The Gender Mortality Differentials in China Since the 1980s

Qiang Ren[1]

Xiaoying Zheng[1]

Guiying Cao[2]

Abstract

This paper is concerned with analyzing the trends of sex mortality differentials in China since the 1980s and contributions to the sex differentials in life expectancy at birth due to the gender differentials in age-specific mortality rates, and compares such kinds of contributions of cause-of-death under decomposition method using the data of censuses and surveys from 1982 to 2000, and of China Health Annals (CHA) in 1989, 1995 and 2000 respectively from Cause-of-death Registration System of China Health Ministry (CDRS). In the past two decades in China, the gap of life expectancy at birth between female and male had been continuing to be widened. Major reasons were of the contributions of sex differences in age-specific mortality rates and their changes, particularly for the population aged 45 years old and above, for the population aged 45 years old and lower, the contributions, however, had been increasing significantly. We also examine cause-of-death contributions to the sex gap of life expectancy at birth with broad age categories between 1989 and 2000, and find that sex disparities in mortality rates due to malignant neoplasms, circulatory diseases and accidents and injuries account for most of the total sex differences, and represent their individual characters in age groups. In the past decade, sex differences due to circulatory diseases, accidents and injuries increased dramatically, and kept steadily due to malignant neoplasms.

Key words

Mortality Life expectancy at birth Sex differentials Decomposition

[1] Institute of Population Research, Peking University, Beijing 100871, P. R. China. Email: renqiang@pku.edu.cn or xzheng@pku.edu.cn

[2] International Institute of Applied Systems Analysis (IIASA), Laxenburg A-2361, Austria. Email: Cao@iiasa.ac.at

INTRODUCTION

Since the last half century, historical population data of most of countries in the world indicated that the level of mortality for male was widely higher than it for female. It seems to be a trend. Why is mortality for male than it for female? Which factors determinate such sex differentials? There are basic two aspects based a great number of literatures: behavior and biological aspects. The former aspect argued that factors affecting higher mortality for male than female include living style (e.g. drinking, smoking etc.), social roles (e.g. profession etc.) and so on. The later argued that sex differential in mortality is mostly due to genetic factors. The studies on natural populations also reflect such kinds of two aspects (see Moore and Wilson 2002; Owens 2002; Promislow 1992). However it is not always true that the life expectancy for female is higher than it for male from current historic mortality data what we have by far. It is only a phenomenon during the recent decades (Wood 1979), especially after the World War II. European mortality data show that mortality for female is very higher than male before industrial revolution; and after that, mortality for reproductive women decreased dramatically with the development of modern medical science and it occurred female lower than male in mortality. At present the life expectancy for female is 7-8 years higher than it for male in West European countries, even above 10 years in some Eastern European Countries, and this trend of gap between female and male seems to extended continuously. There are only a few developed countries such as Sweden, Australia, British and USA, which it is beginning to sharp the gap. Otherwise in some countries with very lower mortality level such as Japan, France and Germany, the gap in life expectancy between female and male continues to be extended. And so do most of developing countries. The gap, in general, is about 3-5 years. The gap for some new industrious countries (e.g. Republic Korea) is now bigger than a few European countries. There are only the mortality data in North Africa and Sub-Sahara indicate that life expectancy at birth for male is higher than it for female. In China, the gap between female and male has increased from 1.5 years to 3.5 years since the 1960s, and present the tendency of being extended in the future. Even though scholars have paid much more attention to this phenomenon, it is still difficult to clearly explain because of complicated interactions among biological, social and behavioral factors (Kinsella and Gist 1998).

Sex equality for health is one of core questions in public health. Only to know the sex differentials in life expectancy is not enough to provide complete information on how to eliminate/alleviate

gender gap in mortality. So when we study the gender differentials in mortality, it is necessary to combine the sex differentials in age structure and death causes. To understand the historic trend and reasons caused gender differentials in mortality and sex characters caused by age structure and death causes, it is useful for us to find potential factors causing gender gap and historic trend and health risk population, and to evaluate the sex inequality of health in the process of mortality pattern transition. It is also important for policy makers to make plan on public health resource and service utility.

The main goal in this paper is to understand the trend of sex differentials in mortality since the 1980s in China. The reason that we just focus on this time of period is not only the rich data but also the great change in social-economic mechanism and public medical systems and so on. In the last twenty years. A series of question on social inequality have been paid much attention by the public. The gender inequality in population health is just one of them. So we will understand the tendency of sex differentials in mortality since the 1980s in China, as well as how it changed with the level of mortality and the gender differentials in death causes. In general, there are three main question should be addressed in this paper: (1) what is the basic trend of gender differentials in mortality since the 1980s; (2) how the sex differentials in age structure affect the sex gap in life expectancy at birth, i.e. what are the contributions of age specific mortality rates on the sex gap in life expectancy at birth; (3) how sex differentials in death causes affect the sex gap in life expectancy at birth, as well as how about the pattern of cause-age-specific mortality.

DATA AND METHODS

Data description

By far mortality data in China from vital registration system are limited due to various reasons. However there is rich information on mortality from several censuses and national population surveys since 1982. Even though there are inevitable reported errors in retrospective censuses and surveys, rich information on mortality may provide good basement for mortality study with borrowing indirect demographic methods. Mortality data used in this paper are from censuses 1982 and 2000, 1 Percent National Population Sampling in 1987 and 1995 (NPS), and China Health Annals in 1989, 1995 and 2000 respectively from cause-of death registration system of

China Health Ministry (CHM). With respect to information on mortality reported in censuses and surveys, we calculated the age-specific mortality rates for 1981, 1986, 1989 and 1995 respectively using the number of death in a year divide the average number of population in the same year; the age-specific mortality rates for 2000 are derived by the number of death from November 1, 1999 to October 31, 2000 divided by average number of population on May 1, 2000. With respect to the concept of life expectancy at birth, it indicates an average level of mortality for several populations. We first adjust the obvious reporting errors in age-specific mortality rates for above-mentioned corresponding years using model life tables, and then construct abridged life tables respectively (Zheng et al. 2004; Ren et al. 2004).

Another data are used for calculation of age-specific mortality rates by sex and death causes from China Health Annals (CHA) in 1989, 1995 and 2000 respectively which are from cause-of-death registration system of China Health Ministry (CODRS), corresponding to mortality rates of censuses and surveys mentioned above. Since the 1980s, the previous registration of cause-of-death that had been done before 1987 were gradually adjusted according to the 9 version of international classification of diseases (ICD-9, WHO 1977), and after that CODRS began with registrations and classifications deaths by the international medical identification of cause-of-death.

Mortality information collected by CODRS is divided into urban areas and rural areas.1 Cities are divided into big cities and middle/small cities; rural areas are divided into 4 type regions (I, II, III and IV) by social-economic conditions and the levels of public health. Because there is no condition to be carried out for cause-of –death registration in the IV Type rural area, CODRS does not include these regions. Therefore the mortality level reflected from CODRS would be undoubtedly lower than actual value. Because we should calculate national age-specific mortality

[1] Urban areas in 2000 include Beijing, Tianjin, Changchun, Shenyang, Dalian, Anshan, Shanghai, Nanjing, Wuhan, Guangzhou, Hangzhou, Chengdu, Chongqing, Xian, Xuzhou, Hefei, Anqing, Maanshan, Tongling, Fuzhou, Xiamen, Yichang, Huangshi, Foshan, Zigong, Guilin, Xiangtan, Hengyang, Changde, Urumqi, Pingdingshan and Xinyang. Rural areas include 90 counties distributed the following provinces respectively: I Type area includes Beijing, Tianjin, Shanghai, Zhejiang, Jiangsu; II Type area includes Fujian, Hubei, Hunan, Guangdong, Sichuan, Henan; III Type area includes Anhui, Guizhou, Gansu. There is no county divided into IV Type area among 90 counties. There was a little change in the number of cities and counties in urban and rural areas respectively. For example, 15 big cities and 20 middle/small cities for urban area and 101 counties for rural area in 1995; 16 big cities and 25 middle/small cities for urban area and 87 counties for rural area in 1989.

rates by sex and cause-of-death and CODRS only provides information by urban and rural areas selected by itself, it can not be get directly from CODRS what we need. Assuming the definition on urban and rural areas are mostly same between CODRS and census and surveys, i.e. the proportions of population in urban area in 1989, 1995 and 2000 are the same between CODRS and censuses/surveys, i.e. 26.2%, 28.6% and 36.9% respectively. Based on this assumption, we calculate the weighted national age-specific mortality rates by sex in 1989, 1995 and 2000 separately for CODRS weighted by age-specific population by sex and urban-rural area in corresponding year censuses and survey.2 The same method is used for estimating national cause-age-specific mortality rates by sex. Through comparing estimations of national age-specific mortality rates based on CODRS and censuses/surveys, figure 1 shows that two lines fit very well except lower age groups. The reasons caused difference between estimations at lower age groups may be attributed to CODRS not covering very poor rural areas (usually with higher infant and childhood mortality rates), both sample errors and reported errors in CODRS and censuses/surveys, as well as adjustment for censuses/surveys based on model life tables. Because of hard work and complicated methodologies to adjust mortality data, as well as lack of information derived from vital registration system, we have not made further evaluation for these two kinds of data. However, through primary understanding of completeness and accuracy for CODRS and Censuses/surveys, the quality of mortality information based on CODRS may be accepted, which may basically represent national age-specific mortality rates. If we assume under-reported rates of various death causes were similar, the quality of cause-of-death may also be reliable (Zheng et al. 2004).

[2] Assuming there is a little change in age structure and proportion of population in urban and rural areas between 1989 and 1990, the proportions of population by age and urban-rural area in the 1990 census are chosen to be as weight.

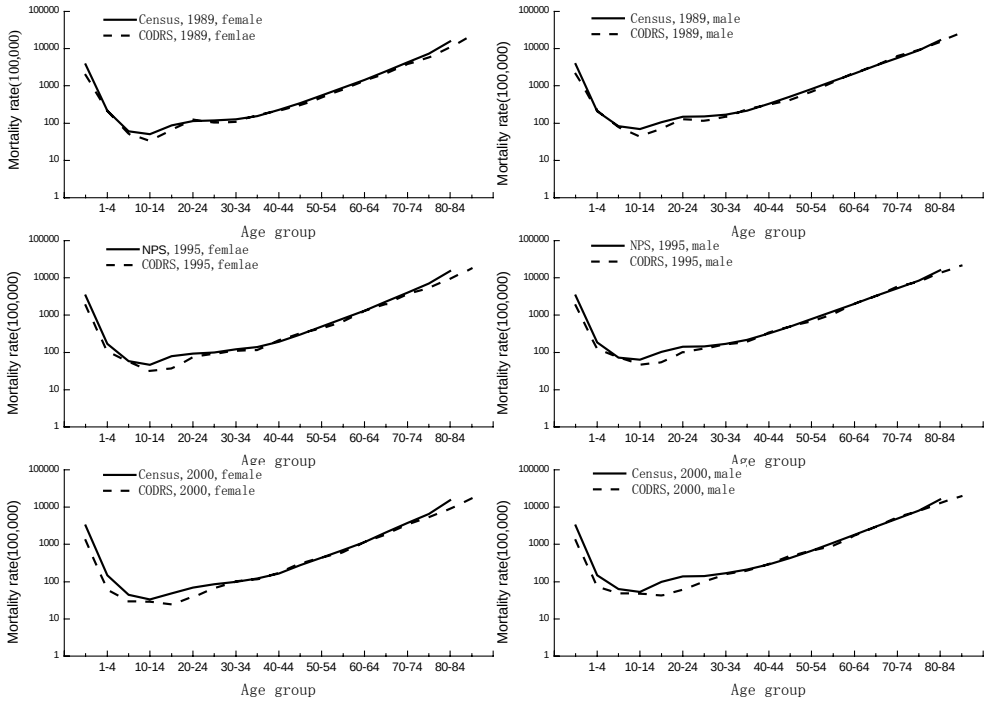

Figure 1 Age-specific mortality rates by sex and year derived from NPS and censuses/ surveys (natural log scale), 1989-2000
Source: CHM (1989, 1995, 2000), NSB (1993, 2002) NSB(1997)

Methods and indices

Crude death rate (CDR) and life expectancy at birth (LE) may usually be used to indicate the level of mortality, as well as to compare the levels of mortality between populations or sub-populations. The main importance of CDR is that calculation is simple and data are easy to be available. CDR, however, may seriously be affected by age structure, especially in countries with lower mortality rates, in which CDR is not sensitive to the change in age-specific mortality rates, i.e. CDR is not a good index to compare the levels of mortality between different periods or sub-populations. Theoretically, LE is a cohort index which may not be affected by age structure. Actually, it is a fictitious cohort index when we apply it to real data, which includes the effects of tempo and change in age-specific mortality rates. These potential effects are that we hope to know in the process to explore sex differentials in mortality. Thus LE was widely recommended by international organizations and scholars, as well as an acceptable index by the public. For example, if we tell the public that the mortality rates declined 0.0025 for a population aged 50, the public

may not have any feelings. However, if we tell the public the life expectancy of a population aged 50 will increase 0.01 years when mortality rates decline 0.0025, such kind of information is very easy for the public to be understanding.

When we compare sex differentials in mortality rates, we hope to know not only how many years life expectancy at birth for female is higher than it for male, but also how sex difference in age-specific mortality rates and its changes affect sex gap in life expectancy at birth. With considering the cause-of-death, similar information is very useful to understand sex differentials in mortality. Traditional methods, single or multiple decrease life tables, may answer such kind of question that life expectancy would be increased how many years if one cause-of-death were eliminated. It, however, can not answer how about the contributions of life expectancy have been made by changes in age-specific mortality rates by cause-of-death, as well as it can not resolve two-sex question at the same time. In order to resolve above-mentioned problems, decomposition method has been developed and applied widely in demographic studies. This method may decompose the effects of changes in age-specific mortality rates by sex on sex difference in life expectancy at birth. Further more, it may explore the effects of changes in the pattern of cause-of-death on sex difference in life expectancy at birth using age-specific mortality rates by cause-of-death. Thus we begin with our study from two dimensions: (1) the characteristics and reasons of sex difference in mortality are studied from points of time, i.e. distinguishing sex difference from a specific point of time; (2) comparative study from cross-sectional views, i.e. which factors enlarge or reduce the sex gap in life expectancy at birth between two points of time. These data, in conjunction with population data, were used to obtain age-specific death rates, as well as age-cause-specific death rates served as input data into the United Nations Mortpak software to obtain life tables. These life tables were used to apply Arriaga's methodology.

Contributions of changes in age-specific mortality rates between two populations or points of time period to changes of life expectancy at birth

It is relatively difficult to decompose the change in life expectancy at birth between populations or points of time period from age structure, because it should be considered not only direct effect caused by change in age-specific mortality rates between different populations and points of time

period but also indirect effect caused by change in mortality of different age groups for the same population or point of time period, and even interactive effects. Many scholars had paid much more attention to this topic (e.g. Arriaga 1984; Pollard 1982, 1988; United Nations 1982). With considering the facility in being used, herein Arriaga's methods have been applied to decompose direct, indirect and interactive effects resulting from changes in age-grouped mortality rates between populations or points of time period on changes in life expectancy at birth. The equations are defined as follows:

$${}_nTE_x = {}_nDE_x + {}_nIE_x + {}_nI_x$$

Here, ${}_nTE_x$, ${}_nDE_x$, ${}_nIE_x$ and ${}_nI_x$ represent total effect, direct effect, indirect effect and interaction term respectively.

where, ${}_nDE_x = \frac{l_x^1}{l_0^1} * \left(\frac{T_x^2 - T_{x+n}^2}{l_x^2} - \frac{T_x^1 - T_{x+n}^1}{l_x^1} \right)$, indicates direct effect term resulting from changes in mortality from age x to x+n on expectancy of life changes. L and T are, respectively, functions in traditional life table. 1 and 2 represent population (or time point) 1 and population (or time point)2 respectively.

Indirect effect term is defined as ${}_nIE_x = \frac{T_{x+n}^1}{l_0^1} * \left(\frac{l_x^1 * l_{x+n}^2}{l_{x+n}^1 * l_x^2} - 1 \right)$, which indicates additional (or reduced) years of life to the life expectancy at age x which are contributed by the additional (or reduced) number of survivors resulting from mortality changes between age interval [x, x+n] who will continue living (or will not live any more) after age x+n as many as the rest of the population. The interaction term of sex differential in mortality at ages x to x+n on sex differential in life expectancy at birth is defined as follows:

$${}_nI_x = \frac{T_{x+n}^2}{l_0^1} * \left(\frac{l_x^1}{l_x^2} - \frac{l_{x+n}^1}{l_{x+n}^2} \right) - \frac{T_{x+n}^1}{l_0^1} * \left(\frac{l_x^1 * l_{x+n}^2}{l_{x+n}^1 * l_x^2} - 1 \right)$$

Finally, the effect the mortality change in the last open-ended age group produces on the total change in life expectancy at age x will be only the direct effect. Whereas it is given by:

$$DE_w = \frac{l_w^1}{l_0^1} * \left(\frac{T_w^2}{l_w^2} - \frac{T_w^1}{l_w^1} \right)$$

Contributions of change in age-cause-specific mortality between populations or time points on life expectancy at birth

When cause-of-death is considered to decompose the change of life expectancy at birth, Arriaga (1989) extended his decomposition method, being enlightened by the concept of causes-reduced life table. First, Arriaga assumed that the number of deaths from cause i occurring in the age group x to x+n is proportional to the total number of deaths occurring in the same age group, i.e., ${}_nD_x = \sum {}_nD_{xi}$, which means that the effect of change in mortality from cause i occurring in age interval [x,x+n] on life expectancy is proportional to the impact of this cause to average mortality rate occurring in the same age group. That is to say, the total effect, ${}_nTE_{xi}$, from cause i occurring in the interval [x, x+n] is equal to total effect, ${}_nTE_x$, times a factor, ${}_nk_{xi}$, which is given by:

$${}_nTE_{xi} = {}_nTE_x * {}_nk_{xi},$$

where,

$${}_nk_{xi} = \left[\frac{{}_nR_{xi}^2 * {}_nm_x^2 - {}_nR_{xi}^1 * {}_nm_x^1}{{}_nm_x^2 - {}_nm_x^1} \right]$$

${}_nR_{xi}$ is that cause i occurring in the age group x to x+n between populations or time periods is proportional to the total number of deaths.

RESULTS

The trend of sex differentials in mortality level

Table 1 shows the trend of gender differentials in life expectancy at birth (i.e. the female expectancy minus male expectancy) since the 1982 census in several selected survey years of China. In the past two decades, life expectancy at birth increased 5 percent (3.43 years) for male, 7 percent (4.74 years) for female. The gender gap of life expectancy at birth was widened by 1.3 years, an increase of 60 percent. Even the sex difference in life expectancy was extended fast and significantly in China, the gap of 3.5 years is only half of those countries such as European, North America countries, Australia and New Zealand, even is less than half of Japan and South Korea.

Table 1 Changes of life expectancy at birth by sex and female-male gap in this measure for selected year between 1981 and 2000

	1981	1986	1989	1995	2000
Female	68.76	70.10	71.07	72.29	73.50
Male	66.56	67.40	67.94	68.92	69.99
Sex difference (female-male)	2.19	2.71	3.13	3.37	3.50

Source: Calculation and adjustment through model life tables by Zheng et al. (2004) using the data issued by NSB (1985, 1988, 1993, 1997, 2002) and MortPak software (UN, 1988).

Figure 2 represents the sex different ratio of age-specific mortality rates derived from three update censuses. The pattern of sex different ratio reflected on age-specific mortality rates had been significantly changed a lot since the 1980s, especially for the age group 15-44. The sex ratio of male to female in age-specific mortality rates increased rapidly under the level of 1981 and 1989 during the last two decades. That is to say, the mortality rates in age group 15-44 decreased much more for female than for male. The mortality rates were higher for female than for male in childhood, which was observed in most developing countries (Preston 1976). One of explanations is attributable to sex inequality of the source of nutrition and food distributed in family (Chen et al., 1981). Comparing internationally with the patterns of sex ratio of age-specific mortality rates, China has transferred from the average level in 1981 to the high level in 2000 according to the classified standard (United Nations 1983).

Figure 2 Sex ratio of age-specific mortality rates in 1981, 1989 and 2000

Source: NSB (1985, 1993, 2002)

Age pattern of sex differences in life expectancy (LE)

Table 2 and Figure 3 give the contributions of sex differences in mortality at each age group to the total sex difference in life expectancy at birth for selected years 1981, 1989 and 2000. Since the 1980s, the gaps are small in the youngest age groups and peak in the oldest age category similar to the pattern in advanced countries. Below age 15, LE differences between the sexes are very small, and show little temporal declines in its gaps. Age group 45-59 reflect similar pattern that little temporal decline in sex gap but a small increase in 1995. For the age groups 15-29 and 30-44, table 2 and figure 3 show rising trends over time in their LE gaps (i.e., increasing female gains over male).

Sex differences in life expectancy have been most attributable to the sex differentials in mortality aged 50-79. However the effect due to age group 50-79 is being weaker gradually but being larger for younger age groups. Sex differences in mortality for age group 60-79 was always the main effect on sex difference in life expectancy during this time period, which caused 1.2-1.5 years higher for female than for male accounting for 40-63 percent of total sex differences. The contributions due to the sex differences in age group 15-49 increased very dramatically, the gap in life expectancy at birth between female and male increased from 0.4 year in 1981 to 1.2 years in 2000, the contribution to the total sex difference in LE increased from 17.8 percent to 33.6 percent. The sex differentials in mortality for childhood affected slightly on sex difference in life expectancy but the pattern changed, which the mortality transferred from higher for female than for male in 1981 to opposite one.

During the past two decades, the direct effects of age-grouped mortality rates were very stable, and were relatively smaller than indirect effects that increased for each age group and the order of contribution rates had changed. For example, Since the 1980s, the gap in life expectancy between female and male was around 1.4 years due to sex difference in mortality for age group 60-79, which was not only the direct change in mortality rates for both female and male but also gender unbalance of number of survivors at age 80 (number is bigger for female than for male) due to the sex different decline of mortality rates in previous ages, who would continue their rest life under

new mortality level and give rise to 0.9 year in 1981, 1 year in 1989 and 1.2 years in 2000 respectively longer life expectancy for female than for male.

Table 2 Effect of sex differences in age-grouped mortality rates on sex gap in life expectancy at birth, 1981, 1989 and 2000

Age group	Independent effect			Interactive effect	Total	Percent
	Direct effect	Indirect effect	Sub-total			
			1981			
0-14	-0.006	-0.101		-0.004	-0.111	-5.0
15-29	0.004	0.080		0.004	0.089	4.0
30-44	0.008	0.115		0.009	0.133	6.1
45-59	0.074	0.600		0.062	0.735	33.5
60-79	0.257	0.899		0.089	1.244	56.7
80+	0.102	0.000		0.000	0.102	4.7
Total	0.440	1.593		0.160	2.193	100.0
			1989			
0-14	-0.003	-0.060		-0.003	-0.065	-2.4
15-29	0.007	0.142		0.009	0.159	5.9
30-44	0.022	0.309		0.026	0.357	13.2
45-59	0.085	0.700		0.073	0.858	31.7
60-79	0.261	0.933		0.091	1.286	47.5
80+	0.112	0.000		0.000	0.112	4.1
Total	0.485	2.025		0.196	2.706	100.0
			2000			
0-14	0.004	0.114		0.006	0.124	4.0
15-29	0.010	0.188		0.012	0.210	6.7
30-44	0.022	0.306		0.027	0.356	11.4
45-59	0.086	0.712		0.081	0.879	28.1
60-79	0.290	1.046		0.111	1.447	46.2
80+	0.116	0.000		0.000	0.116	3.7
Total	0.528	2.366		0.237	3.131	100.0

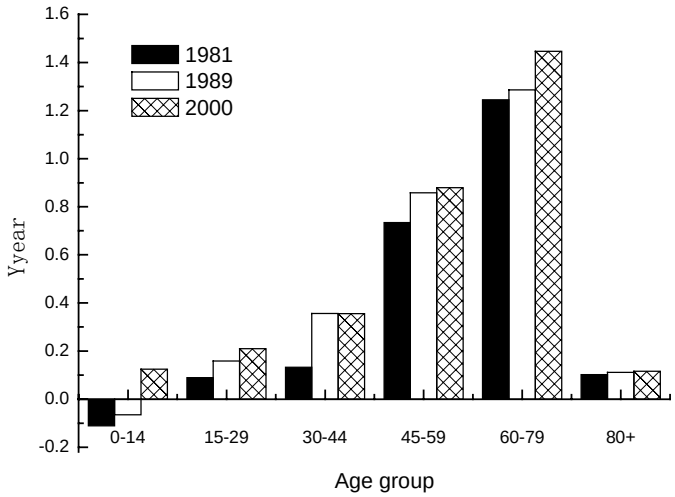

Figure 3 Contribution of sex difference in age-grouped mortality to sex difference in life expectancy at birth for selected years between 1989 and 2000

Change over time in cause component contribution to sex differences in life expectancy at birth

The trends of mortality separately for female and male may clearly show the characters of sex differences in life expectancy caused by different changes in age-specific mortality rates between genders. From 1981 to 2000, life expectancy at birth increased 3.4 years for male and 4.7 years for female; the gap widened 1.3 years. Upon the contributions of declines of age-specific mortality rates on life expectancy (see table 3), female is mainly due to age groups of 0-14, 15-49 and 60-79, respectively corresponding to 1.7, 1.1 and 1.2 years; male is from age groups 0-14 and 60-79, 1.4 and 1 year respectively. With comparison between sexes, the most difference takes place in age group 15-49, an increase of 0.8 year higher for female than for male, accounting for 62 percent of sex difference (1.3 years) occurred in this period. The contributions of decline of death rates on life expectancy caused by all other age groups are always advantage for female, but just little higher for female than for male. We thus may draw a conclusion that increase of sex difference in life expectancy at birth is mainly caused by the sex different decline of death rate aged 15-49 since the 1980s. In general, the decline of death rates for reproductive women was higher than that for the same aged men during this period.

Similarly, the increases of life expectancy for both female and male during this period are mainly due to the indirect effects of mortality change in each age group, relatively little due to direct effects. The decline of death rate in age 15-49 for female makes life expectancy improve 0.98 year, only 0.31 year for male from 1981 through 2000. For other age groups, the indirect effects are also higher for female that for male; the gaps in these age groups between sexes are less significant than that aged 15-49.

Table 3 Effect of changes in age-grouped mortality rates by sex on life expectancy at birth, 1981-2000

Age Group	Independent effect			Interactive Effect	Total	Percent
	Direct effect	Indirect effect	Sub-total			
		Female，1981-2000				
0-14	0.039	1.577		0.087	1.703	35.9
15-29	0.019	0.382		0.023	0.425	9.0
30-44	0.031	0.437		0.032	0.500	10.6
45-59	0.071	0.631		0.057	0.760	16.0
60-79	0.233	0.892		0.079	1.204	25.4
80+	0.150	0.000		0.000	0.150	3.2
合计	0.543	3.920		0.279	4.741	100.0
		Male，1981-2000				
0-14	0.029	1.332		0.051	1.411	41.1
15-29	0.004	0.060		0.003	0.067	1.9
30-44	0.008	0.115		0.008	0.131	3.8
45-59	0.069	0.554		0.049	0.671	19.6
60-79	0.215	0.750		0.068	1.033	30.1
80+	0.119	0.000		0.000	0.119	3.5
合计	0.443	2.810		0.179	3.432	100.0

Contribution of sex difference in age-specific mortality rates by causes of death on the gap of life expectancy between sexes

Now we continue talking about the topic, how to explain the phenomena that life expectancy is lower for male than for female? i.e. what differences are there about risk factors of death between sexes? One of solutions is to study sex difference in cause of death. Figure 3 shows that sex difference in life expectancy mainly present at the age 45-79 which is 2.4 years higher for female than for male accounting for 65 percent and above of increase from 1989 to 2000. Sex difference occurred at age 15-44 raised sharply during the three points in time. The contribution to sex gap

went up from 18 percent in 1989 to 27 percent in 2000.

There was little change in the order of death causes affecting sex gap in LE between 1989 and 2000; they were cancer, accidents and injuries, circulatory diseases, digestible diseases, infectious diseases, verminosis and other diseases. In 2000, sex gap in LE caused by these causes had been widened 1.18, 0.8, 0.81, 0.38, 0.2, 0.12 and 0.01 years respectively. During this period, the effects of sex difference in cancer, digestive diseases and other diseases on sex difference in LE declined a little, however the sex gap due to infectious diseases and parasitic disease made sex difference in LE narrowing significantly (decline 55 percent); there was almost no change due to the effect of respiratory diseases; circulatory diseases, accidents and injuries remarkably increased (47 percent), which means that sex mortality difference due to these diseases is becoming widen over time.

Sex differences in LE within an age group are decomposed into components that can be attributed to various causes of death. Herein each cause component is expressed as having an independent effect on LE difference within a given age range while holding constant the effects of other causes. We may evaluate both period-specific contributions as well as change in contribution of cause components. The former results provides indication of how much a given cause accounts for the difference in survival in a given time point, while the later reflects an assessment of whether a given cause of death acts either to widen or narrow the sex gap in LE.

In the following part we provide an overview of the leading cause components accounting for either a narrowing or a widening of sex differences in LE over time within six broad age categories (Figure 4). Period-specific contributions of infectious diseases, parasitic diseases, cancer, digestive diseases and respiratory diseases to sex differences in LE tend to be largest in the age groups of 45-44 and 60-79. Circulatory diseases occurred in age 60 and above made sex gap in LE widen 20 percent, its contribution increased 168 percent for age 30-59. Sex difference due to accidents and injuries mortality widened gender differentials in LE was mainly caused by youth and adulthood in the past decade, and increased 95 percent. Especially the mortality rate caused by accidents and injuries for male was very higher than for female in 2000, i.e. it made LE be higher 0.53 year for male than for female. The effect of sex differences in mortality caused by other

diseases on gender gap in LE was relatively small, and narrowed gender difference except age groups 15-29 and 30-44 in the past decade.

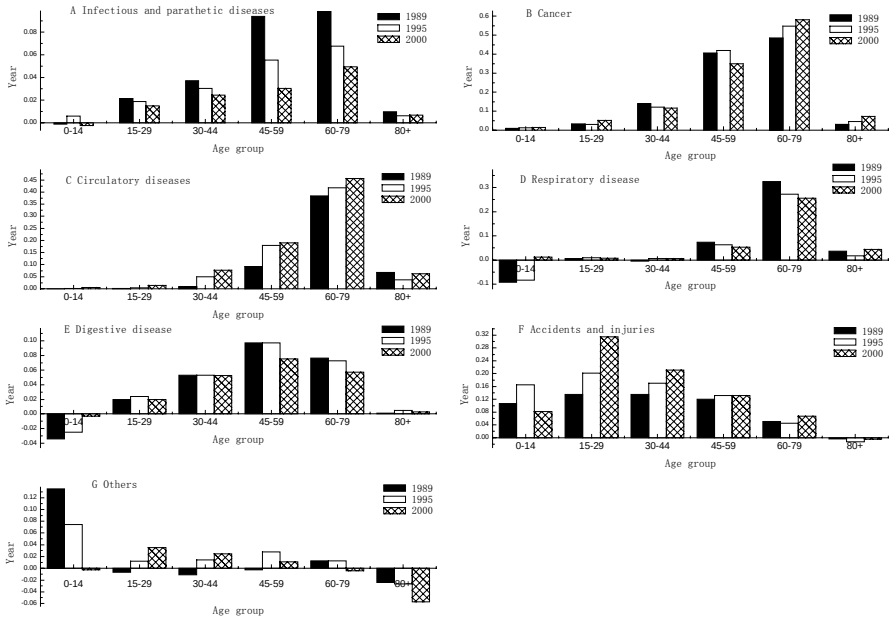

Figure 4 Effect of sex difference in age-grouped mortality rates by cause-of-death on sex gap in life expectancy at birth, 1989-2000

Note: Accidents and injuries include poison, violence etc.; Others include diseases of newborn, urinary disease and decompensate disease.

Conclusion

Since the early of 1980s, life expectancy at birth for male and female increased remarkably. Life expectancy at birth for male raised from 66.6 years in 1981 to 70 years in 2000, and from 68.8 years to 73.5 years for female. Sex difference in life expectancy at birth had been widen 1.3 years during this time period, i.e. females gains in survival over males from 2.2 years in 1981 to 3.5 years in 2000. Major reasons were of the contributions of sex differences in age-specific mortality rates and their changes, particularly for the population aged 45 years old and above, for the population aged 45 years old and lower, the contributions, however, had been increasing significantly. We also examine cause-of-death contributions to the sex gap of life expectancy at birth with broad categories of age between 1989 and 2000, and find that sex disparities in mortality rates due to malignant neoplasms, circulatory diseases, accidents and violence account for most of the total sex differences, and represent their individual characters in age groups. In the

past decade, sex differences due to circulatory diseases, accidents and violence increased dramatically, and kept steadily due to malignant neoplasms.

Acknowledgement

This study is partly supported by China Natural Science Foundation (70373011) and China Social Science Foundation (02BRK007). Thanks are also due to the 211 and 985 programs of Peking University.

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