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2017

Women rights and stroke outcomes

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Countries with women inequalities have higher stroke mortality

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International Journal of Stroke
0(0) 1–6

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DOI: 10.1177/1747493017694389

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Abstract

Background: Stroke outcomes can differ by women's legal or socioeconomic status.

Aim: We investigated whether differences in women's rights or gender inequalities were associated with stroke mortality at the country-level.

Methods: We used age-standardized stroke mortality data from 2008 obtained from the World Health Organization. We compared female-to-male stroke mortality ratio and stroke mortality rates in women and men between countries according to 50 indices of women's rights from *Women, Business and the Law 2016* and Gender Inequality Index from the Human Development Report by the United Nations Development Programme. We also compared stroke mortality rate and income at the country-level.

Results: In our study, 176 countries with data available on stroke mortality rate in 2008 and indices of women's rights were included. There were 46 (26.1%) countries where stroke mortality in women was higher than stroke mortality in men. Among them, 29 (63%) countries were located in Sub-Saharan African region. After adjusting by country income level, higher female-to-male stroke mortality ratio was associated with 14 indices of women's rights, including differences in getting a job or opening a bank account, existence of domestic violence legislation, and inequalities in ownership right to property. Moreover, there was a higher female-to-male stroke mortality ratio among countries with higher Gender Inequality Index ($r = 0.397$, $p < 0.001$). Gender Inequality Index was more likely to be associated with stroke mortality rate in women than that in men ($p < 0.001$).

Conclusions: Our study suggested that the gender inequality status is associated with women's stroke outcomes.

Keywords

Stroke, women, outcome, gender inequality, mortality

Received: 26 July 2016; accepted: 13 November 2016

Introduction

Globally, stroke is a leading cause of death and disability representing its highest burden among women from low- and middle-income countries.¹ Compared to men, stroke is more prevalent in women at older ages due to a longer life expectancy, disparities in stroke prevention, and differences in stroke mechanisms.²

Gender differences in stroke outcomes can be dependent on multiple factors, including: genetics, hormonal, anatomic or physiologic differences, as well as, different risk factor profiles or clinical presentations.^{2,3} Further, social, environmental, or legal gender inequalities may lead to poorer outcomes in women after stroke.^{4,5} The underlying explanation may be that gender inequality covering women's legal rights or socioeconomic status is associated with women's

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health outcome.⁵ Nevertheless, the potential relationship between underlying gender inequalities and women's stroke outcomes has not been explored. We hypothesized that women inequalities, measured by the differences in social indices and by the Gender Inequality Index (GII), is associated with higher stroke mortality.

In this study, we investigated the association between gender inequalities and stroke mortality at the country-level.

Methods

Data sources: Indices of women's status by country-level

Women's rights status was derived from *Women, Business and the Law 2016*.⁶ It builds on the growing body of research and empirical evidence that stresses the importance of legal and institutional frameworks in shaping women's economic rights or opportunities and in improving gender equality. *Women, Business and the Law 2016* draws on real comparable data across several indicators, including: access to health care institutions, women's rights to using property, getting a job, access to incentives in women versus men, financial credit for building a property, women's rights when going to court, and protecting women from violence. For this study, among a total of 142 indices, we excluded the 57 indices because of incomplete descriptive data. Of the remaining 85 indices, 35 indices were further excluded due to poor face-validity when evaluating the biologic plausibility of their associations with stroke outcomes. Finally, we evaluated 50 indices regarding access to institutions (n = 14), access to financial credit to property building (n = 2), access to jobs (n = 4), protecting women from violence (n = 20), providing incentives to work (n = 6), and property rights (Supplementary Table 1).

We also collected country-level information of the GII.⁷ The GII is a composite measure, introduced by the United Nations Development Programme, to compare gender inequalities in reproductive health, empowerment, and labor market participation.⁷ GII values range between 0 and 1, where higher values indicate higher levels of inequalities. The GII for the year 2008 was used in this analysis.

Stroke mortality and country income level

Stroke mortality in women and men were obtained from the World Health Organization (WHO).⁸ Death estimates of 2008 were based on analysis of latest available national information on levels of mortality and cause distributions, and the death rates were age-

standardized to the WHO global standard population.⁹ Stroke was defined according to the International Statistical Classification of Diseases, ninth codes 430–438, or tenth revisions codes 60–69 as defined in the WHO report.⁹

Outcome measures

The primary outcome measure for the present study was female-to-male stroke mortality ratio. The secondary outcome was mortality rate per 100,000 in each sex group.

The country income level and geographic location were determined based on the World Bank definitions.¹⁰

Statistical analysis

For comparison of the difference in stroke mortalities by indices of women's rights, we used the t-test. Spearman test with two-tailed was used for determining the relationship between the GII and female-to-male stroke mortality ratio. We analyzed the difference in the correlation coefficients between GII and stroke mortality rate in women and men using Wolfe's test. We also used a multiple linear regression model for adjusting country income level. Finally, $p < 0.05$ was considered as statistically significant. Analyses were performed using the Windows IBM SPSS software package (version 21.0, Chicago, IL, USA) or R software package version 3.3.0 (<http://www.R-project.org>).

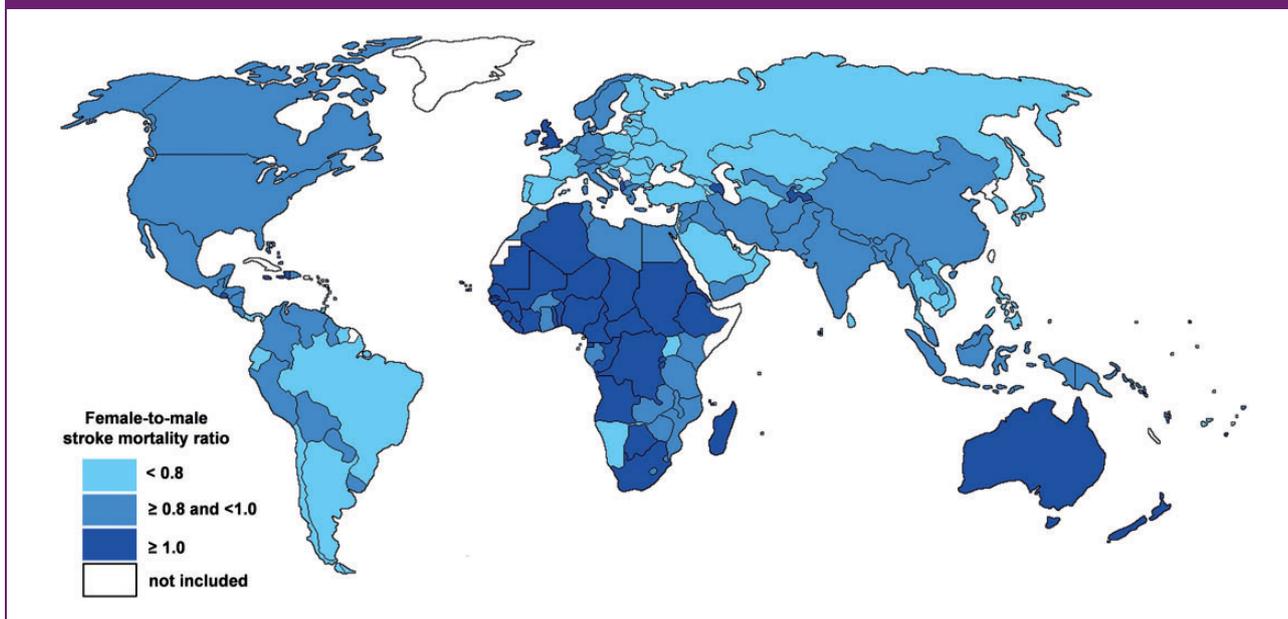
Results

Among 193 countries with data available on stroke mortality rate in 2008, 176 countries were included for this analysis, after excluding 17 countries whose data on indices of women's rights were not available (Supplementary Table 2).

The median (Q1, Q3) female-to-male stroke mortality ratio was 0.89 (0.78, 1.03). There were 46 (26.1%) countries where stroke mortality rate in women was higher than that in men (Figure 1). Among them, 29 (63%) countries were located in the Sub-Saharan African region, followed by East Asia and Pacific (n = 5), Europe and Central Asia (n = 5), and Middle East and North Africa (n = 3).

After adjusting country income level (high- vs. low- to middle-income country), 14 indices of women's rights including getting a job or opening a bank account, existence of domestic violence legislation, or equal ownership right to property were associated with lower female-to-male stroke mortality ratio (Supplementary Table 3). In terms of stroke mortality rate, 16 indices of women's rights such as low accessibility to a job, more barriers to opening a bank

Figure 1. World map showing female-to-male stroke mortality ratio.



account, lack of protection rights to domestic violence, or inequalities on property ownership rights were associated with higher stroke mortality rate in women (Supplementary Table 3).

The female-to-male stroke mortality ratio and stroke mortality rate in women and men were also lower in high-income countries than in low-to middle-income countries (0.85 vs. 0.94, $p=0.003$ for female-to-male stroke mortality ratio, 45.45 vs. 112.33, $p < 0.001$ for stroke mortality rate in women, and 56.14 vs. 119.96, $p < 0.001$ for stroke mortality rate in men).

Among 137 countries where GII was available, a higher GII was associated with higher female-to-male stroke mortality ratio ($r=0.397$, $p < 0.001$) (Figure 2). The correlation between GII and stroke mortality rate was higher in women than in their counterpart men ($r=0.625$ vs. $r=0.516$, $p < 0.001$) (Figure 3). Our results seems contemporary given that the associations between GII and stroke mortality was consistent in a sensitivity analysis using 2014 GII data ($r=0.628$ for stroke mortality rate in women vs. $r=0.502$ for stroke mortality rate in men; $p < 0.001$).

Discussion

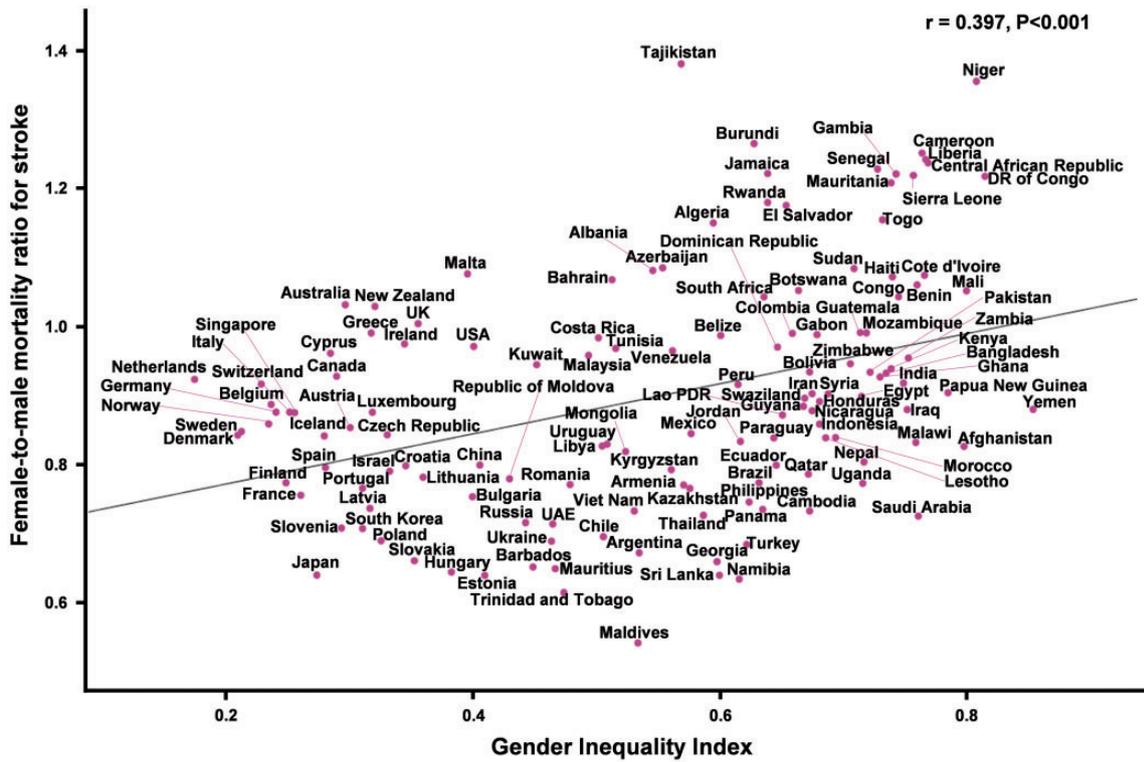
Societal inequalities may be associated with overall women's health status including stroke outcomes.^{5,11} In the present study, we investigated the relationship between women's rights and stroke mortality at a country-level. We examined 50 indices of women's rights and GII and for their association with stroke mortality. We found that in countries with higher

gender inequality (e.g., lower rights for women compared to men), their women had higher stroke mortality. Of the 50 indices examined, lower access to job opportunities or opening a bank account, lack of domestic violence legislation, and inequalities in property ownership rights were associated with higher stroke mortality rate in women. These results are in line with some past studies^{5,12,13} suggesting that gender inequalities relative to women influence their higher cardiovascular mortality rate.

Given the limited information about the relationship between gender inequality and cardiovascular outcomes, differences in stroke mechanisms, or lack of studies to address a causal effect, it is difficult to make definitive conclusions. Cardiovascular mortality or elevated blood pressure was more dependent on the socioeconomic inequality in women than in men.^{11,14} Exposure to economic disadvantages and inequalities related with employment status may increase the risk of cardiovascular diseases in women than in men.^{15,16} In addition, women had higher risk of cardiovascular disease due to psychosocial factors such as work-related or financial stress than men.¹⁷ In terms of the consequences of violence, abused women are often tied to her partner by economic dependency. For example, women working for cash are associated with a reduced risk of partner's violence.¹⁸ Together, this data suggest that women's cardiovascular health may be affected by economic activities and the presence of legislation that protect women from violence or domestic abuse.

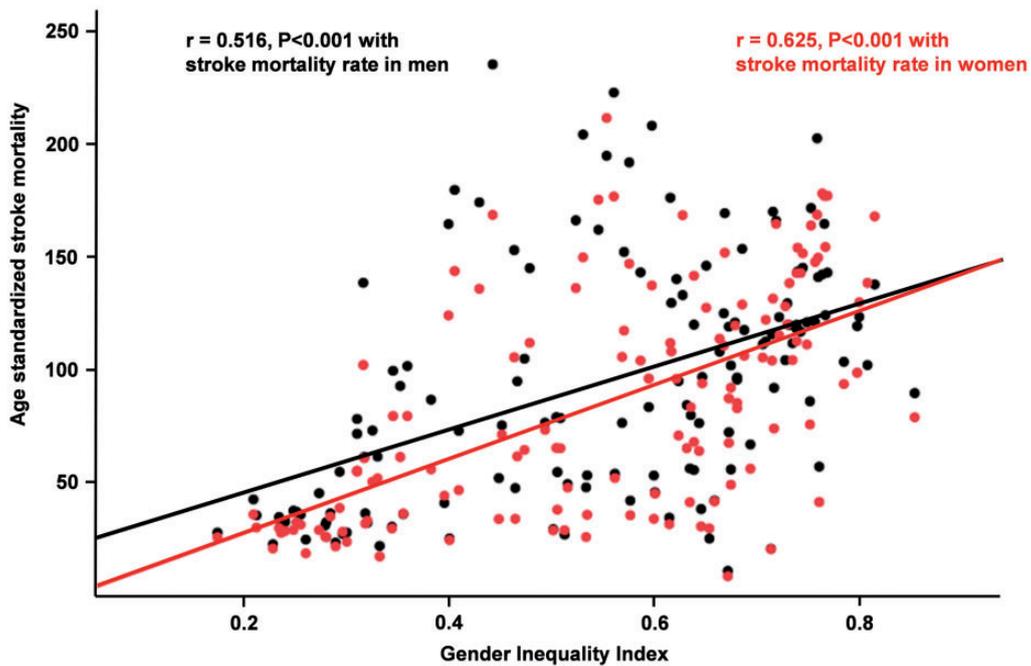
Some indices of women's rights can be confounded by other ecological variables which can affect negatively

Figure 2. Correlation between Gender Inequality Index and female-to-male stroke mortality ratio.



Higher GII values indicate higher levels of inequalities.

Figure 3. Different relationships between Gender Inequality Index and age-standardized stroke mortality rate in women (red line and dots) and men (black line and dots).



Higher GII values indicate higher levels of inequalities.

the health of both sexes.⁵ Some indices showing an association with stroke outcomes in women may also affect stroke outcomes in men (e.g., criminal penalties for domestic violence and protection orders for removal of the perpetrator or prohibiting contact from survivor). However, many indices for women's rights for getting a job, existence of domestic violence legislation or protection order, and equal ownership rights to property were only related with stroke mortality in women. Further, GII was more correlated with women's stroke mortality than men's stroke mortality.

Among the 50 indices used in this study, women's right for citizenship, application for a passport, traveling abroad, and the presence of tax deduction, legislation on specific type of violence or sexual harassment etc. seemed to be less commonly associated with stroke mortality in women, whereas stroke mortality in women had a significant association with the women's rights for getting a job or opening a bank account, existence of domestic violence legislation, or equal ownership right to property. This may suggest certain women's rights may have a stronger association with stroke outcomes. For example, inequality in the access to job security or chance to get a job can have a strong impact on the lower economic status, which is more related with higher stroke incidence, recurrence, and mortality in women than in men.^{4,19} On the contrary, women's independency to travel abroad or getting passport might be less important to cardiovascular outcome, as shown in our study.

Our study has limitations that deserve comment. First, our results should be interpreted with caution considering the ecological design. As such, no causality assumptions should be made. Second, we were only able to evaluate hard outcomes (i.e., stroke mortality). We have no information on gender disparities on stroke disability. Third, data sources were for a study period of the year 2008. However, the consistent association of stroke mortality with gender inequality was observed in the sensitivity analysis using contemporary data.

In conclusion, our study suggests a consistent association between women's rights inequalities and worse stroke outcomes. Our study should be seen as the first step in the understanding of the potential role of social inequalities, and how differences in women's rights may influence stroke mortality. Future prospective studies exploring the association between gender inequalities and functional outcomes after stroke using a pre-specified exposure are needed.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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