Premature stroke mortality and disparities in the Americas

Student Name: Ario Mirian
Program Stream: Implementing Innovations on a Global Scale
Scholarly Paper Advisor: Dr. Pedro Ordunez
Practicum Organization: Pan American Health Organization/World Health Organization; Noncommunicable Diseases and Mental Health Unit
Practicum Supervisor: Dr. Pedro Ordunez

Background: In the Americas, despite cardiovascular diseases (CVDs) being the leading cause of death from 2000-2013, a decline in mortality of 6.51% was observed during this time period (7.88% among women and 5.13% among women).[1] A trend series analysis on premature mortality due to CVDs demonstrated a decline in the Americas by 21% in the period 2000-2010 with a -2.5% average annual rate of change in the last 5 years – a statistically significant reduction of mortality.[2] Mortality from overall ischemic diseases declined by 25% (24% among men and 26% among women) yet specific trends in premature stroke within the Americas region were not described. Considering the major demographic shifts in the Americas[3] and the global epidemiological changes in stroke mortality[4,5,6] it is valuable to determine the trends and burden of premature stroke mortality in this region.

Adequate knowledge of mortality rates and burden of each subtype of stroke is important because of the differences in acute treatment and management as well as lethality rates. Measurements of premature mortality from strokes is representative of the effectiveness of a nation's public policies at preventing and postponing strokes, the ability of a country's healthcare system to diagnose, treat, and manage premature acute strokes, and is less likely to be confounded by co-morbidities in older age. Trends in this age group will also provide insight into Pan American Health Organization's progress towards the goal of reducing premature mortality due to CVDs by 25% before 2025 and the possible impact of country specific programs at reducing CVD burden.

Objectives: The objectives of this study was to identify the demographic patterns of premature stroke mortality at the present time, to determine the trends of premature stroke mortality during the 1998-2013 period in the Americas, and to identify any disparities between countries. We also sought to determine any correlations between economic indicators and premature mortality due to cerebrovascular diseases.

Methodology:

Sources of Data and Case Definition: This study extracted mortality data from the PAHO/WHO Regional Mortality database, which comprises deaths registered in national vital registration systems and are reported annually by national authorities in each country.[7] The World Population Prospects (2012) from the United Nations Population Division was the source of mid-year population used to calculate premature mortality rate.[8] The WHO World Standard Population was used to calculate age-specific mortality rates by direct standardization.[9] To explore the association between premature mortality due to stroke and economic status, we used the income group classification developed by the World Bank, which is based on Gross National Income (GNI) per capita.[10] Health expenditure per capita[11] and health expenditure as a percentage of total Gross Domestic Product (GDP)[12] were also retrieved from the World Bank.

Deaths due to stroke were defined as all deaths whose underlying cause was classified in the subgroup cerebrovascular diseases (I60-I69) of Chapter IX, Diseases of Circulatory System (I00-I99) of the ICD-10. A premature death was defined as a death occurring among people aged 30-69 years old, considering the life expectancy in the countries of Americas[13] and the WHO proposal on NCDs global targets and indicators[14]. The criterion to include countries in this study was to have time-series available for the study period, 1998-2013, and a population size of over 50,000 inhabitants. A total of 38 countries were included and 11 were excluded. Data from countries for which a small population (< 100,000 inhabitants) and number of deaths would lead to fluctuations in death rates were not included in regional calculations.

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Measurements: The focus of this analysis is the population-based trend-series. First, a descriptive analysis was carried out to characterize the current status of premature mortality due to stroke in each country and in the Americas, using the information from the latest year available (2013).

Age-specific premature mortality rates (ASMRs) were calculated by multiplying age-specific mortality rates from each cause- and sex- specific strata with the appropriate weight in the standardized population. The sum of products across all groupings within the 30-69 age range were obtained to calculate the overall age-specific premature mortality rates for each cause- and sex- specific strata.

The unconditional probabilities of dying between the ages of 30-69 years from the combined cause categories were also calculated. We used a life table method to calculate the risk of premature death from any of these causes in the absence of other causes of death. Specific mortality rates for each five-year age group were then calculated for each country using the aforementioned ICD codes for the respective cause categories. Specific mortality rates for each five-year age group were then translated to the respective probabilities of death using the formula in Figure 1. The result was included in the formula in Figure 2 to calculate the overall unconditional probability of premature dying from all cause categories at exact ages of 30-69.

Figure 1.

$$ {}^{*}_{5}q_x = \frac{{}^{*}_{5}M_s * 5}{1 + {}^{*}_{5}M_x * 2.5} $$

Figure 2.

$$ {}^{*}_{40}q_{30} = 1 - \prod_{x=30}^{65} (1 - {}^{*}_{5}q_x) $$

Trends: A trend analysis was undertaken using the Joinpoint Regression Program, from the National Cancer Institute. This analytic technique is employed to detect statistically significant changes in trends over time by fitting the simplest joinpoint model that the data allow. The program identifies points where the slope of the linear trend changes significantly and provides estimates of the average annual percentage of change (AAPC) and confidence intervals. In this study, the dependent variable was the age-specific rate with year as the independent variable and by-variables included sex and income group classification. Constant variation was assumed for all AAPC calculations. Relationships between GNI per capita and ASMRs and AAPC of the last 5 available years were analyzed by calculating Pearson product- moment correlation coefficients (r). Correlations between health expenditure (per capita and as a percentage of total GDP) and ASMRs were also done.

Disparities: Disparities of premature mortality rates from cerebrovascular diseases were compared between included countries. Mortality rate ratios were used to quantify the disparities of premature mortality rates between countries. This was done by dividing the mortality rates of the country of interest by a benchmark country defined as the country with the lowest premature mortality with respect to the cause category. Absolute numbers of excess premature deaths for each cause were also calculated by subtracting the benchmark country's cause-specific deaths from the total cause-specific deaths in the country of interest using data from the latest year available.

Ethical Considerations: As this study analyzed anonymous secondary data on mortality, no ethics approval was required.

Results: The first iteration of results have been completed but are not described here due to a confidentiality agreement. Please contact the author for any related inquiries.