Mortality Decomposition of South Korea and Japan : Sex differentials in causes of death

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Abstract

The purpose of this study is to describe how sex differentials in mortality in terms of causes of death have changed over time in South Korea and Japan. One of the two main research questions is, first, the relative contribution of major causes of death to sex differences in the average length of life in two countries. Second research question is whether the contribution of each age group has been changed substantially as the age composition has changed. Time periods of interest is from 1983 to 2003 when the last stage of epidemiologic transition is in progress in both countries. Vital statistics and Census are analyzed by using decomposition technique in order to describe changing pattern of causes of death that would maintain or change convergence and divergence pattern of sex gap in mortality in both countries during the past two decades.

Extended Abstract

Introduction Sex differentials in mortality have been widely studied in the United States and European countries (Martikainen et al., 2001; Nusselder and Mackenbach, 1997; Nolte et al., 2000; Conti et al., 1999). However, there is little literature about Asian countries let alone cross-national comparisons. Analysis of sex gap in mortality of Asian countries could reveal unique patterns which differentiate them from Western countries. For instance, sex differences in mortality between Asian and Western countries could possibly be associated with health behaviors such as eating practice, or cultural attitudes toward gender equality. In this context, the present study would contribute to demographic studies of sex gap in mortality by focusing on South Korea and Japan. This cross-national perspective would provide insights on whether different pace of epidemiologic transition and unique culture of both countries would lead distinct patterns of changes in sex mortality differentials.

Two main research questions of the present study are, first, the relative contribution of major causes of death to sex differences in the average length of life in two countries. Second research question is which age group contributes most to the sex differences. This finding would suggest which sex is doing better in terms of diseases and mortality in aging society. Time periods of interest is from 1983 to 2003 when the last stage of epidemiologic transition is in progress in both countries.

General trends The difference between life expectancy of males and females has been consistently lower in Japan than in South Korea. The sex difference in South Korea has been converging since 1995, whereas it has been diverging in Japan albeit that it is still lower compared to South Korea. Both countries seem to reach to a plateau in more recent years since late 1990s, approximately at the same time. A closer look at the change of life expectancy separately by sex in Japan reveals that life expectancy of females has been

increased slightly faster than males, which results in the increase of sex mortality differentials. On the contrary, Korea exhibits that the life expectancy of males has been increasing relatively fast, while females' life expectancy has been increased at the same speed of males in early 1980s but slower in 1990s (United Nations).

Theoretical focus This study has implications on two theoretical viewpoints. In the perspective of epidemiologic transition, the first epidemiological transition occurred in the early 1970s in South Korea when the leading causes of death had shifted from infectious and parasitic diseases to cancer and cardiovascular-related diseases (Kim et al., 2000). In the study researched on this trend of Korea until 1996 noted that diseases of the circulatory system have been the leading cause of death since 1965 (Kim et al., 2000). Yet the preliminary results of this analysis found that malignant neoplasm replaced diseases of the circulatory system as the leading cause of death.

For Japan, the life expectancy was the lowest among developed countries at the end of World War II. However, life expectancy has been improved radically since then, and became to enjoy the highest longevity in the world since the mid-1970s. The first reduction in mortality occurred at younger ages, infant morality in particular, but recent gains in life expectancy are largely explained by rapid mortality decline at older ages (Toshiko et al., 2003). Toshiko et al. (2003) found that the main causes of death in older ages have been primarily chronic degenerative diseases, especially cerebrovascular disease, heart disease, malignant neoplasm, and senility in the time periods between 1955 and 1995. They also found that the death rate from cerebrovascular diseases increased during the earlier decades, while malignant neoplasm replaced them in the later decades. The present study found consistent results.

Second theoretical perspective is established by a number of studies of sex differentials in mortality. Given that gender is a proxy for social inequality, sex differentials in mortality might have implications on health inequality of corresponding societies. Based on empirical studies of this field, the general trend of sex gap in mortality indicates two opposite trends: convergence and divergence. The first group mainly consists of Western European developed countries and the United States. The examples of the second group include former Soviet Union and the Eastern European countries where economic downturns and political unrest have possibly affected the trend (Lopez et al., 1983). Japan has been considered as an exceptional case because the sex gap in overall life expectancy remains not only substantial, but also is actually increasing unlike other developed countries with comparable level of economic status (Trovato and Lalu, 1998).

Despite the richness of literature on gender and mortality, the question still remains if Asian countries are repeating the Western pattern of sex mortality differentials when cause-specific deaths are taking into account. According to one comprehensive cross-national study of Asia, mortality differentials by sex in East- and South Asian countries might be expected to be unusual, and easily distinguishable from those of other populations (Zhao, 2003). However, this study found that there is no clear difference between Asian countries of interest (including Korea) and Western countries. The present study elaborates this finding by using causes of death instead of all-cause mortality.

Data Vital statistics of South Korea is from Korean National Statistical Office (NSO). NSO provides the vital statistics since 1983, which has provided causes of death data since 1983. Population estimates are used for all target years. Data for Japan is from Japanese Ministry

of Health, Labor, and Welfare (MHLW). For the analysis of Japan, population estimates are used for 1984, 1996 and 2002, and the actual number of population from Census is used for 1990 analysis. Decomposition years are selected differently by country. For Korea, target years are 1983, 1997, and 2003. For Japan, 1984, 1990, 1996, and 2002 are selected. These target years are selected because no fluctuations are observed during this time period so that the results capture the general trend of change in causes of death without outliers. In terms of changes in International Classification of Diseases (ICD) definitions, NSO modified cause of death of each year based on ICD 10^{th} revision. However, in Japan, vital statistics of 1984 follows ICD 9^{th} revision, while other three years of 1990, 1996, and 2002 follow ICD 10^{th} revision. In order to match the different revisions of ICD, the causes that are exactly same with 10^{th} revision are used. Note that cause of death data used for both countries refers underlying causes.

Research Method For decomposition analysis, life tables of Korea and Japan are created by sex and 5-year age group first. Using life table quantities, cause of death of each country is decomposed separately in order to examine the relative contribution of major causes to sex mortality differentials. For age- and cause-specific decomposition, the present study uses methods described by Arriaga (1984). To estimate the contribution of differences in cause-specific death rates, decomposition analysis assumes that the distribution of deaths by cause is constant within each age group in each population. Under this assumption, the contribution of differences in all-cause mortality in a specific age group can be distributed proportionately to the difference in cause-specific mortality in the corresponding age group (Arriaga, 1984). Although the decomposition technique has been modified and elaborated afterwards (Vaupel et al., 2003), the first model proposed by Arriaga has been traditionally used. Vaupel et al. (2003) described that the results of both models are not significantly different.

In terms of cause-specific decomposition, the contribution made by each cause of death to the difference between life expectancies of two sexes is decomposed into ten major groups of causes first. Based on this preliminary result, causes that contribute the most within each ten categories are selected. As a result, eighteen causes are selected. For each causes, proportion of deaths from cause i between ages x and $x+n$ (${}_nR_x^i$) in males and females is calculated first. Based on ${}_nR_x^i$, and ${}_nL_x$, l_x, T_x^2 and ${}_nm_x$ from life tables, ${}_n\Delta_x^i$ is obtained, which represents the contribution of cause i to sex mortality differences in age group x to $x+n$.

Findings In South Korea, the excess of females' life expectancy has been increased from 8.5 to 9.5 in 1983 and 1991. Then it decreased to 7.9 in 1997, and then to 7.1 in 2003 again, which represents the convergence trend of sex gap. On the other hand, in Japan, it has been steadily increased from 6.3 years in 1984 to 7.6 years in 1995. It increased again to 8.6 years in 2002, which shows the divergence pattern.

For South Korea, the contribution of diseases of the circulatory system (especially heart diseases) are the greatest to the sex mortality differentials followed by external causes of morbidity and mortality (50% of which is intentional self-harm), certain malignant neoplasm, and diseases of liver in 1983. Out of additional 8.5 years of females' life expectancies at birth, 1.2 (cancer), 2.2 (heart diseases), 1.0 (diseases of liver), and 2.0 (external causes) years are attributable to males' higher mortality in these causes than females. In 1991, the pattern has been changed in a way that the contribution of malignant neoplasm has increased, while

the contribution of intentional self-harm has substantially decreased. Diseases of liver have replaced cerebrovascular diseases, the largest contribution to sex gap of 1983. Another noticeable difference is that the contribution of hypertensive diseases disappeared in 1991. In 1997, the major change is that the contribution of malignant neoplasm reached to the same level with heart diseases. Also, other heart diseases except for cerebrovascular diseases have been decreased, while other causes such as diseases of liver and cerebrovascular diseases still show higher contribution to sex gap than others. In terms of malignant neoplasm, liver and intrahepatic cancer contributes the most to the sex gap among other site-specific cancers as in 1983. Finally, the contribution of malignant neoplasm surpassed all other causes in 2003, mostly due to liver and intrahepatic cancer, and trachea and bronchitis cancer. Contribution of heart diseases substantially decreased as well as diseases of liver.

For Japan, contribution of malignant neoplasm and heart diseases is approximately same in 1984. Out of 6.3 years of excess life expectancy at birth of females, women gain 1.8 and 1.7 years more than males thanks to their lower mortality from neoplasm and heart diseases respectively. However, compared to other groups of diseases, males' years of life lost from malignant neoplasm have increased throughout the target years; in 2003, females' 8.6 additional years of e_0 is attributable to their 3.1 years of gain in lower deaths from malignant neoplasm, while they earned 1.9 years from lower mortality of heart diseases. Looking at site-specific cancer, stomach cancer contributed the most among other cancers in 1984. However, trachea and bronchitis cancer outnumbered stomach cancer in 1995. This pattern persists in 2003 as well, which differs from South Korea where liver and intrahepatic cancer is higher than others for all target years. Besides, very high contribution of pneumonia in Japan is unexpected because pneumonia is relatively easy to control through vaccination.

The most noticeable difference between two countries is the age component of causes of death. The cause of death pattern itself does not exhibit such a clear difference between two countries. However, greater contribution occurred at older ages in Japan than in Korea reflecting the greater number of aging population in Japan, especially the oldest old who are aged over 80.

In sum, main findings of this study suggest that the most recent sex gap in mortality in both countries is occurring in chronic and degenerative diseases, which is consistent with the late phase of the epidemiologic transition. Additionally, increasing contribution of cancers in both countries is consistent with their major causes of death patterns, which is intriguing when compared to the U.S. where the cancer mortality of males has been decreasing over the recent decades. Based on preliminary results, divergence pattern of Japan would be attributable to males' greater years of life lost by cancer than females. Convergence pattern of South Korea would be related to decreases in males' mortality of diseases of liver and heart diseases.

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