



The Effects of Unemployment Rate on Health Status of Chinese People

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(Received 19 Jul 2014; accepted 28 Nov 2014)

Abstract

Background: The aim of the study was to estimate the short-run and long-run effects of unemployment rate on health outcomes of Chinese population, which is under studied before.

Methods: The Chinese aggregate data was analyzed (provincial data from 1990-2011). The fixed effect model and infinite distributed lag model (IDL) were applied to analyze the data. It aimed to estimate the short-run and long-run association between unemployment rate and health status of population in China. The mortality was applied as an indicator for health outcomes of entire population.

Results: In the short run, when the unemployment rate was decreased by 1%, mortality will be reduced by approximately 4 % ($P < 0.01$). In the long-run, mortality will be increased by 6.8% with increased unemployment rate of 1% ($P < 0.05$).

Conclusion: The result in China demonstrated that the unemployment rate was positively associated with mortality. The result also showed that the increased unemployment rate has been harmful to health outcomes of population. It will be significant to reduce the unemployment rate for improving potential public health benefits in developing countries like China.

Keywords: Unemployment rate, Mortality, China, Health outcomes

Introduction

A favorable macro-economic situation has been broadly considered to make positive effects on improving population health conditions. This hypothesis has been supported by previous studies with data from developed countries (1, 2). However, in recent study, also with the data from developed countries, it proposed that the population well-being was not so straightforward influenced by macroeconomic conditions. Empirical evidence has shown that some health outcomes improved with weakened economy. From the data in developed countries, falling mortality rates were repeatedly associated with increasing unemployment rate (3-8). Since there were both evidences for sup-

porting the contradictory results, the reducing unemployment rate may not be bound to falling mortality. However, we could not simply conclude the result in developing countries and the actual situations in developing countries should be explored with data analysis.

Although many studies have been performed in developed countries, there were few reports on the association between unemployment rate and health status in the developing country. In developing countries, socio-economic change is likely to be a more important resource for health improvement (9). More evidence that is empirical is required to understand better the possible effects

of unemployment rate on health outcomes in the developing world, particularly in China. The disease profiles and social welfare infrastructure in China was different from that in developed countries. In past 30 years, great achievements have been attained in China, both in economic conditions and population health (10). Thus, it is necessary to take a closer look at the economic conditions of China, as well as the effects from economic development on population health status. In this study, the unemployment was taken as the object of study, directly reflecting the economic conditions. In addition, mortality rate was involved for demonstrating health outcome for entire population. Chinese provincial data from 1990-2011 has been referred to analyze the short-run and long-run association between unemployment rate and health status. The involved analysis methods and models were similar to that of in previous studies (5, 11).

For the relation between unemployment rate and health, similar study has been conducted in developed countries, while this study mainly focused on this issue in developing country with large population. Therefore, it may be helpful for people caring about global health by filling in existing knowledge gap and thereby, providing a more complete picture about global health status. In addition, exploring the relation between macro economy and population health in developing countries like China will help in understanding the situation in vast member of developing countries. It will be conducive to expanding the horizons of health promotion.

Chinese economic growth and health outcomes

China has witnessed great changes in both economy and the health of its population in last three decades. The registered unemployment rate in China has been controlled within 4%. China has distinguished itself through rapid and sustained economic development. It considered that China's favorable economic conditions contributed to 'the greatest increase in wealth for the largest number of people in the shortest time in the history of mankind' (12). Accompanied by excellent eco-

omic conditions, it also obtained great achievements on population health conditions in China. As the world's most populous nation, tremendous improvements in health status have been achieved in China for last a few decades. From 1964 to 1982, an average life expectancy in China was 60 years and it rose to 71 years from 1990 and 2000. It has continued to rise (13). As for 2010, life expectancy was estimated to be 74.5 years and it was assumed to reach 81 years by 2050 (14, 15).

The lower unemployment could be generally related to more favorable economic condition. The lower unemployment rate in favorable economic condition has been significant in reducing the mortality rates (16). First, lower unemployment rate and favorable economic conditions lead to more health investment from government, which could be beneficial to health improvement. According to Okun's law, unemployment rate was negatively associated with economic growth (17). Lower unemployment will allow for abundance, entitled the government to afford more health investment; while higher unemployment rate will result in a serious waste of social labor resources, leading to further huge losses of social wealth. Correspondingly, during economy downturn, the ability of the government to provide health services will be diminished with shrinking investment. Thanks to low unemployment rate and stable economic growth in China, the capacity to provide health care has been improved largely (18). Second, for individuals, the physical status accompanied with unemployment will also influence the health status, such as the material losses associated with unemployment. For those who manage to stay in employment, they may be at risk of losing their job in recessions, lower personal health-related expenditures and possibly lead to unhealthy behavior (e.g. diet) and outcomes (5,19). The unemployment rate would make effects on people, in the aspects of both materials and psychology. First, low unemployment rate would lead to associated good status in security and repose. It was beneficial to good health outcomes. As a developing country like China, a completely sound social network has still not been constructed in China. A large proportion of people had to pay

for health services all by themselves. For example, prior to the current health reforms, many people were left uninsured and they may be in a high risk of financial crisis. Until now, the reimbursement ratio of medical insurance was relatively low. The proportion of individual payment was still high (20). It is well known that, for Chinese people, stress, anxiety and psychological hardship resulted from losing job and financial risks were detrimental to health. It will finally lead to serious health outcomes. On contrary, the security and repose associated with good economic situations would tend to bring about good health outcomes (16). Second, considering the marginal effects, individual health investment will be increased during the period of economic expansion. Thus, for individuals, better healthcare conditions can be provided and more attention will be paid on their health status. Such resources were allocated as limited time, energy, and money in ways reflecting expected costs and benefits (21). Therefore, the decision on health investments was made depending on individual explicit or implicit cost/benefit analysis, such as ranking high or low (16). The marginal effects of health-promoting activities may be altered by economic situation (11). As human capital is one of the sources of economic growth, the population health status has been important (21, 22). The easier for individual to find a job and increase their income, the more effective it could be to turn the value of health capital into reality during economy expansion (17). There were more capitals to be obtained due to the economic expansion (23). Therefore, health will be more cherished for individuals during periods of economy expansion.

Materials and Methods

In this study, mortality rate was applied to demonstrate population health status. To estimate the effects of unemployment rate on mortality, aggregate data of 31 provinces in China has been analyzed (between 1990 and 2011). Such period is length of economic cycle, which could help us with prediction of the relation between unemploy-

ment rate and population health in the future. There was a total amount of 682 observations. The dependent variable of interest was the log of the mortality rate per 1000 people in each province. Mortality rate is a major outcome determined for evaluating in most epidemiologic studies and clinical trials. Mortality rate was “hard” data with easily understandable meaning of the health status outcome (24). As data of macro conditions was limited and unavailable, other health relevant measurements cannot be collected.

Both static and dynamic models were performed in analysis. The static model, with contemporaneous effects only, and a dynamic model, which allows for lagged effects of unemployment on mortality were estimated. In a static context, fixed effect model was applied for estimation. Hausman test was applied to determine the establishment of fixed effects model. $\chi^2=34.60(P<0.01)$. In addition, given that our sample covers all states of a country rather than a random sample of it, the fixed-effects specification is the more natural one. The fixed-effects estimator therefore was used. With the fixed effects model, omitted variable bias could be controlled.

$$M_{jt} = \alpha + \beta_1 E_{jt} + \beta_2 x_{jt} + \rho_t + R_j + \varepsilon_{jt}$$

Where M_{jt} was the all cause (log) mortality of province j at time t , and ρ_t was a year-specific effect, R_j was the regional specific effect. E_{jt} was the log of the provincial registered unemployment rates. x_{jt} was a vector of other covariates and ε_{jt} was the error term. Due to channels through which macroeconomic variables may influence health (25), the health status of a population is not only impacted by macroeconomics, but also fundamentally influenced by its age structure, its exposure to various epidemiological vectors (partially owing to geographic factors), the nature of public policies pursued by a government—the provision of public goods (education) and the quality and quantity of the medical services available to the population. x_{jt} included the log of the change in province real GDP per capita (Compared with real GDP, the nominal GDP was de-

flated to retail price index); the change in the proportion of 65 years and older; urbanizations; university and college students enrollment per 100 persons (log); and the number of doctors and beds per 100 persons (for evaluating the effects of medical service supply on mortality). Converting such variable into difference can assure stationary data and association of unemployment and health can be explored. The LLC test and IPS test rejected the hypothesis of unit roots ($P < 0.001$), indicating that the transformed series are stationary.

A bi-causal relationship was proved to exist between the macro economy and health status (23). On one hand, health conditions have been considered vital in human capitals because it is directly associated to labor supply (22, 26, 27). This point of view has been supported by some empirical researches (28, 29). On the other hand, the effects of economic situations on health could not be ignored (30). Many aspects of individual life would be influenced by macro-economic performance, including household income and assets, medical technique advancement, public health policy. All of these factors would result in variations to population health status (19). The empirical results would be biased without considering the bi-causal relation and interaction between the macro economy and health status. Therefore, in this study, the instrument variable and 2-Step GMM estimation was applied to address and solve technical issues, which were limited in previous studies (31). The potential instrumental variable should be correlated with the unemployment rate. However, the health outcomes would not be affected except by the unemployment rate of this year (31). In this study, unemployment rate of the last two years were employed as instrument variables. Current health outcomes were affected by unemployment rate, but it should not directly influence on the data of unemployment rate in last two years. Two-year lag unemployment rate was referenced because the coefficients on third lag in the first stage of 2-Step GMM estimation were not significant at a level of 10 %.

In next step, a dynamic econometric model was applied to evaluate a lagged effect of unemployment rate on mortality. According to the previous

studies by Neumayor (5), in the infinite distributed lag model, no lag length needs to be taken into account for lagged effect of unemployment rate on mortality. The IDL model can be expressed as follows with panel data context (5, 32):

$$M_{jt} = \alpha + \beta_3 M_{jt-1} + \beta_4 E_{jt} + \beta_5 X_{jt} + \rho_t + R_j + \varepsilon_{jt}$$

The contemporaneous effects could be computed and calculated by β_4 , whereas the long-run effect could be presented by $\frac{\beta_4}{(1-\beta_3)}$.

Robust standard errors were employed, which are robust towards arbitrary autocorrelation as well as heteroscedasticity.

Results

In the whole period, the average mortality rate was 0.627%. In China, mortality has dropped for a long period with a long-term falling trend (the mortality was 0.675% in 1990 and it was decreased to 0.585% in 2011), while it has also oscillated over time. The average mortality rate of China has reached 0.706% in 2008. There were big variations existed in mortality rate among different regions in China. The average mortality rate was lowest in Guangdong (0.493%), while it was highest in Guizhou (0.738%).

There were variations in China's economy during the whole stage. The mean unemployment rate was lowest in 1993 (2.557%), while the mean unemployment rate was highest in 2004 (3.949%). During the period from 1990 to 1993, the unemployment rate was increased and it was followed by a decrease during the period between 1994 and 2004, then increase again (Table 1).

Combining the data, the effects of the unemployment rate and economic growth on mortality rate were estimated and the results were summarized (Table 2). The static model was applied to demonstrate the short-run effect. Fixed-effect Model demonstrated the multivariable regression results without addressing the endogeneity issue. As unemployment rate rose, general mortality increased. The effects of unemployment on mortality in different provinces were estimated, which were positive and statistically significant ($P < 0.01$).

Table 1: Descriptive statistics of provincial data

Variable	Obs	Mean	SD	Min	Max
Mortality (%)	680	0.627	.081	0.421	0.89
Provincial unemployment rate (%)	638	3.312	0.931	0.3	6.8
The change in university and College Student Enrollment per 100Persons	682	0.093	0.23	-2.31	3.05
The change in numbers of beds per 100 Persons	682	0.006	0.021	-0.1	0.24
The change in numbers of phys per 100 Persons	682	-0.001	0.017	-0.172	0.13
The change in Urbanization	677	1.1%	0.027	-18.6 %	27.5 %
The change in the share of old people(>=65)	674	0.1%	0.007	-4.0 %	5.0 %
The change in GDP per capita	682	569.009	739.542	-9417.68	5004.648

In general, a decrease of 1% in unemployment rate would be associated with a mortality reduction of 3.7 %. The other static Model presented the result of endogeneity issue involving 2-Step GMM estimation and instrument variable (the unemployment rate of last two years). When the endogeneity issue has been addressed, the results were consistent. The coefficient of effects from provincial unemployment rates on mortality was 0.048 and was statistically significant ($P < 0.01$). There was a positive relationship between the unemployment rates of last two years and unemployment rates of this year. The result was statistically significant. In the test of the joint significance, the generated F-statistic was 247.62 (P

< 0.05). Our instruments have been proved valid in a number of statistical tests, including the excluded-instrument test, under-identification test, weak-identification test, weak-instrument-robustness test and tests of over identifying restrictions (33, 34). In the dynamic model, the results were similar to the results in static model. A decrease of 1% in the unemployment rate would lead to a reduction of 4.4% in mortality rate. The relation between mortality and provincial unemployment rate was also listed (Table 3). It indicated how mortality rate changed by one percentage point variation in provincial unemployment rate. The long-run effects (6.7%) were not so great compared to that of short-run effects.

Table 2: The effects of unemployment rate on mortality

Variable	Static model		Dynamic Model
	Fixed-effects regression	2-Step GMM estimation	
Provincial unemployment rate (%)	0.037*** (0.014)	0.048*** (0.019)	0.044** (0.021)
The change in university and College Student Enrollment per 100Persons	-0.182 (0.187)	-0.158 (0.171)	-0.096 (0.159)
The change in numbers of beds per 100 Persons	0.018 (0.263)	-0.172 (0.212)	-0.122 (0.222)
The change in numbers of phys per 100 Persons	0.001*** (0.0002)	0.040 (0.111)	0.04 (0.107)
The change in Urbanization	0.503 (0.492)	0.556 (0.611)	0.791* (0.44)
The change in the share of old people(>=65)	0.034 (0.113)	0.023** (0.013)	0.015 (0.012)
The change in GDP per capita	0.042*** (0.009)	0.04*** (0.012)	0.009 (0.011)
Last year mortality			0.34*** (0.048)

^a *statistical significance at 10% level, **at 5 %, ***at 1 %/^b Year-specific dummy variables not shown; Robust standard error

Table 3: Percentage variations in mortality rate due to one percentage point increase in provincial unemployment rate

Models	Unemployment rate (%)
Static model (Fixed-effects regression)	3.7
Static model (2-Step GMM)	4.8
Dynamic model (contemporary effect)	4.4
Dynamic model (long-run effect)	6.7

Discussion

Our current understanding on this association has been updated by examining Chinese data from 1990 to 2011. From the study of latest data in China, a more complete picture could be provided on the relationship between unemployment rate and health outcomes. The addition of data in China into the frame will help us understanding more about the relation between macro economy and health status in developing countries, which has been different from that of in developed countries. Further, the addition of updated data into our frame is more significant because it included the data in recession period started from 2008. In this critical period, the aggregate health status has not been broadly examined and there was little analysis about the effects of macro economy on population health outcomes. To our knowledge, there are only two very recent papers on the association between aggregate health and macro-economic (35). Therefore, it remains an open question.

The contradictory results between China and the reported developed countries may be resulted from different social welfare system development (36). Firstly, the social security safety system and network is not well established in China and the living standard of people can be easily influenced by macro-economy. Decreasing resource endowment would be accompanied by a rise in unemployment rate, which may be health-threatening

(3,19). For example, specifically, the unemployment could lead to a decreased health investment and health services. At the same time, in long-term, the reduced income could lead to poor nutrition and housing condition, as well as less education. All of these factors would be obstacles for improving health status. On the contrary, abundant available resources could bring about a dropping unemployment rate, enabling people to enjoy better living conditions and healthcare services (36).

Secondly, since social safety system and network in China is not yet well developed, fluctuations in unemployment rate can easily make effects on psychological conditions. Without the cushion of social safety nets, the high unemployment rate during an economic recession often leads individuals to get anxiety. They may be worried about being fired and cannot make ends meet. This kind of life pressure usually brought about a health hazard (16).

From the findings in our study, many suggestions could be provided to health policy makers in China. It indicated that economic stability would be very vital for improving health status of population. If there was significant unemployment, the government could choose to accelerate the construction of social safety net or increase financial investment in health industry to guarantee the primary population health services. The results in this study may also be useful for people concerning global public health. At present, global health is going through economic difficulties. Compared to the developed countries, the social safety net in developing countries is generally weaker. It can be also inferred from our results, which is the population health outcomes in developing countries are fluctuations that are more vulnerable to economic. The difference of health status between developed countries and developing countries are believed to be widened. As a result, special attention should be paid to population health in developing countries during economic recession.

There are also limitations in this study. Because limited macro data was available, we could only focus on the unemployment for demonstration the tendency of macro economy. In addition, the

mortality rate was considered to reflect the population health outcomes. Thus, it could only analyze the effects of unemployment rate on mortality. More data needs to be collected and the health outcome shall be evaluated comprehensively from many aspects, such as case fatality rates and life expectancy. In addition, any causal inference was not possible beyond the speculations in our study. In further study, sophisticated analytical techniques should be also involved to verify the causal relationship between economic conditions and population health outcomes.

Conclusion

The result in China demonstrated that the unemployment rate was positively associated with mortality. The result also showed that the increased unemployment rate has been harmful to health outcomes of population. It will be significant to reduce the unemployment rate for improving potential public health benefits in developing countries like China.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

The authors declare that there is no conflict of interests.

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