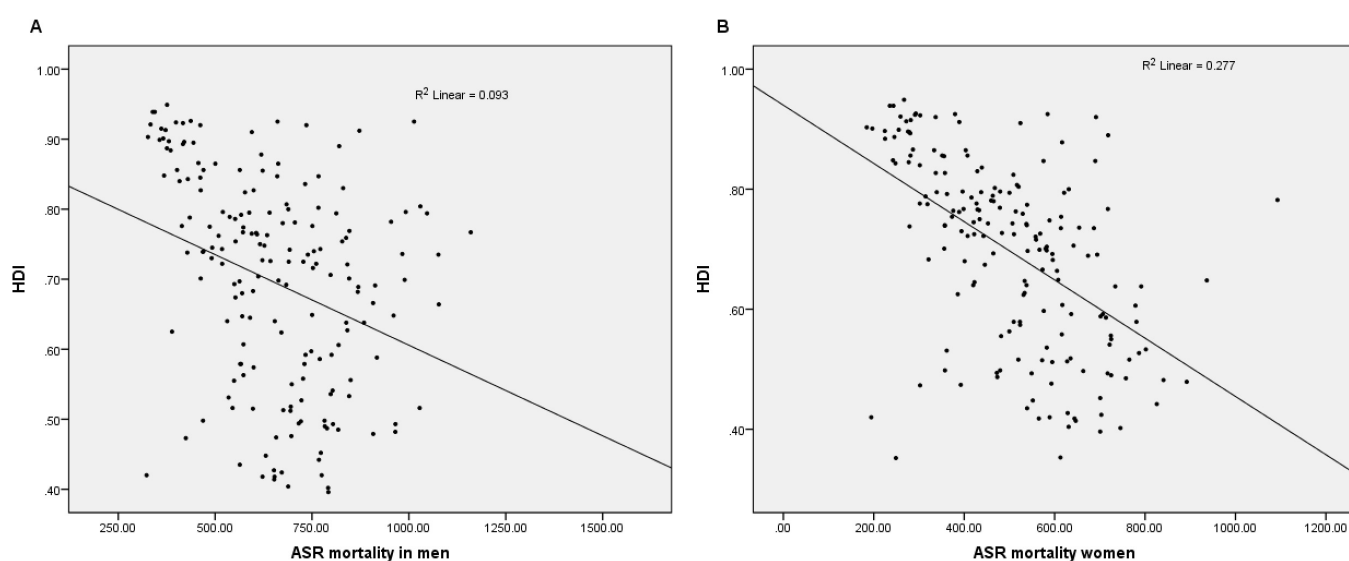


**Figure 1.** **Relation of National HDI and age-standardized mortality from NCDs in men (A) and women (B).**
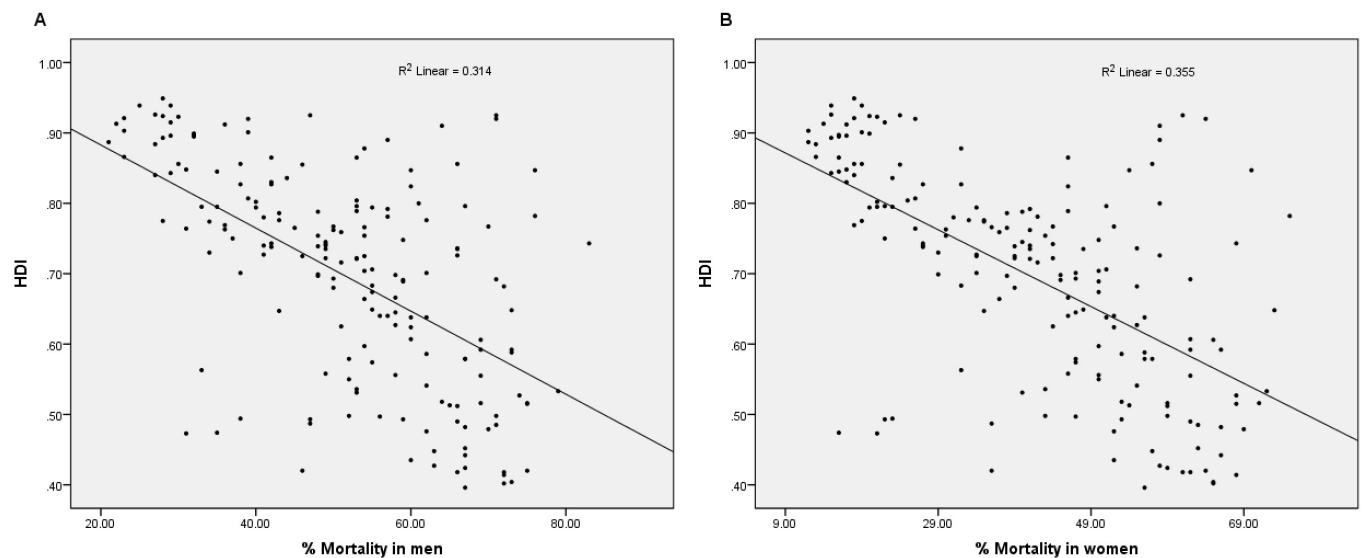
**Figure 2.** Relation of National-HDI and premature mortality % to total NCD in men (A) and women (B).
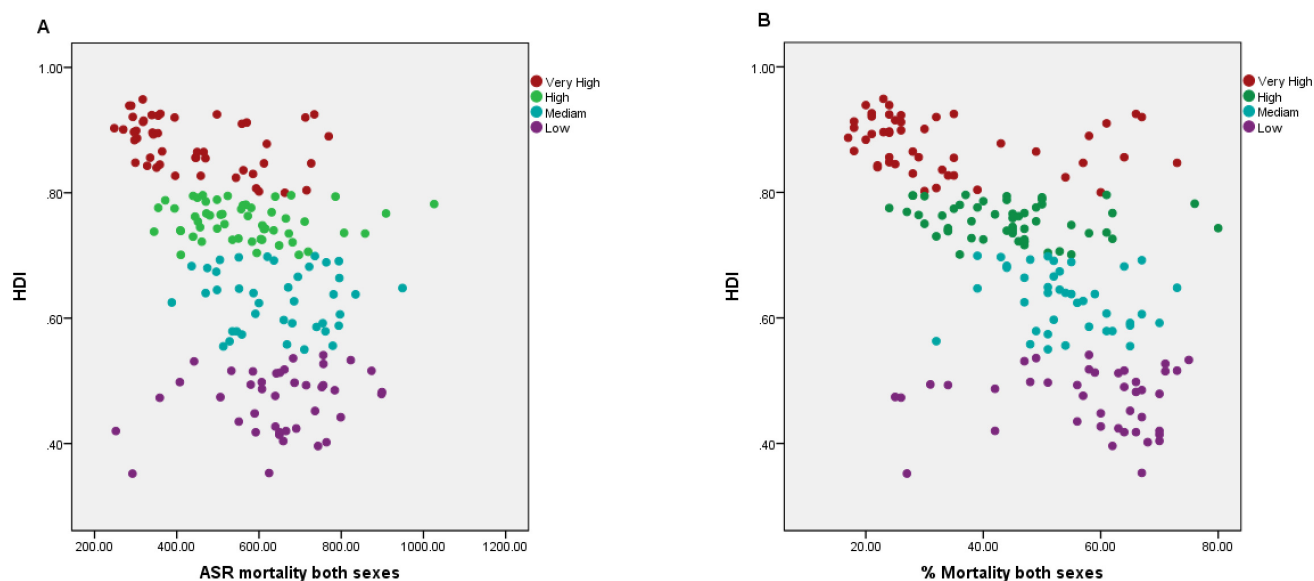
## Results

Pearson correlation suggested an inverse correlation between HDI and ASRM in both men (r =-0.305; p<0.001) and women (r=-0.526; p<0.001). Negative correlation was also reported for % of premature mortality and HDI (r=-0.560; p<0.001 for men; r =-0.596; p <0.001 for women).

Correspondingly, linear regression analysis also demonstrated a negative effect of HDI on ASRM (adjusted $R^2$=0.093, β =-0.305, p<0.001 for men and adjusted $R^2$ =0.273, β =-0.526, p<0.001) (**Fig. 1A, 1B**). In addition, there was negative effect of HDI on % premature mortality (adjusted $R^2$=0.314, β=-0.560, p<0.001 for men; adjusted $R^2$=0.355, β=-0.596, p<0.001 for women) (**Fig. 2A, 2B**).

Tukey post hoc test (p < 0.001) demonstrated that countries with very high HDI have low ASRM and premature mortality than those with high HDI and so on. The highest mortality rate was indicated in low HDI countries (**Table 1**) (**Fig. 3A, 3B**).

**Table 1.** Mean mortality from NCDs (ASRM per 100,000) and premature mortality (% of all NCDs before age 70) in different HDI-group countries

| NCD mortality (ASRM per 100,000) | HDI-group | N | Mean ± standard deviation |
|---|---|---|---|
| NCD mortality in both sexes (ASR per 100,000) | Very High | 48 | 442.79 ± 149.27 |
| | High | 54 | 568.35 ± 140.72 |
| | Medium | 40 | 646.43 ± 129.03 |
| | Low | 41 | 646.37 ± 146.99 |
| | Total | 183 | 569.96 ± 163.41 |
| NCD mortality in men (ASR per 100,000) | Very High | 48 | 536.94 ± 185.15 |
| | High | 54 | 674.03 ± 177.10 |
| | Medium | 40 | 717.57 ± 156.62 |
| | Low | 41 | 701.78 ± 151.40 |
| | Total | 183 | 653.80 ± 182.80 |
| NCD mortality in women (ASR per 100,000) | Very High | 48 | 371.10 ± 143.43 |
| | High | 54 | 483.66 ± 133.20 |
| | Medium | 40 | 590.21 ± 128.91 |
| | Low | 41 | 602.70 ± 160.42 |
| | Total | 183 | 504.10 ± 168.26 |
| **Premature mortality % of all NCDs before age 70** | | | |
| % mortality before age 70 (both sexes) | Very High | 48 | 33.50 ± 15.54 |
| | High | 54 | 44.39 ± 11.58 |
| | Medium | 40 | 54.13 ± 8.980 |
| | Low | 41 | 57.76 ± 13.64 |
| | Total | 183 | 46.66 ± 15.71 |
| % mortality before age 70 (men) | Very High | 48 | 39.96 ± 14.86 |
| | High | 54 | 49.74 ± 11.53 |
| | Medium | 40 | 58.30 ± 8.860 |
| | Low | 41 | 61.93 ± 12.32 |
| | Total | 183 | 51.78 ± 14.71 |
| % mortality before age 70 (women) | Very High | 48 | 27.08 ± 16.55 |
| | High | 54 | 38.37 ± 11.68 |
| | Medium | 40 | 49.88 ± 9.780 |
| | Low | 41 | 53.44 ± 15.23 |
| | Total | 183 | 41.30 ± 16.95 |

**Figure 3.** Relationship of National HDI to ASRM (A) and National-HDI to % Mortality (B) from NCD for both sexes.

## Discussion

The results from 183 countries in the world indicated an inverse correlation between NCD-related mortality and HDI. Likewise, it was shown that HDI is inversely related with NCD-associated premature mortality. There is a direct correlation between ASRM and premature mortality (r=0.719, p>0.001). The highest NCD mortality was reported in medium and low HDI countries.

Previous studies have suggested that in high-income countries the proportional mortality from NCD is higher than low and middle HDI countries. The reason for this is that low mortality rates from infectious diseases, and mother and child death rates, are prevalent in the higher income countries. Nevertheless, the absolute number of mortality from NCD is higher in the middle and low HDI countries due to a larger population in these countries. Similarly, the ASRM from NCD in these low and middle HDI countries is high (WHO, 2011).

Cardiovascular diseases are the primary cause of death globally (Murray et al., 2012). The ASRM from cardiovascular diseases declined since the 1980s, with the most remarkable decline in high-income countries such as North America, Western Europe, and Australia. While in South Asia and former Soviet Union countries, the ASRM increased in the 1990s and decreased after 2000. Central Asia and Eastern Europe had their highest cardiovascular disease mortality in 2010. On average, higher premature mortality of cardiovascular diseases was reported in South Asia, North Africa, the Middle East, and Sub-Saharan Africa (Moran et al., 2014).

Cancer is the second most common cause of death globally after cardiovascular diseases (Murray et al., 2012). County-wide studies have indicated an increasing trend of cancer incidence (Pervaiz et al., 2017). The mortality to incidence ratio of cancer is highest in the low and medium income countries of Africa (Pervaiz & Faisal, 2017) as well as in other parts of the world (Bray et al., 2012).

## Conclusion

It is concluded that NCDs represent the largest health burden in low and medium HDI countries. Governments and stakeholders in low- and-medium- HDI countries should make serious efforts in improving economic development in order to control NCDs, which have become a major global health concern.

## Abbreviations

ANOVA: Analysis of variance
ASRM: Age-standardized mortality rate
HDI: Human development index
NCDs: Non-communicable diseases
SPSS: Statistical Package for Social Sciences
WHO: World Health Organization

## Author Contribution

RP participated in the conception of the study, data acquisition, interpretation and drafting the manuscript. ÖE critically revised the article for important intellectual content.

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