

## Health Inequalities during 20 Years of Rapid Economic Development in China (1980-2000): A Mortality Analysis\*

ZHENG XiaoYing<sup>†,#</sup>, SONG XinMing<sup>†</sup>, CHEN Gong, YOU YunZhong, REN Qiang, LIU JuFen, ZHANG Lei, TAN LingFang, WEI JiHong, and CHEN QiuYuan

*Institute of Population Research, WHO Collaborating Center on Reproductive Health and Population Science, Peking University, Beijing 100871, China*

### Abstract

**Objective** To examine the influence of China's economic reforms on population health and regional mortality rates.

**Methods** Longitudinal study measuring the mortality trends and their regional variations. Using data from the three most recent national censuses, we used the model life table to adjust the mortality levels within the population for each census, and to calculate life expectancy. We then examined the variation in patterns of mortality and population health by economic status, region and gender from 1980-2000.

**Results** Life expectancy varied with economic status, province, and gender. Results showed that, although life expectancy in China had increased overall since the early 1980s, regional differences became more pronounced. Life expectancy for populations who live in the eastern coastal provinces are greater than those in the western regions.

**Conclusion** Differences in life expectancy are primarily related to differences in regional economic development, which in turn exacerbate regional health inequalities. Therefore, it is necessary to improve economic development in less developed regions and to improve health policies and the public health system that address the needs of everyone.

**Key words:** Economic development; Health inequalities; Life expectancy; Model life tables; Mortality

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### INTRODUCTION

Since the economic opening up in 1978, significant economic development has been achieved in China. Due to improved economic conditions, China has experienced a rapid reduction in mortality rate<sup>[1]</sup>. Although a developing country, many health indicators have more closely resembled the rates of middle-income countries. For

instance, in China in 2000 life expectancy at birth was comparable to that of middle-income countries and it exceeded that of developing countries by 6 years<sup>[2]</sup>. However, China is one of 160 countries that fail to reach standards of health expenditure per capita. Health expenditure per capita in China is one tenth of the world average and about 1% of health expenditure per capita in the United States<sup>[3]</sup>. According to the World Health Organization, China's

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<sup>†</sup>Both authors contributed equally to this work.

<sup>#</sup>Correspondence should be addressed to ZHENG XiaoYing. Tel: 86-10-62759185, Fax: 86-10-62751976, E-mail: xyzheng@pku.edu.cn

Biographical note of the first author: ZHENG XiaoYing, E-mail: xyzheng@pku.edu.cn; SONG XinMing, E-mail: xmsong@pku.edu.cn

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public health input, including common bargain input if some author would like to know the details, please see reference 4, because that's too common in the field and social security health expenditure, accounts for about 36% of total health expenditure, equal to half the average of OECD countries and 20% lower than the average level for developing countries as a whole<sup>[4]</sup>. Further improvement in the health of China's total population will be difficult and will necessitate widespread changes in health policy and the public health system.

Despite improvements in human development because of the implementation of reforms, gaps remain between urban and rural populations, men and women, and people of different social groups. This indicates that the disparities in population development could still remain even if the macroeconomic situation improves. This paper addresses the influence of China's economic reforms on the population's health and regional mortality rates. Using data from the three most recent national censuses, we examined mortality and the population's health patterns by economic status, region, and gender, from 1980-2000.

## METHODS

We used mortality data from the third, fourth, and fifth National Population Censuses conducted in 1982, 1990, and 2000. We used the west module of model life tables<sup>[5]</sup> to smooth the mortality level within the population for each census, and to calculate life expectancy. We then examined the variation in patterns of mortality and population health by economic status, region, and gender from 1980-2000.

Several steps were taken to evaluate and adjust the data. Under-reporting was avoided because the mortality data were taken from the census. Then we smoothed the fluctuation of mortality for all ages within a population based on the assumption that a population should have the same mortality level as the rule of model life table. We evaluated some specific situations against the reality including infant mortality rate and mortality for the middle aged. We also assumed that the overall mortality level would decline over time, especially for infants and the elderly. The mortality rate for the middle aged increased over time. We carefully evaluated this phenomenon through referring to other socio-economic factors and comparing with other countries' patterns. After evaluating the data systematically, we used the United Nations software

package for Mortality Measure<sup>[6]</sup> to calculate life tables for each census year based on adjusted age-specific mortality rates. We finally investigated the trend of life expectancy at birth and its variations in regions by socio-economic factors.

## RESULTS

### *Infant Mortality Rate*

Table 1 shows changes in infant mortality rates by province in China from 1981-2000 during which time the infant mortality rates declined for both males and females in all provinces. However, there were substantial regional differences in the pace of transition of infant mortality rates. Declines in infant mortality rates were negatively associated with the infant mortality levels of 1981. In other words, the lower the infant mortality rate, the sharper the decline in infant mortality tended to be. For example, Shanghai was one of the provinces with the lowest infant mortality rate while Yunnan was one of the provinces with the highest infant mortality rate in 1981. The declines in infant mortality rates in Shanghai were greatest with 52.8% for males and 45.7% for females, while the corresponding figures for Yunnan were only 27.2% and 19.9%.

Infant mortality rate is closely related to socio-economic conditions. These data suggest that the economic level of a province had a direct impact on the infant mortality rate. More specifically, economic development led to a decrease in infant mortality rate. Furthermore, disparity in regional economic development resulted in greater regional differences in infant mortality rate.

### *Life Expectancy at Birth*

From 1980-2000, overall life expectancy at birth increased in China. Results of the current study indicate that life expectancy at birth for males and females increased from 66.8 and 69.2 years in 1980-1985 to 69.5 and 72.9 years in 1995-2000. Although these improvements were promising, international comparisons still put China behind some developed countries. China's life expectancy at birth in 1980-1985 was similar to that in the 1950's or 1960's in selected developed countries as shown in Table 2. This table also shows that the average annual increase of China's life expectancy at birth during the period between 1980-1985 and 1995-2000 was 0.18 year for males and 0.25 year for females. These figures are far below those of Japan during the

periods between 1960-1964 and 1970-1974 and those of Greece during the periods between 1960-1962 and 1970.

**Table 1.** Changes in Infant Mortality Rates in China from 1981-2000, by Province and Gender

Province	Infant Mortality Rate (‰)				Change (%)	
	Male		Female		Male	Female
	1981	2000	1981	2000		
Shanghai	21.8	10.3	17.3	9.4	-52.8	-45.7
Beijing	19.9	12.9	17.6	10.2	-35.2	-42.0
Taiwan	25.0	14.5	18.1	11.4	-42.0	-37.0
Tianjin	20.8	12.9	19.4	9.7	-38.0	-50.0
Liaoning	37.0	20.5	32.8	18.1	-44.6	-44.8
Jiangsu	35.0	22.2	30.9	18.1	-36.6	-41.4
Hebei	33.0	19.0	29.3	15.2	-42.4	-48.1
Jilin	35.0	19.0	32.8	16.1	-45.7	-50.9
Shandong	32.6	22.2	27.6	18.1	-31.9	-34.4
Heilongjiang	37.8	20.5	34.7	19.6	-45.8	-43.5
Zhejiang	43.3	26.0	38.5	21.1	-40.0	-45.2
Guangdong	43.3	25.7	38.5	21.1	-40.6	-45.2
Shanxi	40.6	24.2	39.1	22.1	-40.4	-43.5
Henan	41.0	25.7	38.5	25.0	-37.3	-35.1
Anhui	45.6	29.2	42.3	27.6	-36.0	-34.8
Fujian	43.3	29.2	40.3	25.9	-32.6	-35.7
Inner	43.2	26.8	39.1	22.1	-38.0	-43.5
Shaanxi	48.0	25.7	46.1	24.3	-46.5	-47.3
Hunan	50.3	33.0	46.1	27.6	-34.4	-40.1
Hubei	52.6	33.0	49.9	27.6	-37.3	-44.7
Jiangxi	45.6	33.0	40.3	27.6	-27.6	-31.5
Hainan	---	33.0	---	30.9	---	---
Guangxi	41.0	33.0	38.5	32.1	-19.5	-16.6
Gansu	50.3	33.0	46.1	30.9	-34.4	-33.0
Sichuan	54.8	33.0	49.9	32.8	-39.8	-34.3
Ningxia	45.6	33.0	44.2	29.3	-27.6	-33.7
Chongqing	---	38.2	---	34.7	---	---
Xinjiang	57.1	41.0	49.9	34.7	-28.2	-30.5
Qinghai	54.8	41.0	49.9	34.7	-25.2	-30.5
Guizhou	64.0	50.3	56.0	44.2	-21.4	-21.1
Yunnan	84.6	61.6	72.4	58.0	-27.2	-19.9
Tibet	---	72.1	---	62.2	---	---

**Note.** Data Source: (You and Zheng, 2005).

**Table 2.** Average Annual Increase in Life Expectancy at Birth during Specified Periods in Select Countries

Country	Period	Life Expectancy (years)	
		Male	Female
China	1980-1985	66.8	69.2
	1995-2000	69.5	72.9
	Annual Increase	0.18	0.25
Canada	1950-1952	66.3	70.8
	1970-1972	69.3	76.4
	Annual Increase	0.15	0.28
Japan	1960-1964	66.5	71.4
	1970-1974	70.4	75.0
	Annual Increase	0.39	0.36
England	1950-1954	67.1	72.3
	1970-1974	69.1	75.4
	Annual Increase	0.10	0.16
Greece	1960-1962	67.5	70.7
	1970	70.1	73.6
	Annual Increase	0.29	0.32
Switzerland	1948-1953	66.4	70.8
	1968-1973	70.3	76.2
	Annual Increase	0.20	0.27

**Note.** Data Source: (United Nations, 1982b); (You and Zheng, 2005).

**Relationships between GDP Per Capita and Life Expectancy at Birth**

Factors such as income, educational attainment, medical care, and living conditions all affect human mortality. Figure 1 shows the relationship between life expectancy at birth and economic status measured by GDP per capita for both males and females. Both graphs show a positive relationship, a trend shaped like a logistic function, and a tendency for male and female results to align closely in both 1989 and 2000.

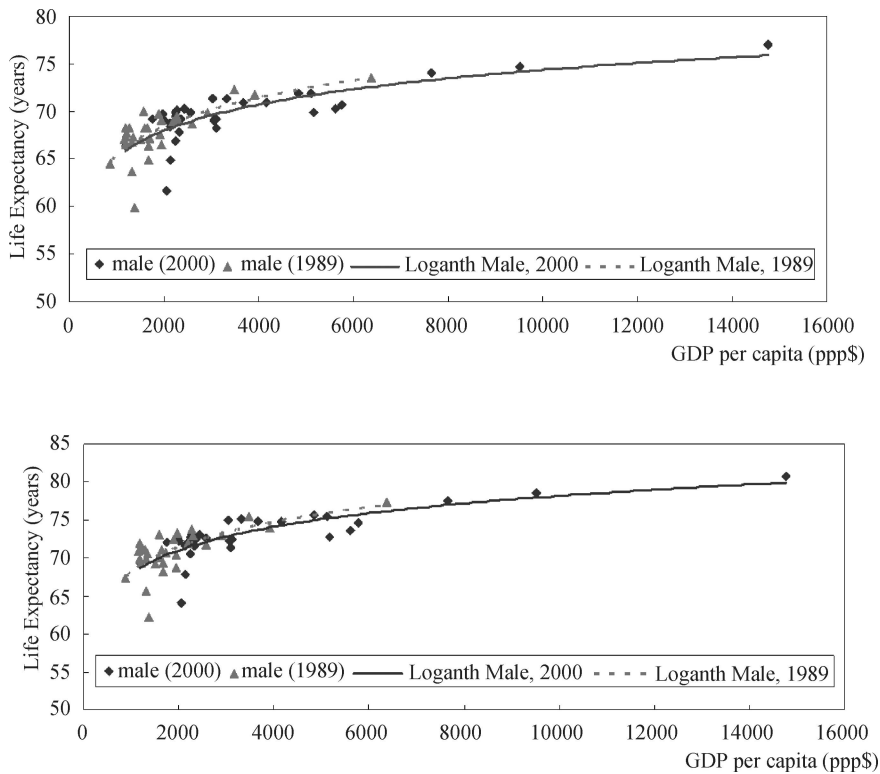
To investigate the relationship between life expectancy and per capita income, we used the following equations<sup>[7]</sup>, in which average life expectancy (E) is a function of per capita income (I):

For males

$$E(I) = \frac{81.30}{1 + 59.32 \exp(-0.06613I)} \quad (1)$$

For females

$$E(I) = \frac{86.56}{1 + 79.56 \exp(-0.7003I)} \quad (2)$$



**Figure 1.** Relationship between the economy and life expectancy at birth for males and females in 1989 and 2000. Data Source: (You, 2005); (UNDP, 2004).

Using China's 2001 per capita income of \$3950 ppp, provided by the World Bank, equations (1) and (2) calculated an average life expectancy in 2001 of 65.13 years for males and 70.12 years for females. These predicted values were lower than the life expectancies calculated from the census data which are shown in Table 2. This suggests that China has achieved a relatively high average life expectancy given its relatively low income level.

China's economic development varies by region, as does the population's health. In recent years, regional polarization has increased in terms of both economic development and health. For example, GDP per capita on the east coast, (Shanghai, Beijing, and Tianjin) is far higher than in other provinces, and the increase in life expectancy is greater than in the undeveloped western provinces. In 1981, life expectancy at birth was longest in Shanghai and shortest in Yunan, with a difference of 10.9 years for males and 12.7 years for females. In 1989 and 2000, the longest life expectancy was in Shanghai and shortest in Tibet. The rates for males and females in Shanghai were 13.7 and 15.2 years, and these were 15.4 and 16.7 years longer than those in Tibet. As economic development improves, opportunities

emerge for advances in education and health that directly influence life expectancy.

### **Gender Gap in Life Expectancy at Birth**

Life expectancy at birth around the world varies, sometimes considerably, between males and females. Globally, life expectancy at birth for females is four years longer than that for men<sup>[8]</sup>. Differences between male and female life expectancies in Asia are relatively small. The gap between male and female life expectancies at birth in China is less than the world average. Nevertheless, one trend that emerged from 1981-2000 data was an unequal rate of change in life expectancy according to gender. In fact, in the 1980s and 1990s, increases in life expectancy at birth for females exceeded those for males, and this differential rate of change has produced a growing gap between males and females since the 1980s. Table 3 shows male and female life expectancies at birth by province for the years 1981, 1989, and 2000. In 1981, only 10 provinces had a gap of more than three years between male and female, but by 1989 17 provinces had such a gap, and by 2000 the number was up to 25.

**Table 3.** Life Expectancy at Birth in China by Province and Gender for 1981-2000

Province	1981		Province	1989		Province	2000	
	Male	Female		Male	Female		Male	Female
Shanghai	71.4	75.4	Shanghai	73.5	77.4	Shanghai	77.0	80.8
Beijing	70.7	73.4	Beijing	72.3	75.5	Beijing	74.7	78.5
Tianjin	68.2	72.1	Tianjin	71.7	74.0	Jiangsu	74.0	77.5
Liaoning	70.1	72.1	Jiangsu	69.5	73.8	Tianjin	71.9	75.7
Jiangsu	67.9	71.6	Shandong	69.0	73.2	Shandong	71.9	75.5
Hebei	68.7	71.5	Hebei	70.0	73.1	Hebei	71.3	75.2
Jilin	67.5	70.7	Zhejiang	69.0	73.0	Liaoning	71.3	74.9
Shandong	67.0	70.7	Liaoning	69.8	72.9	Zhejiang	70.9	74.8
Heilongjiang	67.1	70.3	Jilin	69.7	72.4	Guangdong	70.9	74.8
Zhejiang	67.0	70.0	Henan	68.3	72.0	Henan	70.7	74.6
Guangdong	67.9	70.0	Heilongjiang	68.9	71.9	Jilin	70.3	73.6
Shanxi	66.0	69.5	Guangdong	68.6	71.8	Guangxi	70.2	73.1
Henan	67.0	69.3	Shanxi	68.2	71.1	Heilongjiang	70.3	73.1
Anhui	65.7	69.1	Jiangxi	67.7	71.0	Fujian	69.9	72.7
Fujian	66.5	69.1	Anhui	68.2	71.0	Anhui	69.8	72.7
Inner Mongolia	65.9	68.8	Guangxi	67.0	70.9	Jiangxi	69.8	72.6
Shaanxi	66.1	68.5	Hainan	67.1	70.8	Shanxi	69.7	72.6
Hunan	65.9	67.8	Shaanxi	67.3	70.5	Inner	69.2	72.4
Hubei	65.6	67.7	Fujian	67.6	70.4	Gansu	69.2	72.4
Jiangxi	65.0	67.5	Inner	68.3	70.0	Hunan	69.5	72.4
Hainan	65.2	67.4	Gansu	67.3	69.8	Shaanxi	69.1	72.3
Guangxi	65.0	67.2	Hunan	66.7	69.8	Ningxia	69.0	72.2
Gansu	64.7	66.9	Sichuan	66.5	69.3	Xinjiang	69.2	72.1
Sichuan	64.6	66.9	Hubei	66.3	69.3	Hubei	68.4	71.7
Ningxia	63.8	66.3	Ningxia	67.0	69.2	Sichuan	68.8	71.6
Chongqing	63.7	65.7	Xinjiang	66.5	68.7	Qinghai	67.9	71.6
Xinjiang	62.5	64.9	Qinghai	64.9	68.1	Guizhou	68.3	71.4
Qinghai	60.5	62.7	Guizhou	64.5	67.4	Yunnan	66.9	70.5
Guizhou	---	---	Yunnan	63.6	65.7	Hainan	66.3	69.3
Yunnan	---	---	Tibet	59.8	62.2	Tibet	64.8	67.8
Tibet	---	---	Chongqing	---	---	Chongqing	61.6	64.1

**Note.** Data Source: (You and Zheng, 2005).

## DISCUSSION

### *Socio-economic Development and Life Expectancy*

The results show that China's life expectancy at birth has reached a relatively high level, but this high national average conceals significant regional differences. These findings echo those of You<sup>[8]</sup>, who found significant differences between cities and provinces in terms of declining mortality. The results presented here show that the highest mortality levels are in the western and southern areas, whereas the lowest are in the eastern coastal areas. In addition, as life expectancy at birth increases overall, the differences between the regions widen.

Differences in regional life expectancy at birth reflect different natural resources, geographical environments, socio-economic conditions and cultures. Compared to the rest of the country, opportunities for acquiring education and health care in western areas are minimal. With the exception of Xinjiang, provinces with gross national product per capita less than the national average (e.g. Guizhou, Gansu, Qinghai, and Ningxia) also have higher rates of illiteracy among those 15 years old or older relative to the national average. According to the 2004 UNDP Human Development Reports, the coastal region of China developed rapidly in the 1990s<sup>[9]</sup>. The annual economic growth rate of that area was five times greater than the western and northern areas. A series of

anomalies appeared in remote, poor and rural areas, including data related to low birth weight and child malnutrition. In a field investigation, we also found that the prevalence of birth defects was very high in some provinces, such as Shanxi and Guizhou.

### **Policies for Improving Population Health**

Results show that the economy is the principal factor influencing population health. Thus, it is essential to improve regional economies in rural areas, thereby breaking the vicious cycle of poverty and poor population health.

Although the economy is the principal factor affecting the population's health, it is not the only factor. Caldwell found that the population health levels of China, Sri Lanka, and Costa Rica were higher than those of countries with the same level of economic development<sup>[10]</sup>. However, he also found that affluence was not necessary to improve the level of health. Similar methods can be used to increase life expectancy and improve population health so the vicious cycle of poverty and disease can be transformed into a positive cycle of economic development and health improvement.

Policies should focus on increasing life expectancy by reducing mortality due to poverty-related diseases and infectious diseases. The health information and statistics center of China's Ministry of Health divides rural areas into four classes. Class I includes Districts from eastern municipalities or provinces such as Beijing, Tianjin, Shanghai, and Jiangsu. Class II includes counties from the central provinces. Class III includes counties from the western provinces such as Guizhou and Gansu. Class IV rural areas are the poorest. Results from one study show that if mortality due to poverty-related diseases and infectious diseases in western rural areas were reduced to the level of eastern rural areas in 1993, the life expectancy at birth in western rural areas would increase by 5.18 years for males and by 5.56 years for females<sup>[11]</sup>.

Policies should aim to increase healthy life expectancy. Although life expectancy at birth in China may be acceptable, healthy life expectancy is relatively low. Since the 1980s, the greatest increase in life expectancy in developed areas such as Shanghai, Beijing, and Tianjin has occurred among those older than 60. The decline in the elderly mortality rates has contributed substantially to the increase in average life expectancy<sup>[8]</sup>. Policies should focus on the prevention and treatment of chronic

disease in order to increase both life expectancy and healthy life expectancy.

### **CONCLUSION**

This study investigated variations in population mortality in China from 1980-2000 by province, region, economic status and gender. Overall, the population's health in China has improved since the economic reforms began in 1978. The decline in infant mortality rates during this 20-year period varies considerably among regions. From around 1980 to the turn of the century, there have been improvements in life expectancy overall, but within the country differences have grown more pronounced. In light of these data, we argue that average life expectancy is closely related to socio-economic development, and thus regional differences in life expectancy reflect varying degrees of socio-economic development (e.g. income, education and available health care). Eliminating, or even reducing, poverty and communicable diseases could considerably increase life expectancy in rural areas, particularly in western regions. In the eastern regions, especially in developed areas, life expectancy can be increased through attention to the health needs of the aging population.

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