RESEARCH REPORT

Provincial income inequality and self-reported health status in China during 1991–7

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Background: The relationship between income inequality and health has been widely explored. Today there is some evidence suggesting that good health is inversely related to income inequality. After the economic reforms initiated in the early 1980s, China experienced one of the fastest-growing income inequalities in the world. The state of China in the 1990s is focussed on and possible effects of provincial income inequality on individual health status are explored.

Methods: A multilevel regression model is used to analyse the data collected in 1991, 1993 and 1997 from nine provinces included in the China Health and Nutrition Survey. The effects of provincial Gini coefficients on self-rated health in each year are evaluated by two logistic regressions estimating the odds ratios of reporting poor or fair health. The patterns of this effect are compared among the survey years and also among different demographic groups.

Results: The analyses show an independent effect of income inequality on self-reported health after adjusting for individual and household variables. Furthermore, the effect of income distribution is not attenuated when household income and provincial gross domestic product per capita are included in the model. The results show that there is an increased risk of about 10–15% on average for fair or poor health for people living in provinces with greater income inequalities compared with provinces with modest income inequalities.

Conclusions: In China, societal income inequality appears to be an important determinant of population health during 1991–7.

The relationship between income inequality and health status has been widely explored. However, the hypothesis that an individual's health depends not just on the individual's income but also on relative income (ie, the distribution of income within the society in which people reside) has produced mixed results.^{1–4} Many USA and cross-national studies have found income inequality considerably and positively related to all cause-specific mortality, life expectancy and self-rated health status, independent of individual poverty levels or median income.^{5–9} However, some studies in other Western countries and in Japan have failed to find such associations. Subramanian and Kawachi¹⁰ argue that the reason for the conflicting findings may be that many of these studies focus on countries such as Japan, Sweden, Denmark, New Zealand and UK, which are more egalitarian in their distribution of income than the USA and have more comprehensive welfare systems.

Wilkinson and Pickett's¹¹ latest review of the effect of income inequality on health suggests that the studies that have not found an association typically used small geographical units rather than large ones (eg, a community rather than a state). They argue that this is because income inequality is more evident in a larger context than in a smaller homogeneous community and therefore a statewide inequality has more effect on population health than a communitywise inequality. Wilkinson and Pickett conclude that most studies actually support the hypothesis that good health is inversely related to income inequality, when the size of the research units is large enough to show the inequality level.

Research on income inequality and health in developing countries is scarce, partly due to the lack of quality data. Findings from South American countries such as Chile, Brazil and Ecuador generally support the hypothesis that health is worse in societies with wider income gradients.^{12–14} Chile is a

particularly intriguing case because the country has experienced a dramatic increase in income inequality and now has a more unequal distribution of income than the USA. The study of Chile supports the hypothesis of the independent effect of societal income inequality on poor self-rated health status after adjusting for household income and community income.

To date, we are not aware of any studies that have undertaken this research in China. China has experienced dramatic economic reforms with similar patterns of decentralisation and privatisation as observed in Chile. In fact, after the economic reforms initiated in the early 1980s, China has been experiencing one of the fastest-growing income inequalities in the world. The Gini coefficient increased from around 0.3 in the early 1980s to 0.38 in 1988 and to 0.42 in 1995.¹⁵ The Gini ratio for China was reported to be higher than those for India, Pakistan and Indonesia in the 1990s.¹⁶

On the other hand, China's health performance has slipped dramatically in the last 20 years when compared with pre-economic reform rates.¹⁷ Although the Chinese are now enjoying relatively longer life expectancy (>70-years old) than many developing countries, it seems that most of this achievement was attained before the economic reforms.¹⁸ New health problems appeared and started threatening the health of the nation. One third of the world's cigarettes were consumed in China, where 20% of the world population lived. HIV/AIDS cases are rising at the rate of 30% per year. Schistosomiasis, tamed in the 1950s, is again spreading. Tuberculosis, previously under control, is also on the rise. Severe Acute Respiratory Syndrome (SARS) still remains a threat and avian influenza is becoming increasingly problematic. Environmental deterioration and food safety issues are

Abbreviations: CHNS, China Health and Nutrition Survey; GDP, gross domestic product

also affecting the general health of the population.¹⁸ Rapid economic growth has not been reflected in increasing public investment in health. Instead, the economic reforms have turned the public-financed and central-planned health system into a more commercialised and decentralised one. The government share in the total health expenditure has steadily declined from 32% in 1978 to 15% in 2002. About 80% of the population did not have health insurance in the 1990s.¹⁹

As a result, health inequality is widening. The ratio of female to male infant mortality rate increased from 0.9 to 1.3 from 1981 to 1995.²⁰ The infant mortality rate in selected rural areas was as high as 96.2 deaths per 1000 births compared with cities, where it averaged 20 deaths per 1000 births.²¹ Lower income groups in China bear a disproportionate share of the morbidity burden.²² The nutrition intake for the poor also declined in the 1990s.²³

China represents a strong case in the developing world in terms of its changes in inequality and health. Therefore, a study on China, a country with a similar income inequality pattern as that of the USA and Chile, contributes to the literature in this area. In this paper, we examine how income inequality at the provincial level affects individual health, using longitudinal data from the China Health and Nutrition Survey in the 1990s. We hypothesise that provincial income inequality has an independent negative effect on individual health status.

THEORETICAL MODEL

The pathways for the associations between income inequality and health have not been clearly specified in the literature. Some theorise that income inequality may have a direct effect on people's health by increasing stress and thus affecting self-esteem.¹¹ Income distribution may also indirectly affect health because an unequal society may under-invest in public programmes such as welfare benefits for the poor and basic health facilities for the sick.²⁴ Therefore, besides age, sex, ethnicity, marital status and other individual-level socioeconomic factors, income inequality could also have an independent effect on health.

Subramanian and Kawachi summarise two effects from income inequality on health: the "concavity effect" and the "pollution effect". The first assumes a concave relationship between income and health. Therefore, transferring a certain amount of income from the rich to the poor will result in better average health, as the loss in health among the rich is less than the improvement in health among the poor. In other words, a society with a more equitable income distribution has better average health than a society with a less equitable income distribution. The pollution effect accounts for the contextual effects of income inequality on health. It represents an independent effect that is detrimental to the population health. Testing this independent effect in China is the main purpose of this study.

To examine these effects, a multilevel regression model is used to test the hypothesis:

$$Y_{ij} = \beta^*(X_{ij}) + \alpha(G_i) + \mu_j + e_{ij}$$

where individual "j" in society "i" has health status "Y_{ij}", which is affected by both the income at the individual level (X_{ij}) and income inequality at the societal level (G_i). Provincial income inequality was chosen to make the study comparable to previous studies, where noticeable results are found at the state level. Therefore, β* captures the "micro" between-individual-within-province income effect, and α captures the "macro" between-province income effect (ie, societal income inequality). μ_j and e_{ij} are between and within error terms.

We acknowledge that the distinction between absolute income and relative income can become weaker, as both

absolute income and relative income can serve as proxies for social status.²⁵ Therefore, it is difficult to draw a clear distinction amid the "macro" between effect and the "micro" within effect. In other words, both absolute and relative income may include some pollution effect. However, Wilkinson and Pickett argue that including both absolute income and relative income could therefore overcontrol for the effect of inequality. We argue for a more conservative approach by including both income levels into our model. If our results suggest an effect of income inequality after controlling for absolute income, there is clearly a pollution effect, nevertheless underestimated. Therefore, our model tests the following hypothesis: societal inequality, in terms of provincial-level income inequality, increases the likelihood of reporting fair and poor health status for people regardless of their own income in China between 1991 and 1997.

Data

We used pooled data from the China Health and Nutrition Survey (CHNS) for 1991, 1993 and 1997. The CHNS is a longitudinal survey conducted by the Carolina Population Center at the University of North Carolina at Chapel Hill, the National Institute of Nutrition and Food Safety and the Chinese Center for Disease Control and Prevention. CHNS contains six waves (1989, 1991, 1993, 1997, 2000 and 2004) and has collected self-reported health data since 1991. The recently released 2000 and 2004 data are not included in this analysis because at this point there are no recent Gini data available. As described below, the Gini coefficient used in this study is a calculated average between 1985 and 1995.

The data were collected using a multistage random cluster process from nine provinces that vary considerably in geographical locations, economic development, public resources and health indicators. Detailed information on health and income was collected. Although the survey was not designed to be representative of the Chinese population, it does provide a sufficient range of values for a sample large enough to correctly model and estimate general behavioural relationships in China during the survey years.²⁶ Our pooled sample includes 9594 heads of household, aged ≥18 years, from 4744 households within 225 communities across nine provinces of China. Whereas some households were included only in one of the three survey years, others participated in two or three of the surveys.

The dependent variable in this model is self-reported health status. Studies have shown that self-reported health status is a predictive measure of mortality, independent of other medical, behavioural and psychosocial factors.²⁷ The CHNS asks individuals, "how would you describe your health compared to that of other people your age?" The response options include excellent, good, fair and poor. To make this study comparable to previous studies of self-reported health studies, we recoded the four categories into a dichotomous outcome of self-rated health, where 0 stands for "excellent and good" health; and 1 stands for "fair and poor" health. On average, about 28.7% of the sample respondents reported "fair and poor" health (ie, 28.8% in 1991, 28.6% in 1993 and 28.6% in 1997). And the rest reported "excellent and good" health.

Individual socioeconomic predictors of self-reported health status include age, sex, marital status, education attainment, health insurance and rural/urban residential affiliation. As only household heads are included in our analysis, the average age in our sample is 48. Females compose 16% of the sample. Almost 90% of the people are married. The average education is 6 years of primary education. In all, 68% of the sample live in rural areas and 30% have health insurance. The average household income is about 5293 yuan/year. We categorise the logarithm of per capita income (with a normal

distribution) into six groups (ie, very poor, poor, low, middle, high and very high), expressed as mean and standard deviation (SD). Two SDs or more below the mean is grouped as "very poor"; from two SDs below the mean to one SD below the mean is "poor", and from one SD below the mean to the mean is "low". Similarly, we create "middle", "high" and "very high" income groups.

Income inequality is measured by the Gini coefficients at the provincial level. Due to the difficulty in getting appropriate data, there are very few studies on the provincial-level Gini coefficients in China. Therefore, we borrow the results from Xu and Zou's study in which the means of Gini coefficients by province were calculated for the period 1985–1995.²⁸ The time period of the average Gini coefficients in this study corresponds well to the time period of our study (from 1991 to 1997). Moreover, in the sense that the Gini ratios are from 5 years earlier, the effect of income inequality could be appropriate because of a possible "lag effect" as suggested by Mellor and Milyo.²⁹

Multilevel logit regression analyses are used to test our hypothesis with pooled and individual year data. The SAS PROC Glimmix procedure fits logistic regression models for binary or ordered categorical responses in multilevel models.³⁰ In our study, this PROC Glimmix is used to estimate the binary response variable (poor and fair health, or good and excellent health) in a two-level model—that is, individual level and provincial level.¹ Also in our analysis, repeated observations from the same household head were weighted, to assure that multiple-year observations had the same relative weight as single-year observations.

To examine the relation between provincial income inequality and self-reported health, we use two logistic regression models. Table 1 shows the results. Model 1 gives the multivariate odds ratios (ORs) of reporting poor and fair health fully adjusting for individual variables, age, sex, marital status, education attainment, residential affiliation and health insurance.

According to model 1, there is an increased risk of 3% of reporting poor or fair health for people living in provinces with a 1% increase in income inequality. In other words, if the difference between the Gini coefficients for two provinces reaches 10%, the risk for reporting poor health would be 30%.

¹As we are looking at the effect of a provincial-level variable (Gini coefficient), it is more appropriate to control for province-level variability. A multilevel model can account for different factors and different sources of variability at both individual and provincial levels.

higher for the province with a higher income inequality than the province with a lower income inequality. Model 2 adds the effect of individual-level income into model 1. The OR of the effect of income inequality is attenuated slightly (from 3.1% to 2.6%), but the significance and direction remain the same. Further, the nine provinces are separated into three groups (high income-inequality, middle income-inequality, low income-inequality) according to their Gini coefficients. People from the higher income-inequality group experience approximately 10–15% more risk of reporting poor health compared with those from the low income-inequality provinces. This indicates that after adjusting for the effect of individual income, there is still an independent effect of income inequality from 1991 to 1997 in our sample. Correlation and collinearity analysis are used to assess the appropriateness of including both variables in the model. Neither is problematic.

We also analyse the possible effect of income inequality on each of the individual survey waves. In 1991, the risk of reporting fair or poor health increases about 3% with each percentage increase in income inequality (table 2). The risk increases to 8% in 1993 and 7% in 1997. In other words, the effect of income inequality on health increases in our sample from 1991 to 1993 and 1997.

In a separate analysis, we included gross domestic product (GDP) per capita in each province in our model for years 1993 and 1997ⁱⁱ to control for a broader measure of standard of living in addition to individual income. We found that the odds of the effect of income inequality were attenuated but still remained positive and noticeable, showing that despite different levels of GDP per capita in each province, the effect of income inequality on the risk of reporting poor health remains at the individual level.

Besides provincial income inequality, we also find that individual income mattered in terms of health status. As individual income increases, the probability of reporting lower levels of health status decreases. In terms of reporting poor and fair health, the probability of the highest income group is 47%, 67% and 66% of the lowest income group in 1991, 1993 and 1997, respectively. Even after controlling for

ⁱⁱ1993 GDP per capita is from Lee J. Changes in the sources of China's regional inequality. *China Econ Rev* 2000;11:232–45. 1997 GDP per capita is from <http://www.uschina.org/statistics/regionalstats.html>. While we mention this additional analysis, we chose not to report on a more detailed analysis because the accuracy of GDP data available is still under scrutiny.

Table 1 Multilevel logit regression estimates along with p value, odds ratios and 95% confidence interval

Parameters	Estimate	SE	Model 1			95% CI			Estimate	SE	Model 2			95% CI		
			p Value	OR		Lower	Upper				p Value	OR		Lower	Upper	
Constant	−3.14	0.17	<0.01	0.04		0.03	0.05		−2.82	0.18	<0.01	0.06		0.05	0.07	
individual predictors																
Age	0.04	0.00	<0.01	1.04	1.04	1.05	1.05		0.04	<0.01	<0.01	1.04	1.04	1.04	1.05	
Education	−0.01	0.00	<0.01	0.99	0.99	0.99	0.99		−0.01	0.00	<0.01	0.99	0.99	0.99	0.99	
Female	0.15	0.03	<0.01	1.16	1.09	1.23	1.18		0.03	0.03	<0.01	1.20	1.12	1.28		
Married	−0.02	0.04	0.63	0.98	0.91	1.06	−0.01		0.04	0.86	0.99	0.92	1.07			
Rural	−0.32	0.03	<0.01	0.73	0.69	0.77	−0.39		0.03	<0.01	0.68	0.64	0.72			
Health Insurance	−0.15	0.03	<0.01	0.86	0.82	0.91	−0.06		0.03	0.04	0.94	0.89	1.00			
Income																
Very poor (comparison group)																
Poor									0.00	0.06	0.94	1.00	0.90	1.12		
Low									−0.16	0.05	<0.01	0.85	0.76	0.94		
Middle									−0.31	0.06	<0.01	0.73	0.66	0.82		
High									−0.35	0.06	<0.01	0.70	0.63	0.79		
Very high									−0.56	0.07	<0.01	0.57	0.50	0.66		
State predictor																
Gini	0.03	0.01	<0.01	1.03	1.02	1.05	0.03		0.01	<0.01	1.03	1.01	1.04			

Table 2 Multilevel logit regression estimates along with p value, odds ratios and 95% confidence interval

Parameters	Year 1991			95% CI			Year 1993			95% CI			Year 1997			95% CI	
	p Value	OR	Lower	Upper	Estimate	SE	p Value	OR	Lower	Upper	Estimate	SE	p Value	OR	Lower	Upper	
Individual predictors																	
Age	<0.01	1.04	1.03	1.04	0.04	<0.01	<0.01	1.04	1.03	1.05	0.05	<0.01	<0.01	1.05	1.04	1.05	
Education	0.28	0.99	0.98	1	<0.01	0.01	0.042	1	0.98	1.01	-0.01	0.01	0.09	0.99	0.98	1	
Female	0.04	1.27	1.01	1.6	0.19	0.13	0.13	1.21	0.95	1.54	0.17	0.11	0.14	1.18	0.95	1.48	
Married	0.19	1.21	0.91	1.6	-0.16	0.15	0.29	0.85	0.63	1.15	0.2	0.13	0.13	1.22	0.94	1.59	
Rural	0.1	0.85	0.7	1.03	-0.15	0.11	0.15	0.86	0.7	1.06	-0.52	0.09	<0.01	0.59	0.5	0.71	
Health insurance	0.1	1.19	0.97	1.46	0.03	0.11	0.81	1.03	0.82	1.29	-0.16	0.1	0.11	0.85	0.7	1.04	
Income																	
Very poor (comparison group)		1												1			
Poor	0.45	1.27	0.69	2.32	-0.27	0.2	0.19	0.77	0.52	1.14	0.07	0.22	0.73	1.08	0.71	1.64	
Low	0.32	0.74	0.41	1.34	-0.29	0.2	0.15	0.75	0.51	1.11	0.05	0.21	0.81	1.05	0.7	1.59	
Middle	0.26	0.71	0.39	1.28	-0.64	0.21	<0.01	0.53	0.35	0.79	-0.02	0.21	0.92	0.98	0.65	1.48	
High	0.14	0.63	0.34	1.16	-0.5	0.22	0.02	0.61	0.4	0.93	-0.06	0.22	0.78	0.94	0.62	1.44	
Very high	0.03	0.47	0.23	0.93	-0.4	0.28	0.15	0.67	0.39	1.15	-0.41	0.26	0.11	0.66	0.4	1.1	
State predictor																	
Gini	0.24	1.03	0.98	1.09	0.08	0.03	0.01	1.08	1.02	1.15	0.07	0.03	0.01	1.07	1.02	1.13	

Specifically, the mean Gini coefficients during 1985 and 1995 for the nine sample provinces, Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning and Shangdong are 19.96%, 21.45%, 21.72%, 22.16%, 18.57%, 22.02%, 19.02%, 18.89% and 18.5%, respectively.

Specifically, the mean Gini coefficients during 1985 and 1995 for the nine sample provinces, Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning and Shandong are 19.96%, 21.45%, 21.72%, 22.16%, 18.57%, 22.02%, 19.02%, 18.89% and 18.5%, respectively.

GDP per capita at the provincial level, the pattern did not change. We extended the above analysis to the whole CHNS sample—that is, everyone surveyed in a household rather than just the heads of household—and found the results to be similar and even more distinctive than the ones reported here.ⁱⁱⁱ

DISCUSSION

In this study, we find evidence of an independent effect of income inequality on self-reported health status after adjusting for potential confounding individual-level and provincial-level variables in China during 1991–7. In our analysis, the risk of reporting poor and fair health increased by 2.6% with each percentage increase in income inequality. Compared with those living in provinces with modest income inequalities, there was an increased risk of 10–15% of reporting poor and fair health for people living in provinces with greater inequalities in income after adjusting for both micro-level (household income) and macro-level (GDP per capita) income variables. The pattern of the income inequality effect is similar among the 3 years analysed. However, the effect of income inequality on health intensified from 1991 to 1993 to 1997, indicating that the health status in provinces with greater income inequality was increasingly influenced adversely by income inequality, all other things being equal.

Our findings do not render absolute individual income unimportant. On the contrary, individual income was found to be strongly and consistently associated with health status over time. Policy makers should take both effects into consideration instead of either of them in isolation. Other variables, including age, sex, education and residential affiliation (ie, living in rural or urban areas), also have an effect on self-reported health status. This suggests that vulnerable groups warrant more attention (eg, the elderly, females, less educated and those living in rural areas), as these groups also suffer more from the contextual and societal inequalities in our study.

Our model may overcontrol for the effect of income inequality on health. This is because besides relative income, individual income could also serve as an indicator for social status and therefore contain some pollution effect as previous studies have suggested.^{11–31} A similar argument could apply in terms of residential affiliation as living in rural or urban areas also indicates different social status in China. Typically, people living in urban areas enjoy better social welfare than those living in rural areas. But our study shows that even after controlling for several important socioeconomic variables, the effect of inequality on health related to income persists. Future studies need to consider using different measures of inequality in contemporary China and examine their effects on health.

Owing to limitation of the data, we did not check the possible psychosocial pathways connecting inequality with ill health. But the fact that suicide became the fifth most important cause of death in China during the 1990s does suggest a plausible explanation.³² Similar psychosocial behaviours connecting inequality with ill health include the dramatic increase of smoking and alcohol misuse in China, which could also be due to the relative deprivation and the stress associated with social inequality.³³ We were also not able to examine the distribution of public health investment in each province for a relationship between inequality and health. Both of these questions warrant future study.

A possible limitation of this study relates to the use of the Gini coefficients as a measure of provincial income inequality in our model. The Gini coefficient is not year specific; instead,

ⁱⁱⁱThe results are not reported here due to the space limitation. It can be requested from the author.

What this paper adds

The relationship between income inequality and health has been widely explored, but most of the studies have been conducted in developed countries. The case of China as the biggest developing country experiencing fast-growing income inequality represents a good example in the developing world contributing to the literature about the association between income inequality and health.

Policy implications

Although many developing countries are now focusing more on the absolute economic and income growth, the experience from China indicates that absolute increase in income does not necessarily guarantee the improvement of health for all. Policy makers in developing countries should consider both the level of income and the distribution of income instead of either of them in isolation.

it is a means of measurement for a 10-year period (1985–95). Use of the Gini coefficient of a period earlier than our study period is on the basis of our contention that there is a certain “lag effect” in terms of income inequality on health. To assess the validity of the Gini coefficients, we re-processed the model by calculating our own provincial Gini coefficients using the CHNS data and examined how Gini coefficients in an earlier year affect self-reported health in later years. The results remained unchanged. Further, the effect of the income inequality on health using the Gini coefficients from the CHNS sample was stronger than using the mean Gini coefficients from a 10-year period. The effect also consistently increased from 1991 to 1997. As the CHNS data are not nationally representative, we choose to use Xu and Zou’s Gini coefficients in our analysis as their data resource is considerably bigger and more representative.

In summary, on the basis of data from nine provinces, this study indicates that provincial-level income inequality exerts an independent effect on individual risk for poor health. There seems to be a clear contextual effect of income inequality on health status in China between 1991 and 1997. Further, this association is not confined to the poor. People with higher absolute individual income face societal income inequality when living in a province with higher income inequality. However, the strongest relationship between income inequality and health status is found among people of lower income levels. The findings of this study are consistent with many previous studies, such as those in the USA and Chile. The example of China as a country experiencing dramatic changes in income distribution amidst social and economic transitions suggests that income inequality is an important social determinant of population health. Although many developing countries are now focusing more on the absolute economic and income growth, the experience from China indicates that absolute increase in income does not necessarily guarantee the improvement of health for all.

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X Pei conceived the idea for the study and conducted the statistical analysis. Both authors were involved in the study design, interpretation of the analysis and the preparation of the manuscript.

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